Stress and tone in Dagaare*

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Abstract

Dagaare (Gur) is a two-tone language of northwestern Ghana with approximately 1,000,000 native speakers. Most of the canonical disyllabic nominals fall into three tonal classes: L-H, H-L and H-H. In the first two, the second tone is a polarity tone: a suffix assumes the opposite tone to that of the root. L-L is systematically absent. Based on our primary descriptive work, supplemented by the fieldnotes of Kennedy (1966), we show that several tonal processes distinguish between lexical and derived tones and, in addition, there is evidence for penultimate stress. The surface tonal patterns result from an attempt to optimally satisfy (i) one-to-one correspondence between input tones, output tones and TBUs and (ii) the preference of stressed syllables for H and lexical tones. We show that the lexical/derived distinction and several familiar tonal phenomena, e.g. spreading, contour formation and floating tones can be captured by the notion of correspondence (McCarthy and Prince 1995). Tonal polarity is analyzed as a stress phenomenon: penultimate stress attracts lexical tones and leaves the unstressed final syllable with whatever is the contextually optimal derived tone, i.e. the polarity tone. Similarly, underlyingly toneless words which are at least two syllables long become H-H due to stress which explains the systematic absence of L-L.

1 Introduction

Dagaare (Gur, Niger-Congo) is a two-tone language spoken in northwestern Ghana and adjoining areas of Burkina Faso.[1] Minimal pairs like *bá* 'to move fast' vs. *bà* 'to put up a pole' and *báá* 'a dog' vs. *bàà* 'to grow up' are prima facie evidence for a lexical contrast between H and L tones. However, in the nominal system, tonal contrasts are most of the time restricted to the penultimate syllable, the remaining tones being predictable. The following nouns are typical members of the disyllabic core vocabulary:

(1)	(a) H-L	(b) L-H	(c) H-H	(d) L-L
	yí-rì	wì-rí	pọ́g-ọ́	–
	house-SG	horse-SG	woman-SG	–

The root morphemes *yí* and *wì-* in (1a) and (1b) are H and L respectively. The singular suffix *-ri* shows TONAL POLARITY: its tone is opposite to that of the adjacent root and thus predictable. (1c) shows that tonal polarity falls short of predicting all suffixal tones as here one single H tone is spread over both the root and the suffix. L-L nouns are systematically absent.

In the first part of the paper, we argue that Dagaare is a mixed system in two orthogonal dimensions. First, several tonal processes distinguish between LEXICAL and DERIVED tones. In particular, the root tones in (1ab) are lexical, the polarity tones and the spreading H tone in (1c) are derived. Second, we present evidence for penultimate STRESS independent of tone, showing that Dagaare falls somewhere between free tone languages and metrical stress languages (McCawley 1970, McCawley 1978, Hyman 1978, van der Hulst and Smith 1988). Thus, for each syllable, we have three binary choices: H vs. L, lexical vs. derived, stressed vs. unstressed. This amounts to eight possible combinations. Not all combinations are equally well represented: a lexical H is typically assigned to a stressed syllable, a derived L is always assigned to an unstressed syllable and derived H and lexical L may occur on either.

(2) The distribution of Dagaare tones. T = lexical tone, [T] = derived tone.

	STRESSED	UNSTRESSED
H	+	+
[H]	+	+
L	+	+
[L]	–	+

In the second part, we propose an explanation for the surface tonal patterns of Dagaare nominals in terms of Optimality Theory (OT) (Prince and Smolensky 1993, McCarthy and Prince 1995). The analysis is driven by a uniform system of constraints on the associations between tones and tone-bearing units. Classical tone rules such as association, spreading, insertion and deletion are not primitives of the grammar, but arise from an attempt to get as close as possible to the optimal configuration. Abstracting away from the lexical/derived distinction, this optimal configuration is shown in (3):

(3) CONFIGURATION	CONSTRAINTS
TBU	(a) Every tone is linked to exactly one TBU.
|	(b) Every TBU is linked to exactly one tone.
T	

As is usual in Optimality Theory, what is optimal for a subsystem is not necessarily optimal for the language as a whole and the optimal tone configuration does not always get realized. For example, the number of tones and TBUs may not match, yet faithfulness keeps one from deleting and inserting elements at will. In the present approach, the grammar will simply state the optimal goal, leaving it up to constraint interaction to figure out the cheapest repair. Consider a TBU without a tone. Constraint (3b) will report a problem, but will not know how to fix it. There are several possibilities, for example "Insert tone" or "Spread tone", both of which give rise to further choices ("Insert H/L", "Spread from Left/Right"). One might also try deleting the offending TBU. Which of these options is actually chosen is decided by the language-specific constraint ranking. This is the mode of explanation native to Optimality Theory: constraints are maximally simple and context-free; the specific repairs are emergent properties of the system.

2 Lexical and derived tones

2.1 Introduction

In Dagaare, the vast majority of simple nominals fall into three tonal classes: LH, HL and HH.[2]

(4)	bàá	river-SG	bàrị́	river-PL
	bààlá	sick person-SG	bààlbá	sick person-PL
	bògí	hole-SG	bògrí	hole-PL
	bòngó	donkey-SG	bònní	donkey-PL
	bọ̀ọ̀rị́	sacrifice-SG	bọ̀gọ́	sacrifice-PL
	dìé	room-SG	dèrí	room-PL
	dùó	pig-SG	dòrí	pig-PL
	fị̀lị́	sore-SG	fị̀lẹ́	sore-PL
	gyìlí	xylophone-SG	gyìlé	xylophone-PL
	gbìé	forehead-SG	gbèrí	forehead-PL
	kpòlúú	termite-SG	kpòló	termite-SG
	kùùrí	hoe-SG	kùé	hoe-PL
	lọ̀nnọ́	squirrel-SG	lọ̀nnị́	squirrel-PL
	mọ̀lụ́ụ́	kind of animal-SG	mọ̀llị́	kind of animal-SG
	ọ̀ngọ́	rat-SG	ọ̀nnị́	rat-PL
	pị̀ẹ́	basket-SG	pẹ̀rị́	basket-PL
	pììrí	rock-SG	pìé	rock-PL (Central dialect)
	pìé	rock-SG	pììrí	rock-PL (Southern dialect)
	pọ̀lị́	path-SG (for rats)	pọ̀lọ́	path-PL (for rats)
	sẹ̀ngẹ́	bed-SG	sẹ̀nnị́	bed-PL
	tị̀ẹ́	tree-SG	tị̀ị̀rị́	tree-PL
	tị̀rị́	spoon-SG	tị̀ẹ́	spoon-PL
	tòòrí	ear-SG	tòbó	ear-PL
	tọ̀ọ̀rị́	far-away-SG	tọ̀ẹ́	far-away-PL
	wị̀ẹ́	farm-SG	wẹ̀rị́	farm-PL
	wìrí	horse-SG	wìé	horse-PL
	yùòní	year-SG	yùòmó	year-PL
	yụ̀ọ̀rị́	penis-SG	yọ̀ẹ́	penis-PL
	zị̀ẹ́	red-SG	zị̀ị̀rị́	red-PL
	zàgá	animal house-SG	zàgrị́	animal house-PL
	zàmmụ́	onion-SG	zàmá	onion-PL

(5)	bírì	seed-SG	bíè	seed-PL
	dólì	dry spot-SG	dólò	dry spot-PL
	gánị̀	book-SG	gámà	book-SG
	gụ́ọ̀	thorn-SG	gụ́ụ́rị̀	thorn-PL
	gyẹ́lị̀	egg-SG	gyẹ́lẹ̀	egg-PL
	gbẹ́rị̀	leg-SG	gbẹ́ẹ̀	leg-PL
	kógò	mahogany-SG	kógrì	mahogany-PL
	mírì	rope-SG	míè	rope-PL
	nẹ́nị̀	meat-SG	nẹ́mẹ̀	meat-PL
	nị́ẹ̀	person-SG	nụ́bọ̀	person-PL
	nụ́ọ̀	hen-SG	nụ́ụ́rị̀	hen-PL
	nụ́ọ́rị̀	mouth-SG	nọ́ẹ̀	mouth-PL
	ọ́ràà	type of berry-SG	ọ́rrị̀	type of berry-PL
	páárị̀	vagina-SG	pẹ́ẹ̀	vagina-PL
	pánị̀	door-SG	pámạ̀	door-PL
	sánị̀	debt-SG	sámà	debt-PL
	wẹ́gẹ̀	log-SG	wẹ́grị̀	log-PL
	wógì	tall-SG	wógrì	tall-PL
	yírì	house-SG	yíè	house-PL
	yúórì	name-SG	yóè	name-PL

(6)	báá	dog-SG	báárị́	dog-PL
	bíé	child-SG	bíírí	child-PL
	bọ́gọ́	shoulder-SG	bọ́grị́	shoulder-PL
	bụ́ọ́	goat-SG	bụ́ụ́rị́	goat-PL
	dángná	owner-SG	dángmá	owner-SG
	dụ́ngọ́	animal-SG	dụ́nnị́	animal-PL
	dọ́ọ́	man-SG	dọ́bọ́	man-PL
	fáá	bad-SG	fáárị́	bad-PL
	gbáálị́	open pot-SG	gbáálá	open pot-PL
	gọ́lláá	wild mouse-SG	gọ́llị́	wild mouse-PL
	kụ́láá	river-SG	kụ́llị́	river-PL
	kúó	rat-SG	kúúrí	rat-PL
	lị́ẹ́nị́	kind of fruit-SG	lị́ẹ́mẹ́	kind of fruit-PL
	lúgrí	prop-SG	lúgó	prop-PL
	lụ́ọ́ráá	lion-SG	lụ́ọ́rị́	lion-PL
	nyágrị́	root-SG	nyágá	root-PL
	ngmánị́	calabash-SG	ngmámá	calabash-PL
	pẹ́gị́	shell-SG	pẹ́grị́	shell-PL
	píráá	button-SG	pírrí	button-PL
	pị́ẹ́	roof-SG	pị́ị́rị́	roof-PL
	pọ́gọ́	woman-SG	pọ́gbọ́	woman-PL
	pụ́ọ́	stomach-SG	pụ́ụ́rị́	stomach-PL
	tángá	mountain-SG	tánnị́	mountain-PL
	tị́ngẹ́	town-SG	tị́nnị́	town-PL
	túú	forest-SG	túúrí	forest-PL
	váálị́	rubbish-SG	váálá	rubbish-PL
	wáláá	antelope-SG	wállị́	antelope-PL
	zíé	place-SG	zíírí	place-PL
	zụ́mmụ́	fish-SG	zụ́mọ́	fish-SG

Before addressing the specific tonal properties of Dagaare nominals, a few general observations are in order. Following Kennedy (1966), we posit the syllable as the TBU. On his analysis, the Dagaare word consists of a sequence of one or more PRIMARY syllables, each with contrastive length, followed by a word-final optional SECONDARY syllable which is always (C)V. The canonical simple word is disyllabic. Some representative examples are given in (7).

(7)	(a)	CV.CV	tị̀.rị́	‘spoon’
	(b)	CVV.CV	tị̀ị̀.rị́	‘trees’
		CVV.V	náá.ꜝụ́	‘cow’
	(c)	CV.V	yí.è	‘houses’
		CVV	dáá	‘push’
	(d)	CVC.CV	bòg.rí	‘holes’

Examples (b) and (c) suggest that word-medially CVV sequences are monosyllabic, but word-finally either CVV or CV.V is possible. This asymmetry is noted by Kennedy (1966, 8-11) who shows that word-medial VV-sequences are either long vowels (/i:, ị:, a:, ụ:, u:/) or diphthongs (/ie, ịẹ, uo, ụọ/), whereas word-finally genuine vowel sequences are also found. In support of this, we note that VV-sequences like /ee, oe, ue/ are absent word-medially, but occur word-finally.[3] The CV.V syllabification obviates the need for a new syllable type found only in word-final position. As for tonal evidence, we note that the tonal patterns CV̀V́CV́ and CV́V̀CV̀ which would be expected under the CV.V.CV syllabification (and also if the TBU were the mora) are systematically absent, yet word-finally we find *yíè* ‘houses’ and *vị̀làá* ‘good’ where a two-tone melody is split over a final CVV, suggesting CV.V. Word-final CVV-sequences also show contextual variation which can be attributed to competing syllabifications. For example, *sàá* ‘father’, *dá̱à̱* ‘beer’ and *vị̀làá* ‘good’ have alternative pronunciations *sàà*, *dá̱á̱* and *vị̀làà*. The second tone emerges especially clearly under emphatic lengthening as in [sà:::́] ‘father!’. In the closely related Dagbane, the emergent second tone has been explained in terms of an additional TBU (Wilson 1970, Hyman 1993). We attribute this variation to the variable resyllabification of CV.V as CVV in postlexical phonology. It follows, correctly, that similar variation is excluded in CVCV-words which are unambiguously CV.CV.

The more marginal word types include *bá* ‘friend’, *zú* ‘head’, *nú* ‘hand’ (CV), *bààl.bá* ‘sick people’ (CVVC.CV), *vị̀.là.á* ‘good’ (CV.CV.V) and *k̀po.lúú* ‘termite’ (CV.CVV). There are also simple words with more than two tones, for example *kpàrụ́ụ̀* (LHL) ‘shirt-SG’. These cases will be discussed later. Trisyllabic words, for example *nọ̀ọ̀tị́rị̀* ‘shoe’ and *símírì* ‘eye’, generally seem either recent loans or compounds and involve additional tonal complexities we will not attempt to analyze in this paper.[4]

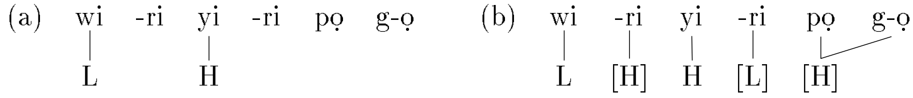
2.2 Tonal polarity

The surface inventory LH, HL and HH is not the expected one. In a maximal two-tone system, each syllable would have its own tone with no regard for the tone of other syllables, yielding two kinds of monosyllables (H, L) four kinds of disyllables (HH, HL, LH, LL) and so on.[5] In words like *wì-rí* ‘horse’ and *yí-rì* ‘house’ the first syllable bears a contrastive tone while the second syllable automatically assumes the opposite tone. This syndrome, known as tonal polarity, is attested in several West African languages, for example Hausa, Margi, Kanakuru (Chadic) (Hoffmann 1963, Pulleyblank 1986, Newman 1995), Moore and Lama (Gur) (Kenstowicz et al. 1988). On this view, the H-H type constitutes an exceptional class. Put in another way, while an initial L tone is always polarizing, initial H tones come in two flavors: one is polarizing, the other spreads. Nothing in the word (segmental phonology, meaning) helps in figuring out the tonal type.

(8)	wẹ́g-rị̀	log-PL	pẹ́g-rị́	shell-PL
	gụ́ụ́-rị̀	thorn-PL	bụ́ụ́-rị́	goat-PL
	nụ́ụ́-rị̀	hen-PL	pụ́ụ́-rị́	stomach-PL
	nụ́-bọ̀	person-PL	dọ́-bọ́	man-PL

We propose the following representations for *wìrí* 'horse', *yírì* 'house' and *pọ́gọ́* 'woman' and call them classes A, B and C, respectively. The underlying forms are given in (9a), the surface forms in (9b).

(9)



In types A and B, the root tone is LEXICAL and does not spread, consequently forcing tone insertion on the toneless suffix. This newly inserted DERIVED tone (annotated by square brackets) will assume a value opposite to the root-final tone by the Obligatory Contour Principle (Leben 1973) which prohibits two adjacent identical tones (*HH, *LL), hence polarity. The analysis implies that there is no synchronic reason to presume that the suffix tone started underlyingly as some specified tone or other. In class C, both the root and the suffix are lexically toneless which induces the insertion of a derived H tone which spreads on both syllables. This may seem surprising given that L is the typical default tone. We will later propose that this H tone is induced by the presence of word stress which overrides the general preference for L tones.

(10) The main features of the analysis:

(a) Lexical tones induce polarity but do not spread.
(b) Derived tones spread and do not induce polarity.
(c) Polarity tones are derived tones.

There are of course many alternatives available. One initially plausible solution would be that A and B stems come with the complex tones LH and HL, C stems are H and suffixes are toneless. In the case of complex-toned stems, the second tone would always be realized on the number suffix due to a constraint against contour tones. We call this the COMPLEX TONE ANALYSIS.

(11) The COMPLEX TONE ANALYSIS

UR	ASSOCIATE	SPREAD	OUTPUT
wi -ri LH	wi -ri L H	–	wi -ri L H
yi -ri HL	yi -ri H L	–	yi -ri H L
pọg -ọ H	pọ g-ọ H	pọ g-ọ H	pọ g-ọ H

Kenstowicz et al. (1988, 78-79) consider this analysis for Moore, but reject it for two reasons. First, it fails to account for the systematic absence of L-L words, a glaring gap that any analysis should explain. The analysis raises, but does not answer, the question why there are no L stems analogous to H stems. Second, phonological inventories are typically hierarchical in nature and the presence of more complex members presupposes the existence of simpler ones. In this case, the posited tonal inventory violates this basic principle of phonological organization: it posits both HL and LH contours in absence of a basic L.

Alternatively, one might stick with the assumption that the roots are H, L and toneless, but propose that all suffixes are underlyingly H and that there is a dissimilation rule which lowers H suffixes after H stems, thus yielding the appearance of tonal polarity. We call this the DISSIMILATION ANALYSIS.

(12) Lowering rule (= Meeussen's rule)
$H\ H \rightarrow H\ L$

(13) The DISSIMILATION ANALYSIS

UR	ASSOCIATE	SPREAD	MEEUSSEN	OUTPUT
wi -ri L H	wi -ri L H	–	–	wi -ri L H
yi -ri H H	yi -ri H H	–	yi -ri H L	yi -ri H L
pọg -ọ H	pọ g-ọ H	pọ g-ọ H	–	pọ g-ọ H

This analysis has been defended for at least Moore (Kenstowicz et al. 1988), Dagbane (Hyman 1993) and Margi (Pulleyblank 1986).[6] The absence of polarity in class C now follows: the only tone present is the suffixal H and the lowering rule needs two H tones to apply. The absence of L–L words follows as well: suffixes are underlyingly H and lowering is not possible after L tones.

However, the analysis does not reflect the fundamental insight that tonal polarity is essentially NEUTRALIZATION, i.e. suspension of tonal contrast. It is exactly for this reason that it typically occurs in prosodically weak positions: word-finally rather than word-medially, on clitics and affixes rather than roots, very much like extrametricality (Pulleyblank 1986, 214). In the dissimilation analysis it is precisely the suffix – sometimes even *only* the suffix – that carries the underlying H tone and bears the descriptive burden in the analysis.

> The reason why polarity is so natural and its occurrence so expected is because tone functions prosodically and works naturally with melodic patterns [...] Whereas content words (especially nouns and verbs) have the body to carry distinctive tone, with short, unstressed grammatical morphemes, a specific tone, whether it be high or low, has very little saliency (Newman 1995, 776).

Neither does the dissimilation analysis generalize in the right way. In Dagaare, free-standing nonemphatic CV-pronouns are L toned. However, if the pronoun is cliticized on a L-toned verb, it polarizes to H as (16) shows.

(14) **Ǹ/fụ̀/ụ̀** Nmị̀ẹ̀-rẹ́ **mà/fụ̀/ụ̀** lá
1P/2P/3P beat-IMPERF 1P/2P/3P FACT
I/you/he.she.it was beating me/you/him.her.it

(15) **ụ̀** nị́ẹ́ **mà/fụ̀/ụ̀** lá
3P step 1P/2P/3P FACT
He stepped on me/you/him.her.it

(16) ụ́ná lá Nmẹ̀ **má/fụ́/ụ́**
3P.EMPH FACT beat 1P/2P/3P
It was he who beat me/you/him.her.it

These facts show that tonal polarity cannot be accounted for merely by the lowering rule in (12). We will later suggest that nonemphatic pronouns are toneless and get a default L in non-polarity contexts. This agrees with our claim that polarity tones are derived, not lexical. Finally, the absence of L–L words only follows given the stipulation that all suffixes are H, a fact hardly less puzzling than the absence of L–L words itself.

To summarize our proposal, tonal polarity is tone insertion on a toneless TBU. If there is an adjacent lexical tone, the OCP induces the opposite tone. If no tone is present, a single H tone is inserted and spread across the whole word. In the sections to come, we will present more evidence for the distinction between lexical and derived tones and for the proposed analysis.

2.3 High tone suppression

Our analysis claims that the H tones in *yírì* and *pọ́gọ́* are of different origin which is reflected in the presence vs. absence of tonal polarity. Another difference emerges in the noun+adjective (N+A) construction. In Dagaare, as in Dagbane and Moore, adjectives come after the noun. The number suffix appears only once, on the last adjective, which also determines the shape of the suffix allomorph.

(17)	A	wìr-í + tọ̀ọ̀r-ị́	→	wìr-tọ̀ọ̀r-ị́	horse-far.away-SG
		wìr-í + zị̀-ẹ́ + tọ̀ọ̀r-ị́	→	wìr-zị̀-tọ̀ọ̀r-ị́	horse-red-far.away-SG
		wìr-í + fá-á	→	wìr-fá-á	horse-bad-SG
	B	yí-rì + tọ̀ọ̀r-ị́	→	yí-tọ̀ọ̀r-ị́	house-far.away-SG
		yí-rì + zị̀-ẹ́ + tọ̀ọ̀r-ị́	→	yí-zị̀-tọ̀ọ̀r-ị́	house-red-far.away-SG
		yí-rì + fá-á	→	yí-ꜝfá-á	house-bad-SG
	C	pọ́g-ọ́ + tọ̀ọ̀r-ị́	→	pọ̀g-tọ̀ọ̀r-ị́	woman-far.away-SG
		pọ́g-ọ́ + zị̀-ẹ́ + tọ̀ọ̀r-ị́	→	pọ̀g-zị̀-tọ̀ọ̀r-ị́	woman-red-far.away-SG
		pọ́g-ọ́ + fá-á	→	pọ̀g-fá-á	woman-bad-SG

The main observation is that class C stems lose their H tones before adjectives. In Class B, the H tone stays put and we observe a downstep if a H toned adjective follows (*yí-ꜝfá-á*). Again, we propose that derived H tones are suppressed, lexical H tones are not. As (18) shows, polarity [H] is suppressed even in cases like *sàá* 'father' which have no number suffix:[7]

(18)					
	A	sàá + sàá	→	sàá sàá	father's father (N+N, no suppression)
		sàá + sàá + vị̀l-àá	→	sàá sàà-vị̀l-àá	father's good father (N+N+A)
		sàá + vị̀l-àá + sàá	→	sàà-vị̀l-àá sàá	good father's father (N+A+N)

We now have two independent tests for checking H tones: derived tones should both spread and be suppressed; lexical tones should do neither. Note that our classification is no longer innocent nomenclature: it would be entirely possible for a H tone to spread, but not be suppressed, or not to spread (i.e. trigger tonal polarity) and yet be suppressed. However, such mixed behavior does not exist. As the following examples show, even non-canonical longer words, some of which are obvious loans, behave as predicted: whenever there is tonal polarity, the H tone survives (B); whenever there is spreading, the H tone is suppressed (C):

(19)	B	fị̀ntị́l-ẹ̀ + fá-á	→	fị̀ntị́l-ꜝfá-á	lamp-bad-SG
		dị̀ndọ́-rị̀ + fá-á	→	dị̀ndọ́-ꜝfá-á	door-bad-SG
		kàrànsụ́n-ị̀ + fá-á	→	kàrànsụ́n-ꜝfá-á	kerosine-bad-SG
		nọ̀ọ̀tị́-rị̀ fá-á	→	nọ̀ọ̀tị́-ꜝfá-á	shoe-bad-SG
		sàkúú-rì + fáá	→	sàkú-ꜝfáá	school-bad-SG
	C	bádẹ́r-ị́ + fá-á	→	bádẹ̀r-fá-á	spider-bad-SG
		bángyị́r-áá + fá-á	→	bángyị̀r-fá-á	latrine-bad-SG
		dànkyín-í + fá-á	→	dànkyìn-fá-á	wall-bad-SG
		gbátị́r-ụ́ụ́ + fá-á	→	gbátị̀r-fá-á	kind of plant-bad-SG
		gyị́rị́mị́n-ị́ị́ + fá-á	→	gyị́rị́mị̀n-fá-á	slimness-bad-SG
		kómmí-rúú + fá-á	→	kómmì-fá-á	tomato-bad-SG
		kpántól-ó + fá-á	→	kpántòl-fá-á	topknot-bad-SG
		kùnkún-í + fá-á	→	kùnkùn-fá-á	tortoise-bad-SG
		símí-é + fá-á	→	símì-fá-á	Bambara beans-bad-SG
		sọ́wọ́l-ọ́ + fá-á	→	sọ́wọ̀l-fá-á	kind of food-bad-SG
		tákór-ó + fá-á	→	tákòr-fá-á	window-bad-SG

At this point, we return to the DISSIMILATION ANALYSIS discussed in section 2.2. The analysis claims that class C stems are toneless, the surface H tone being of suffixal origin. This generalizes to H tone suppression in *pọ́g-ọ́ + fá-á → pọ̀g-fá-á*. Since the suffix *-ọ́* is not present, the toneless stem *pọg-* surfaces with the default L tone (Kenstowicz et al. 1988, 85). However, the examples in (19) remain problematic: the H tone does surface except in the last syllable of the root. If the H tone in *bádẹ́r-ị́* and other HHH words indeed were of suffixal origin, then we would expect the following unattested forms:

(20)	C	bádẹ́r-ị́ + fá-á	↛	*bàdẹ̀r-fá-á	spider-bad-SG
		bángyị́r-áá + fá-á	↛	*bàngyị̀r-fá-á	latrine-bad-SG
		gbátị́r-ụ́ụ́ + fá-á	↛	*gbàtị̀r-fá-á	kind of plant-bad-SG

To salvage the analysis, one could suggest that the stable first tones are lexically prespecified as H and thus not susceptible to suppression. However, one would still wonder what keeps them from spreading onto the toneless syllable. This problem of partial H-tone suppression in long words and the descriptive generalization "no [H] tones on the TBU on the immediate left of a N+A juncture" will remain a challenge for our analysis as well. Our main result is in showing that, at the N+A juncture, derived [H] tones are suppressed, but lexical H tones survive, with downstep if a high tone (lexical or derived) follows.

2.4 Downstep and downdrift

In this section, we will take a closer look at downstep and downdrift in various contexts. Once again, lexical and derived tones turn out different.

In many tone languages, a L tone lowers the overall pitch range or key. Thus, in the sequence H_1LH_2, H_2 has a lower pitch than H_1. If the L tone is explicitly present on the surface we call the phenomenon DOWNDRIFT, if "hidden" we have DOWNSTEP. Since downdrift is predictable it is usually left untranscribed. Downstep on the other hand can be surface-phonemic. Here we follow a standard interpretation by which downstep equals a floating L tone (Pulleyblank 1986).

(21)

	REPRESENTATION	TRANSCRIPTION	PHENOMENON
(a)	ta ta ta │ │ │ H L H	tá.tà.ꜝtá	downdrift, pitch levels = 1-3-2
(b)	ta ta │ │ H L H	tá.ꜝtá	downstep, pitch levels = 1-2
(c)	ta ta │ │ H H	tá.tá	neither, pitch levels = 1-1

Dagaare has both downstep and downdrift (Kennedy 1966). We will now examine downstep/downdrift in the following environments:

(22) (a) across root+suffix juncture
(b) across N+A juncture
(c) across N+N juncture (associative constructions)

At this point, we introduce nouns of the form HꜝH and call them Class D. Here the situation is a bit more complicated as the same stem may be class B in the singular, but class D in the plural or vice versa.

(23)

bụ́nị̀	thing-SG	bụ́mꜝmá	thing-PL
dá̱à̱	beer-SG	dá̱á̱ꜝnẹ́ẹ́	beer-PL
ị́ị́ꜝlị́	horn-SG	ị́ị́lẹ̀	horn-PL
káà	oil-SG	kááꜝnẹ́ẹ́	oil-PL
kụ̱́ọ̱̀	water-SG	kụ̱́ọ̱́ꜝnẹ́ẹ́	water-PL
kụ́ọ́ꜝráá	farmer-SG	kọ́rị́ꜝbọ́	farmer-PL
kpá̱á̱ꜝụ́	guineafowl-SG	kpị́nnị̀	guineafowl-PL
nááꜝụ́	cow-SG	nị̂ị̂	cow-PL
pị́ꜝrụ́ụ́	sheep-SG	pị́ị́rị̀	sheep-PL
sáánà	stranger-SG	sááꜝmá	stranger-PL
sọ́gꜝláá	black-SG	sọ́glọ̀	black-SG
sụ́ꜝá	rabbit-SG	sụ́ọ́ꜝnị́	rabbit-PL
sụ́ọ́ꜝNáá	rabbit-SG	sụ́ọ́ꜝnị́	rabbit-PL
yụ́ọ́ꜝráá	tourist-SG	yọ́rị́ꜝbọ́	tourist-PL
zị̱̂ị̱̂	blood-SG	zị̱́ị̱́ꜝnẹ́ẹ́	blood-PL
zú	head-SG	zúꜝrí	head-PL

Assuming that downstep is due to a floating L tone, we can posit the tonal melody HLH for class D. Next, we observe that class D patterns together with class B with respect to the N+A construction: the root H is not suppressed and if a H-toned adjective follows we hear an intervening L tone.

(24)	B	yí-ꜝfá-á	house-bad-SG
	D	dá̠á̠-ꜝfá-á	beer-bad-SG
		kpáá-ꜝfáá	guineafowl-bad-SG
		pị́-ꜝfá-á	sheep-bad-SG
		sụ́ọ́-ꜝfá-á	rabbit-bad-SG
		zú-ꜝfá-á	head-bad-SG
		ị̂ịl-ꜝfá-á	horn-bad-SG
		kụ́ọ̀r-ꜝfá-á	farmer-bad-SG
		sụ́ọ̀n-ꜝfá-á	rabbit-bad-SG
		yụ́ọ̀r-ꜝfá-á	tourist-bad-SG

Phonetically, the intervening L is realized either as a downstep (H-ꜝH) or an actual contour (HL-H). While we do not have a formal explanation for this difference, we note that all the contour cases we have observed involve a syllable closed by a sonorant consonant.

One possible hypothesis is that B and D stems are both underlyingly H, but that D stems select inherently H-toned number suffixes (singular, plural, or both). This selection must be morphologically conditioned as the same stem may take a regular polarity suffix in the singular, but a H suffix in the plural, or vice versa. The intervening L tone can now be explained as an automatic consequence of the OCP: two adjacent H tones trigger L-interpolation.

The closely related Dagbane shows that the internal downstep may also originate from a HL stem. As in Dagaare, canonical nouns fall into four tonal classes and in the N+A construction the noun appears without a suffix.

(25) Dagbane (Hyman 1993, 237)

A	/wàh-ú/ + /títá-lí/	wàr-títá-lí	horse-big-SG
B	/sán-à/ + /títá-lí/	sáán-títá-lí	stranger-big-SG
C	/pág-á/ + /títá-lí/	pàg-títá-lí	woman-big-SG
D	/kpáN-ꜝá/ + /títá-lí/	kpáN-ꜝtítá-lí	guineafowl-big-SG

In Dagbane, B and D behave differently: only D triggers downstep. This can be explained by assuming that in Dagbane the OCP does not trigger downstep insertion and that the stems are H and HL respectively. Thus, it would not be too surprising if Dagaare too had genuine HL toned stems. For now, we simply note that both (26a) and (26b) are possible representations for class D.

(26) (a) kp á̠ á̠ - ꜝ ụ́ (b) kp á̠ á̠ - ꜝ ụ́

H [L] H H L H

With these preliminaries behind us, we now show that lexical tones trigger downstep, derived tones do not. For the data, we turn to the associative construction (N+N) which typically has a possessive meaning.

(27)	(a)	kpá̱á̱-ꜝụ́ ꜝyí-rì	guineafowl-SG house-SG
		kpá̱á̱-ꜝụ́ ꜝbí-é	guineafowl-SG child-SG
		kpá̱á̱-ꜝụ́ ꜝkpá̱á̱-ꜝụ́	guineafowl-SG guineafowl-SG
		pị́-ꜝrụ́ụ́ ꜝyí-rì	sheep-SG house-SG
		pị́-ꜝrụ́ụ́ ꜝbí-é	sheep-SG child-SG
		pị́-ꜝrụ́ụ́ ꜝkpá̱á̱-ꜝụ́	sheep-SG guineafowl-SG
		sụ́ọ́-ꜝNáá ꜝyí-rì	rabbit-SG house-SG
		sụ́ọ́-ꜝNáá ꜝbí-é	rabbit-SG child-SG
		sụ́ọ́-ꜝNáá ꜝkpá̱á̱-ꜝụ́	rabbit-SG guineafowl-SG
	(b)	bí-é yí-rì	child-SG house-SG
		bí-é bí-é	child-SG child-SG
		bí-é kpá̱á̱-ꜝụ	child-SG guineafowl-SG
		pọ́-gọ́ yí-rì	woman-SG house-SG
		pọ́-gọ́ bí-é	woman-SG child-SG
		pọ́-gọ́ kpá̱á̱-ꜝụ	woman-SG guineafowl-SG
		wì-rí yí-rì	horse-SG house-SG
		wì-rí bí-é	horse-SG child-SG
		wì-rí kpá̱á̱-ꜝụ	horse-SG guineafowl-SG
		bààl-á yí-rì	sick.person-SG house-SG
		bààl-á bí-é	sick.person-SG child-SG
		bààl-á kpá̱á̱-ꜝụ	sick.person-SG guineafowl-SG
		kpòl-úú yí-rì	termite-SG house-SG
		kpòl-úú bí-é	termite-SG child-SG
		kpò-lúú kpá̱á̱-ꜝụ	termite-SG guineafowl-SG

The examples in (27) show abutting H tones across a word boundary. In (a), the first tone is lexical (class D suffix) with a following downstep, in (b) the first tone is derived (polarity tone or class C tone) with no downstep; both H tones remain equally high.[8] This reveals a parallel between tonal polarity and downstep.

(28) The Downstep Generalization:

H H → H [L] H = H ꜝH
H [H] → H [L] H = H ꜝH
[H] H → no change = H H
[H] [H] → no change = H H

Similar facts are found in Dagara and Dagbane although descriptive statements vary. According to Delplanque (1983), in Dagara a root H causes downstep across words, whereas a suffix H does not:

(29) Dagara (Delplanque 1983, 124)

(a) zèlè zúú ꜝnú (*zúú nú)
'C'est la tête du mendiant.'

(b) sò-ró ná (*sò-ró ꜝná)
'Ce sont les couteaux.'

Delplanque's generalization which is stated in terms of morphology (root vs. suffix), not phonology (lexical vs. derived), is only approximately true in Dagaare: there are H suffixes which trigger downstep (class D) and H roots which do not (class C). Yet it seems clear why the generalization should work in most cases: statistically, root tones tend to be lexical (underlyingly specified) whereas suffixal tones tend to be derived.

In (30) we see the parallel facts in Dagbane (Wilson 1970, Hyman 1993). The data looks different due to the postlexical processes of vowel elision and rightward tone spreading which destroy surface polarity. At the lexical level, however, we encounter the familiar Dagaare pattern:

(30) Dagbane (Hyman 1993, 238)

	Lexical	Spreading	Elision	Gloss
A	/wàhú/	wàhù	[wàh yílí]	horse's house
B	/sánà/	sáná	[sán ꜝyílí]	stranger's house
C	/págá/	págá	[pág yílí]	woman's house
D	/kpáNꜝá/	kpáNꜝá	[kpáN ꜝyílí]	guineafowl's house

In the three cases where downstep is audible in principle (B, C, D), we get the expected pattern: the downstep in B is due to the suffixal [L]-tone; in C there is no downstep as predicted; in D the internal downstep of *kpáN ꜝá* is heard on the following word due to elision.

Finally, we consider downdrift across words. Here two H tones are separated by a word-final L toned syllable. The absolute pitch levels are indicated numerically: 1 denotes the highest, 5 the lowest tone.

(31) (a) ẹ́-bàà ꜝbí-é crocodile-SG child-SG 1-3 3-3
(b) ẹ́-bàà ꜝpọ́g-ọ́ crocodile-SG woman-SG 1-3 3-3
(c) ẹ́-bàà ꜝyí-rì crocodile-SG house-SG 1-3 3-5

Compared to downstep, the pitch lowering is remarkably dramatic. In (31a), the downdrift-triggering second tone of *ẹ́-bàà* and the second word are phonetically equally low (= 3). However, the phonological H/L contrast is preserved. This is evident from (31c) where *-rì* remains lower than *yí-*. Now, consider *áyọ̀ọ̀* ‘female name’, at first hearing similar to *ẹ́-bàà*. In this case, downdrift is noticeably less dramatic: high remains higher than low.

(32)	áyọ̀ọ̀ bí-é	Ayọọ-SG child-SG	1-3 2-2
	áyọ̀ọ̀ pọ́g-ọ́	Ayọọ-SG woman-SG	1-3 2-2
	áyọ̀ọ̀ yí-rì	Ayọọ-SG house-SG	1-3 2-4

The crucial difference between the low-toned syllables in *á-yọ̀ọ̀* and *ẹ́-bàà* is that in the former the low tone is lexical, in the latter derived. This difference emerges clearly under emphatic lengthening: *ẹ́-bàà:::* has a steadily falling contour whereas *áyọ̀ọ̀::́* has a final rise, i.e. a polarity tone. While not audible on the surface of *á-yọ̀ọ̀*, the polarity tone [H] blocks downdrift on the following H.

We now summarize our results so far. Three independent diagnostics for identifying lexical vs. derived tones have been proposed: (i) tonal polarity; (ii) H tone suppression; (iii) downstep. If applied to the same tone, the results should converge. Indeed, words which do not show tonal polarity undergo H suppression (*pọ́g-ọ́, pọ̀g-fáá*) and do not trigger downstep (*pọ́g-ọ́ bíé*). Polarity tones, being derived, are suppressed (*sàá, sàà-vị̀làà*) and do not trigger downstep (*wìr-í yí-rì*). Words which trigger downstep on the following adjective (*yí-ꜝfáá*) polarize their suffixes (*yí-rì*). It is difficult to see how all these facts could be connected under an analysis which does not differentiate between two kinds of tones along the lines of our lexical vs. derived distinction.

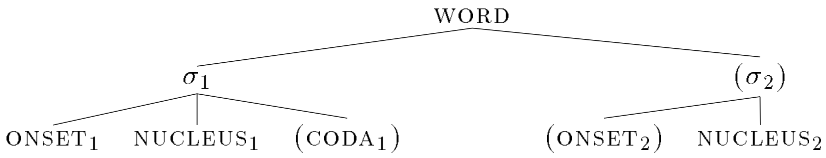
2.5 Word stress

Finally, we turn to evidence for STRESS in Dagaare. Our conclusion will be that stress interacts with both lexical and derived tones, yet it can be identified with neither.

In many tone languages, there is evidence for ACCENT independent of tone. While in some cases accent is hardly more than a diacritic, in others it has genuine stress-like properties. Typically, only one contrastive tone per word is found; this tone is assigned to a metrically strong position and it does not spread or assimilate. All these are well-known properties of stress (McCawley 1978, Hyman 1978, Hayes 1995). In Bantu, H tone attraction to strong positions is common. To take a few examples from recent literature, in Lamba underlying H tones are phonetically manifested at the heads of trochaic feet, creating an alternating tonal pattern (Bickmore 1995). In Luganda, the second mora bears an accent which induces H tone attraction and lengthening and blocks consonant deletion/mutation (Hyman and Katamba 1993). In Kizigua, lexically supplied H tones are attracted to prominent positions of the metrical grid: penult and the initial syllable, a metrical system like that of Polish (Kenstowicz 1989). In Chicheŵa, lexical words end in a disyllabic foot with accompanying penultimate H tone assignment (Kanerva 1989). In Zulu and Xhosa, H tones shift to the metrically strong position in the final foot (Goldsmith 1988). In Kimatuumbi, nouns have a single accented syllable which receives a H tone, all others receive L. Moreover, accented H tones distinguish themselves by refusing to obey tone shift (Pulleyblank 1983, Odden 1995). Finally, in Tonga, a L tone is associated with the accented syllable, much as in the intonation associated with yes-no questions in English (Goldsmith 1983). As for Dagaare, we propose that word stress falls on the penultimate syllable.

The first hint about stress in Dagaare comes from segmental asymmetries. According to Kennedy (1966, 3-4), the simple word consists of a primary syllable followed by an optional secondary syllable. Kennedy's diagram (slightly modified for clarity) is given below.[9]

(33) The structure of the simple word (Kennedy 1966):



The secondary syllable is weaker than the primary syllable in several ways. Not only is its structure simpler (optional onset, no coda), but it also supports fewer contrasts. The crucial nuclear asymmetry is that only NUCLEUS$_1$ may carry contrastive length (*kù.rí* 'to hammer' vs. *kùù.rí* 'a hoe'). As for margins, ONSET$_1$ permits all the 24 consonant phonemes listed in (34), whereas both CODA$_1$ and ONSET$_2$ maximally permit six, namely those segments not enclosed in parentheses (Kennedy 1966, 3). If both CODA$_1$ and ONSET$_2$ are present, the restrictions are even more stringent. According to Kennedy, the only possible combinations in this case are /gr/ and /gl/.[10]

(34)	(p)	(kp)	(t)	(ky)	(k)	(?)
	(b)	(gb)	d∼r	(gy)	g	
	m	(Nm)	n	(ny)	N	
	(f)		(s)			(h)
	(v)		(z)			
			l	(y)	(w)	

Secondary (i.e. noninitial final CV) syllables also undergo postlexical reduction, a phenomenon quite widespread in Gur languages (Rialland 1985, Hyman 1993).

(35) Apocope

kúl-ì	∼	kúl-	go home-INF
kùù-rí	∼	kùù-r	hoe-SG
pọ́g-ọ́	∼	pọ́g-	woman-SG
tòòr-í	∼	tòòr-	far away-SG
wóg-ì	∼	wôg-	tall-SG
Dàgáá-rè	∼	Dàgáá-r	Dagaare-SG

Another diagnostic for stress is tone. It is well-known that tones are attracted to stress in many languages, including English (Hayes 1995). In Dagaare, the phenomenon of tonal polarity itself can be derived from tone-to-stress attraction: characteristically, lexical tones, both H and L, associate to the stressed penult and final syllables get whatever is the contextually appropriate derived tone, i.e. the polarity tone. This agrees in spirit with Newman's (1995) suggestion that the prosodically prominent root is more capable of realizing lexical contrasts than the unprominent suffix.

In conjunction with tone-to-stress attraction, penultimate stress predicts that the number of syllables should make a difference in the placement of lexical tones. For confirming evidence, consider nouns which take a singular suffix of the form -CVV instead of the canonical -CV. Since a word-final CVV can be syllabified either CVV or CV.V, we predict two distinct stress patterns and, given tone-to-stress attraction, two distinct tone linearization patterns. This prediction is borne out. In some CV.CVV words, lexical tones show evidence for CV.CV.V with stress in the middle, others for CV.CVV with initial stress. The choice seems tied to a particular suffix and is thus morphologically conditioned. The following data is organized by the familiar classes A, B, C, D. Classes A′ and B′ are new. The stressed penult is underlined.

(36)	(a)	A	ẹ́.bàà	ẹ́r.rị̀	‘crocodile sg./pl.’
			ọ́.ràà	ọ́r.rị̀	‘kind of berry sg./pl.’
		A′	kpà.lá.à	kpǎl.lì	‘sling sg./pl’
			kpà.rụ́.ụ̀	kpǎr.rị̀	‘shirt sg./pl.
			ù.lé.è	ǔl.lì	‘branch sg./pl.
		B	mọ̀.lụ́ụ́	mọ̀l.lị́	‘kind of animal sg./pl.
			kpò.lúú	kpòl.lí	‘termite sg./pl.’
		B′	vị̀.là.á	vị̀ẹ̀.lị́	‘good sg./pl.’
			pị̀.là.á	pị̀ẹ̀.lị́	‘white sg./pl.’
			sị̀.là.á	sị̀l.lị́	‘hawk sg./pl.’
		C	kụ́.láá	kụ́l.lị́	‘river sg./pl.’
			wá.láá	wál.lị́	‘antelope sg./pl.
		D	pị́.ꜝrụ́ụ́	pị́ị́.rị̀	‘sheep sg./pl.’

In A, the lexical H is attracted to the penult (= the first syllable) and the final syllable gets a polarity tone. In A′, the lexical H shifts between the first and the second vowel depending on syllabification. The initial L tone is lexical. In the singular it is realized on the first vowel, in the plural it gets trapped between the H tone and left edge, resulting in a contour. B/B′ show the same effect for lexical L tones.[11] In C, there is no tonal evidence either way: the words are toneless and get a derived [H] under both syllabifications. In D, all the exceptionally H-toned suffixes are syllabified CVV; else we would expect **pị́.ꜝrụ́.ụ̀*, with the suffixal H on the penult plus a final polarity tone. As expected, these suffixes do not form falling contours under emphatic lengthening, but remain level.

The stress-sensitive tones are lexical. We are not aware of any cases where derived tones, for example polarity tones, would shift towards stress. The lexical status of the shifting L tones is evident from the fact that they trigger polarity. For the H tones, we may also concatenate the relevant roots with a H-toned adjective. The result is an intervening downstep instead of H-suppression.

(37)

kpăl-ꜜfá-á	sling-bad-SG
kpăr-ꜜfá-á	shirt-bad-SG
ŭl-ꜜfá-á	branch-bad-SG

Finally, we note a connection between H tone and emphasis. In Dagaare, as in many other languages, certain lexical items come in emphatic/nonemphatic pairs; here we consider pronouns and tense markers. Nonemphatic pronouns are all monosyllabic, hence unstressed, and all bear the default L tone. Their emphatic counterparts are all at least disyllabic, hence stressed, and all bear a H tone. The past and future tense markers behave analogously.[12]

(38) Personal pronouns (Bodomo 1997):

NONEMPHATIC	EMPHATIC	GLOSS
Ǹ, mà	má.à	1.SG
fụ̀	fụ́.ụ̀	2.SG
ụ̀	ụ́.nọ́	3.SG
tị̀	tị̀.nị̲́.ị̲̀	1.PL
yẹ̀	yẹ̀.nị̲́.ị̲̀	2.PL
bà	bá.ná	3.PL.HUM
à	á.ná	3.PL.NONHUM

(39) Tense markers:

dà	general past (long ago past, past today)
dá.á	2–6 days ago
nà	general future (shall/will)
ná.á	be going to

One alternative would be to propose that H tone is an underlying accent and L tone absence thereof. This would mean that in *yí.rì* 'house' the first syllable would be stressed and in *wì.rí* 'horse' unstressed. However, this is clearly the wrong analysis for Dagaare. First, both lexical H and lexical L tones are stress-sensitive. Second, if H tone could be identified with stress, one would expect stress-related asymmetries between initial H and L syllables. However, both permit the same syllable types (CV, CVC, CVV, CVVC), both participate in the same morphophonological length alternations (*nụ́ụ́-rị̀*/*nụ́-ọ̀* hen-PL/SG, *kùù-rí*/*kù-é*, hoe-SG/PL), both may take emphatic stress and both are equally common. Thus, the contrast between H and L seems genuinely tonal and independent of stress.

2.6 Summary

We now summarize the diagnostics. For obvious reasons, test 3 does not apply to L tones.

(40)

DIAGNOSTIC	LEXICAL	DERIVED
1. Trigger polarity	yes	no
2. Spread	no	yes
3. Undergo H suppression	no	yes
4. Trigger downstep	yes	no
5. Attracted by stress	yes	no

The same tone can be subjected to multiple diagnostics. Consider the H tone in *kùnkúní* 'tortoise'. By all the applicable diagnostics, H is derived.

(41) Testing the H tone:

Spreading, no polarity	kùnkún-í (*kùnkún-ì)
No downstep	kùnkúní yírí (*kùnkúní ꜝyírí)
Suppressed	kùnkùn-fáá (*kùnkún-ꜝfáá)
Not attracted by stress	kùn.kú.ní (*kŭn.kú.ní)

We have now established empirically that Dagaare tones can be assigned into two mutually exclusive groups: lexical and derived. This is where the explanatory work begins. Why do these diagnostics work in the first place? Why should these disparate tonal properties cluster? This will be the topic of the rest of this paper.

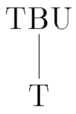
3 Tonal correspondences

In this section, we derive the behavior of Dagaare nominal tones from optimal CORRESPONDENCES between input tones, output tones and tone-bearing units. The idea of defining well-formedness in terms of declarative input-output constraints evaluated in parallel was proposed by Koskenniemi (1983) and given an optimality-theoretic interpretation by McCarthy and Prince (1995). The original idea has recently been extended to base-reduplicant (McCarthy and Prince 1995) and output-output relations (Benua 1995, Burzio 1996). As McCarthy and Prince point out, the notion of correspondence is a very general one and straightforwardly extends to autosegmental associations such as tone–TBU associations. This is of course not to say that they are the same relation. For example, input–output relations are further constrained by identity, tone–TBU relations by synchrony.

3.1 Introduction

We propose (42) as the optimal tone-TBU correspondence. These two constraints subsume the core clause of most versions of the autosegmental Well-Formedness Condition (Goldsmith 1976, Halle and Vergnaud 1982, Pulleyblank 1986).

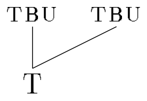
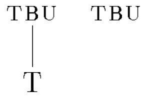
(42) CONFIGURATION CONSTRAINTS



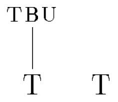
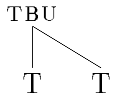
(a) Every tone is linked to exactly one TBU = (T,TBU)
(b) Every TBU is linked to exactly one tone = (TBU,T)

It will be immediately obvious that in most tone languages (T,TBU) and (TBU,T) cannot be surface-true. For example, both floating tones and tone spreading violate (T,TBU): in the first case there is a tone without a TBU, in the second case the tone is associated to several TBUs. However, as soon as these two constraints are embedded in Optimality Theory (Prince and Smolensky 1993) more reasonable results start to emerge. The two possible rankings generate two kinds of languages: one with spreading and floating tones, another with toneless TBUs and contours.

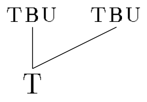
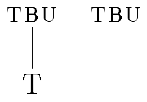
(43) Too many TBUs. Solution: Spreading

		(TBU, T)	(T, TBU)
(a) ⇒			*
(b)		*!	

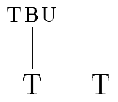
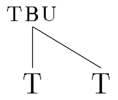
(44) Too many tones. Solution: Floating tone

		(TBU, T)	(T, TBU)
(a) ⇒			*
(b)		*!	

(45) Too many TBUs. Solution: Toneless TBU

		(T, TBU)	(TBU, T)
(a)		*!	
(b) ⇒			*

(46) Too many tones. Solution: Contour

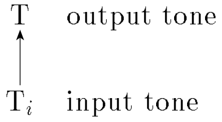
		(T, TBU)	(TBU, T)
(a)		*!	
(b) ⇒			*

These two simple correspondence constraints, embedded in Optimality Theory, predict four familiar kinds of tonal phenomena. This is a direct implementation of the intuition that many tonal processes result from a more or less successful alignment of the tonal melody with the segmental melody. As Kenstowicz (1989) puts it:

> West African systems with contour tones and additional pitch heights are probably the surface reflex of a housing shortage–too many high and low tonal atoms crowding into the same syllabic space. Because of their greater size, Bantu words tend to have the opposite problem–a good deal of tonally unoccupied space.

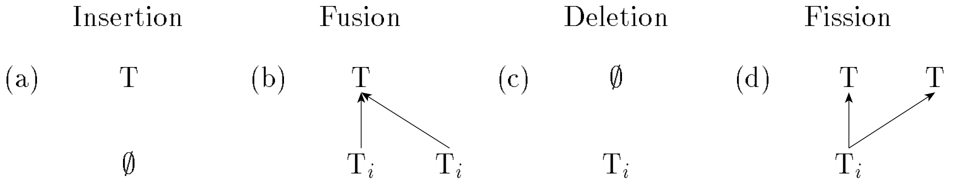
Four more tonal processes need to be addressed. In the traditional OT terminology, tone deletion is a violation of PARSE(T), tone insertion a violation of FILL(T). Here we state these constraints as correspondences between input tones and output tones. The optimal correspondence is shown in (47). For the sake of notational clarity, we use an arrow for input–output correspondence.

(47)



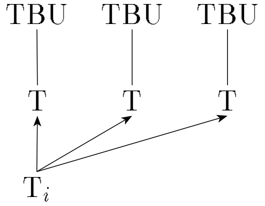
Two more constraints are now added to the system: (T,T_i) = every output tone corresponds to exactly one input tone and (T_i,T) = every input tone corresponds to exactly one output tone. Besides tone insertion and tone deletion, these constraints militate against two types of multiple correspondence, less often discussed, but nevertheless predicted by Correspondence Theory: tone fusion and tone fission. In the segmental domain, these processes have been dubbed “Coalescence” and “Breaking” (McCarthy and Prince 1995, 123-4).

(48)



Tone deletion and tone insertion are very common processes. An example of both is provided by Meeussen's Rule. As discussed earlier, one standard analysis is that a sequence of two adjacent H tones triggers the deletion of the second tone, yielding H∅, which through default insertion produces the surface sequence HL. Tone fusion is found for instance in Kipare (Bantu: Tanzania) where adjacent underlying H tones merge into one H tone due to the high-ranking OCP (Odden 1995, 462-3) and also in Shona (Myers 1996). Convincing cases of tone fission are harder to find. One potential example is tone copying instead of the usual association-cum-spreading (Hyman and Pulleyblank 1988). An obvious explanation for the absence of fission is the OCP.

(49) Tone fission (unattested?)



The four-constraint system is summarized in (50).

(50) Summary of constraints

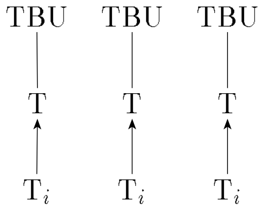
(a)	(T,TBU)	*Spread, *Float
(b)	(TBU,T)	*Contour, *Toneless
(d)	(T,T$_i$)	*Insertion, *Fusion
(c)	(T$_i$,T)	*Deletion, *Fission

3.2 Some consequences

In Optimality Theory, a fresh set of constraints forces one to explore how they interact under different possible rankings. In this case, the constraints make some quite specific predictions about the behavior of tones. While it is impossible to survey even a tiny fraction of the relevant empirical material in a paper on just one tone language, Dagaare, we will begin the work by spelling out some of the more obvious consequences.

In the simplest situation where the number of tones and TBUs is identical and tone linearization is not affected by any factors beyond the number of units, such as stress, the result will be a perfect one-to-one mapping. After all, this is what all the constraints strive for; there is no room for improvement.

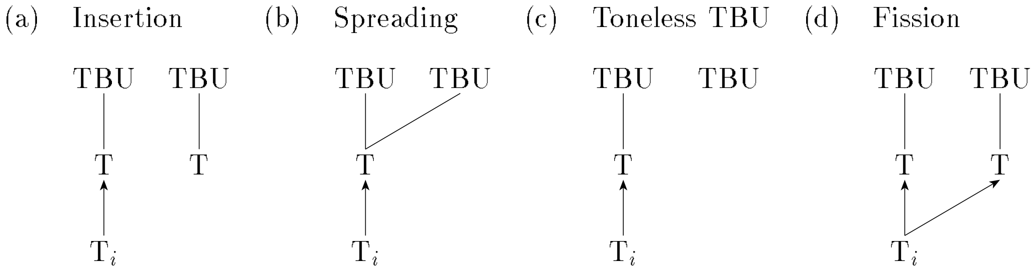
(51)



Most tone languages deviate from this ideal in one way or another and, as a result, various tonal processes arise. We examine two possible deviations: (i) too few tones (ii) too many tones. Our four-constraint system yields twenty-four possible tonal grammars which differ minimally in how they treat anomalous situations.

In (52), two TBUs compete for one lexical tone. There are four possible repairs. Which one is actually chosen depends on which of the four constraints ranks the lowest. The corresponding rankings are shown in (53).

(52)

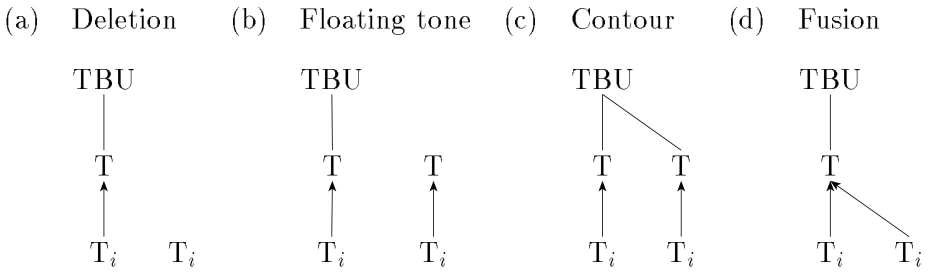


(a) Insertion (b) Spreading (c) Toneless TBU (d) Fission

(53) (a) {*Toneless, *Spread, *Fission} $\gg$ *Insert
(b) {*Toneless, *Insertion, *Fission} $\gg$ *Spread
(c) {*Spread, *Insertion, *Fission} $\gg$ *Toneless
(d) {*Spread, *Insertion, *Toneless} $\gg$ *Fission

In (54), we have the converse situation: two lexical tones competing for the same TBU. Again, four possible solutions arise out of the rankings in (55). The four constraints in (55) are the same constraints as in (53), only mnemonically relabelled.

(54)

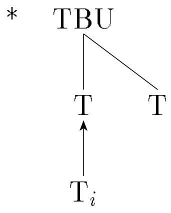


(a) Deletion (b) Floating tone (c) Contour (d) Fusion

(55) (a) {*Contour, *Float, *Fusion} $\gg$ *Deletion
(b) {*Contour, *Fusion, *Deletion} $\gg$ *Float
(c) {*Float, *Fusion, *Deletion} $\gg$ *Contour
(d) {*Float, *Deletion, *Contour} $\gg$ *Fusion

The system excludes certain tone configurations as universally impossible. Since in OT every universal claim is relative to some set of constraints – the Galilean syllable theory of Prince and Smolensky (1993) being a prime example – we will call these predictions SOFT UNIVERSALS. All else being equal they will hold, but independent higher-ranking constraints may flout them in well-defined situations.

(56) Soft Universal 1: Only lexical tones form contours.



(57) Soft Universal 2: Derived tones don't float.

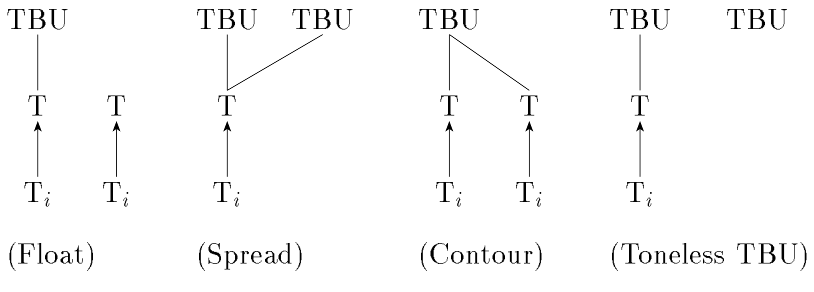
*   T

These soft universals derive from the fact that output tones may exist for two reasons: to realize a lexical tone or to satisfy a TBU. Neither condition obtains here. In (56), a tone has been inserted simply to form a contour, but we know that contours are no good and we would be better off without them. Thus, omitting the output tone can only render the structure better. In (57), the output tone serves no purpose whatsoever. All it does is violate the constraint *Float and by removing it we get a better (i.e. empty) structure.[13]

So far, we have only considered T_i–T and T–TBU correspondences. The system permits one more pair of constraints: (T_i,TBU) = "each input tone corresponds to exactly one TBU" and (TBU,T_i) = "each TBU corresponds to exactly one input tone". We will assume that input tones can be linked to TBUs only through an output tone; there is thus no way to satisfy either constraint except by positing a mediating output tone. We conclude this section by showing how these two constraints interact with the rest of the grammar. Crucially, they will be responsible for the lexical/derived distinction discussed in the first half of the paper.

The fact that the same constraint works against both no association ("at least one correspondent") and multiple association ("at most one correspondent") predicts two types of languages. The ranking (TBU,T) $\gg$ (T,TBU) predicts a language with floating and spreading while (T,TBU) $\gg$ (TBU,T) predicts a language with contours and toneless syllables.

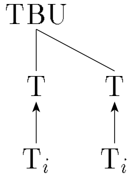
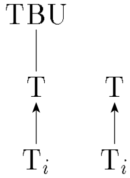
(58) Language type 1: (TBU,T) $\gg$ (T,TBU)   Language type 2: (T,TBU) $\gg$ (TBU,T)



The two types of languages strikingly resemble prototypical tone languages and prototypical stress languages, respectively. Floating and spreading are characteristically "tonal" phenomena, rare in stress languages, thus one would generally expect true tone languages to rank (TBU,T) $\gg$ (T,TBU). On the other hand, both contours and toneless TBUs are common in stress languages. For example, the English question tune (M)*LH (Liberman 1975, Hayes 1995) can be mapped onto anything from a whole sentence as in *Whāt's wròng with your mothér?* to a single TBU as in *Whăt!?*. In the first case, the tones are far apart and the intervening syllables are phonologically toneless, in the second we have a contour. The hypothesis is that the traditional descriptive typology which groups languages to tone vs. stress languages follows from the two possible rankings of two correspondence constraints.

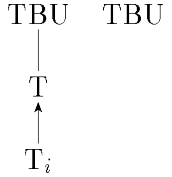
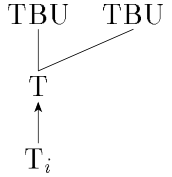
The following question now arises: since a language must inevitably choose one or the other ranking, how can mixed systems exist at all? Yet we know there are languages with, say, both spreading and contours, in fact Dagaare is one such language. In the context of Optimality Theory, what this suggests is that one of the processes is MARKED, forced by some higher-ranking constraint, the other UNMARKED. Since Dagaare is a tone language, we expect the ranking (TBU,T) $\gg$ (T,TBU) which predicts spreading and floating as the unmarked options and contours only under special circumstances. There are strong hints where to look: (i) on theoretical grounds, we know that only lexical tones may form contours; (ii) on empirical grounds, we know that only lexical tones do form contours in Dagaare; (iii) of the six possible constraints, the two we have not yet examined refer to lexical tones. The problem is solved by ranking the constraint (T$_i$,TBU) above the rest.

(59) Lexical tones don't float, but form contours.

		*Float$_i$ = (T$_i$,TBU)	*Contour = (TBU,T)	*Float = (T,TBU)
(a) ⇒			*	
(b)		*!		*

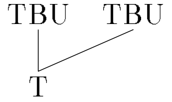
Not only have we explained why lexical tones may form contours, but also why lexical tones do not spread.

(60) Lexical tones don't spread.

		*Spread$_i$ = (T$_i$,TBU)	*Toneless = (TBU,T)	*Spread = (T,TBU)
(a) ⇒			*	
(b)		*!		*

The lexical tone will not spread since spreading an input tone is worse than having a toneless TBU. The remaining solutions are spreading a derived tone (none is present), inserting a tone (the actual solution in Dagaare), or leaving the TBU toneless (in Dagaare, being toneless is worse than insertion). Note that a derived tone will spread in the same situation, another correct prediction.

(61) Derived tones spread.

		*Spread$_i$ = (T$_i$,TBU)	*Toneless = (TBU,T)	*Spread = (T,TBU)
(a)			*!	
(b) ⇒				*

We now sum up the argument. Being a tone language, Dagaare has the ranking (TBU,T) $\gg$ (T,TBU) which predicts spreading in the case of overspace (too many TBUs, too few tones) and floating in the case of underspace (too few TBUs, too many tones). The problem is that Dagaare occasionally solves the underspace problem by forming contours. Our theory suggests that this has to do with the special behavior of lexical tones. The constraint (T$_i$,TBU) correctly predicts lexical contours and the fact that lexical tones do not spread.

All six constraints require that there be exactly one correspondent. It remains to be seen whether this is empirically too restrictive. In that case, one could easily weaken the theory by splitting each constraint into two parts: 'at least one' and 'at most one'. 'At least one' is familiar from Goldsmith's (1976) Autosegmental Well-Formedness Condition, restated in OT as PARSE(TONE) 'Every tone has a TBU' and SPEC(TONE) 'Every TBU has a tone' (Zoll 1996) or alternatively in terms of MAX, DEP, INTEGRITY and UNIFORMITY (Myers 1996, McCarthy and Prince 1995).[14] Making 'at least one' and 'at most one' separate constraints gives one more descriptive flexibility because each half can be ranked independently. On the explanatory side, one will lose the prediction that lexical tones both trigger polarity and form contours. The observed connection would then become purely coincidental. The soft universals ("Only lexical tones form contours", "Derived tones don't float") would continue to follow as they in no way depend on whether the constraints are split.

3.3 Tone and stress

Accounts of tone-accent interaction usually posit some principle such as the Tone-Accent Attraction Condition of Goldsmith (1987) which guarantees that tones are preferably associated to accented syllables. In Dagaare, the strength of the attraction depends on two factors: whether the tone is lexical or derived and whether it is high or low. We have identified three types of stress-induced tonal effects in Dagaare: default [H] tones, lexical contours and tonal polarity. We will now examine each one in turn.

We start by figuring out the ranking of *INSERTION by examining the toneless class C where insertion is vital. The stressed syllable (penult) is underlined.

(62) Class C, toneless words

		*CONT = *TLESS = (TBU,T)	*INS = (T,T_i)	*SPR = *FLO = (T,TBU)	[H́]	[Ĺ]
(a) ⇒	pọ́ gọ́ |╱ H		*	*		*
(b)	pọ̀ gọ̀ |╱ L		*	*	*!	
(c)	pọ́ gọ̀ | | H L		*!*			*
(d)	pọ́ gọ | H	*!	*			*
(e)	pọ gọ	*!*			*	*

Ranking *INSERTION between *TONELESS and *SPREAD yields the desired result. Insertion is preferred over toneless TBUs as (d) and (e) show, but it must be minimal: in the optimal candidate only one tone is inserted and then spread. This contrasts with the ungrammatical candidate (c) where both TBUs have their own derived tones.

We are left with the choice between (a) and (b). This is no more a matter of finding the optimal tone–TBU configuration: we must decide between H and L tones. We propose that stressed syllables universally prefer (i) lexical tones to derived tones and (ii) H tones to L tones. It follows that lexical H is the universally best and derived [L] the universally worst choice for stressed syllables. The status of lexical L and derived [H] is set language-specifically; it is here that the two principles conflict.

(63) Constraints:

(a) H́ = If stressed, then H.
(b) Ĺ = If stressed, then L.
(c) [H́] = If stressed, then [H].
(d) [Ĺ] = If stressed, then [L].

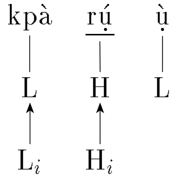
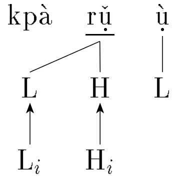
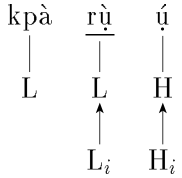
(64) Universal ranking: H́ ≫ [Ĺ]

Full ranking (Dagaare) H́ ≫ Ĺ ≫ [H́] ≫ [Ĺ]

As long as the ranking *Contour ≫ [H́] holds the correct result is guaranteed. The opposite ranking would predict a language where stressed syllables would always bear a H tone; if none were present lexically, a derived [H] tone would be inserted even on pain of contour. Since the data underdetermines the position of the subhierarchy [H́] ≫ [Ĺ] within the global ranking, we arbitrarily place it at the bottom of the hierarchy. We further assume that the tonal preference hierarchy for stressed syllables has a corresponding inverse hierarchy [L] ≫ [H] ≫ L ≫ H for unstressed syllables. Thus, all else being equal, the optimal tone for unstressed syllables is [L]. For the purposes of this paper, the inverse hierarchy is responsible for the assignment of default [L] to unstressed syllables. Minimally, the constraint [L] (and hence the rest of the hierarchy) must rank below *Ins. Ranking it above *Ins would wrongly predict that toneless unstressed syllables get [L] by insertion. In reality, the stress-induced [H] tone spreads on all syllables: /pọg-ọ/ 'woman' → *pọ́.gọ́*.[15]

The following two tableaux show how stress plays a role in deriving contour tones. We assume that lexical tones are underlyingly unassociated, association being yet another consequence of constraint interaction. In particular, we posit no Universal Association Convention which seems correct (Archangeli and Pulleyblank 1994, Hyman and Ngunga 1994, Tranel 1995, Zoll 1996).

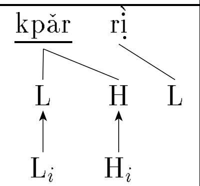
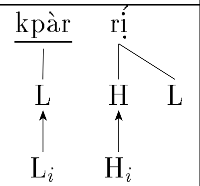
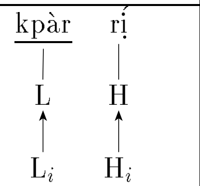
(65)

		*SPR$_i$ = *FLO$_i$ (T$_i$,TBU)	H́	*CONT = *TLESS = (TBU,T)	Ĺ	*INS = (T,T$_i$)	*SPR = *FLO = (T,TBU)	[H́]	[Ĺ]
(a) ⇒					*	*		*	*
(b)				*!*		*		*	*
(c)			*!			*		*	*

In *kpàrụ́ụ̀* 'guineafowl-SG', the lexical H tone is aligned with the stressed syllable which in turn forces a polarity tone on the final syllable. Candidate (b) motivates the ranking *CONTOUR ≫ Ĺ: lexical L tones are attracted to stress, but not at the expense of a contour. Candidate (c) loses because stressed syllables prefer H tones to L tones.

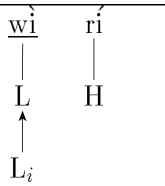
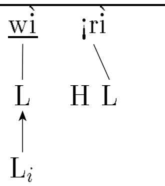
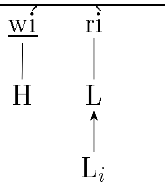
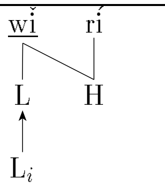
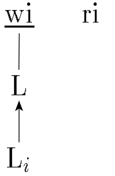
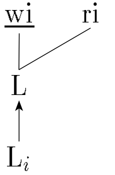
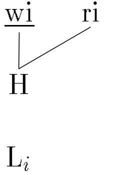
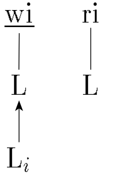
Tableau (66) shows the corresponding plural which has fewer syllables. Given the choice between stressed and unstressed, the lexical H tone chooses the stressed syllable, forming a contour. This confirms the ranking H́ ≫ *CONTOUR: lexical H tones are attracted to stress to the extent that they form contours if necessary.

(66) The stress-sensitivity of lexical H tones

		*Flo$_i$ = (T$_i$,TBU)	H́	*Cont = (TBU,T)	Ĺ	*Ins = (T,T$_i$)	*Flo = (T,TBU)	[H́]	[Ĺ]
(a) ⇒				*		*		*	*
(b)			*!	*		*		*	*
(c)			*!					*	*

Perhaps the most characteristic phenomenon of Dagaare tonology, tonal polarity, also follows from stress. Tableau (67) shows in rather great detail why tonal polarity exists.

(67) Class A (tonal polarity)

		OCP	*Spr$_i$ = *Flo$_i$ = (T$_i$,TBU)	H́	*Cont = *Tless = (TBU,T)	Ĺ	*Ins = (T,T$_i$)	*Spr = *Flo = (T,TBU)	[H́]	[Ĺ]
(a) ⇒				*			*		*	*
(b)				*			**!	*	*	*
(c)				*		*!	*			*
(d)				*	*!		*	*		*
(e)				*	*!				*	*
(f)			*!	*				*	*	*
(g)			*!	*		*	*	*		*
(h)		*!		*			*		*	*

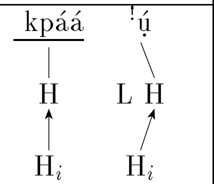
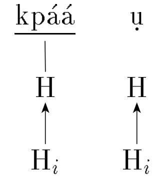
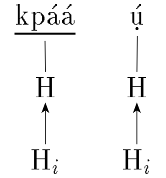
The optimal candidate (a) *wì-rí* has simply acquired a polarity tone on the toneless suffix. In the ungrammatical candidate (c) **wí-rì* the lexical L tone has migrated to the suffix giving rise to "root polarity". This does not happen because the stressed root is more capable of realizing lexical contrasts than the unstressed suffix. Another interesting failure is (d) **wǐrí* where a derived [H] tone has spread onto the stressed syllable. While this satisfies [H́], it violates the higher-ranking *CONTOUR; lexical tones may form contours, derived tones may not. Candidate (g) **wírí* ignores the lexical tone altogether and posits a derived [H] tone just as in the toneless word *pọ́gọ́*. This fails because lexical tones have to be realized on some TBU. Finally, (h) **wírí* fails because of the OCP. For the time being, we will assume that the OCP refers to output tones and rank it at the top of the hierarchy.[16]

In this section, we have derived the following tonal phenomena: the insertion of [H] on toneless words; contours involving lexical H tones on stressed syllables; tonal polarity. In all three, penultimate stress turned out to play a crucial role.

3.4 Downstep and the OCP

What happens when two lexical H tones collide due to morphological concatenation? As Class D shows, the result is an internal downstep (H-ꜜH):

(68) Class D (internal downstep)

		OCP	*FLO$_i$ = *SPR$_i$ = (T$_i$,TBU)	H́	*TLESS = *CONT = (TBU,T)	Ĺ	*INS = (T,T$_i$)	*FLO = *SPR = (T,TBU)	[H́]	[Ĺ]
(a) ⇒						*	*	*	*	*
(b)			*!		*	*		*	*	*
(c)		*!				*			*	*

The floating buffer tone in (a) is a derived tone. While the SOFT UNIVERSAL 2 "Derived tones don't float" does hold with respect to the configurational constraints, it is here superseded by an independent higher-ranking constraint: the OCP. This example also establishes the ranking OCP ≫ *INSERTION. However, so far no conclusive evidence for the derived status of the internal downstep has been provided. In fact, both (69a) and (69b) were considered equally plausible:

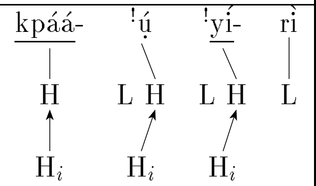
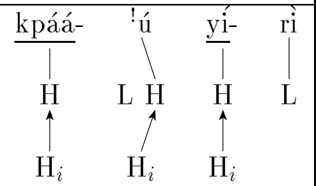
(69) (a) kp á̠ á̠ - ! ụ́ (b) kp á̠ á̠ - ! ụ́

H [L] H HL H

At this point, this indeterminacy is resolved. If the buffer tone were lexical, it would not float, but form a contour, resulting in **kpáà!ụ́* due to the ranking *Float$_i$ $\gg$ *Contour. Thus, the grammar selects the representation H-H complemented by [L] tone interpolation over HL-H which was proposed as a possible alternative earlier.

Example (70) shows that the OCP also triggers downstep postlexically, explaining the external downstep after !H suffixes.

(70) The associative construction: downstep

		OCP	*Spr$_i$ = (t$_i$,tbu)	H́	*Tless = (tbu,t)	Ĺ	*Ins = (t,t$_i$)
(a) ⇒						**	***
(b)		*!				**	**

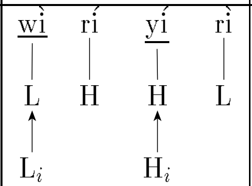
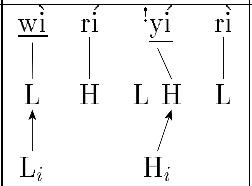
So far we have been assuming that the OCP applies at the level of outputs. The remaining examples show that this formulation is in need of revision. According to Myers (1994, 14), the OCP is sensitive to "parsed representational elements" which in our framework translates to input tones with output correspondents. Unfortunately, this formulation will not work for our purposes. Among other things, it would fail to trigger polarity in *wìrí* = L [H] where there is only one input tone with an output correspondent. We propose the following version of the OCP for Dagaare:

(71) OCP (Dagaare):

A lexical tone may not be followed by an identical tone.

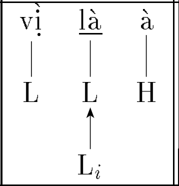
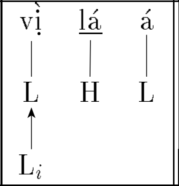
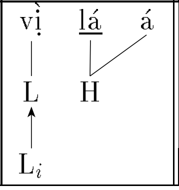
This formulation is more specific than one would hope (note especially its inherent directionality), yet it seems descriptively correct for Dagaare. First, it readily explains tonal polarity which only occurs after lexical tones. Second, it captures both the presence of downstep in (70) and its absence in (72):

(72) The associative construction: no downstep

		OCP	*FLO$_i$ = (T$_i$,TBU)	H́	*TLESS = (TBU,T)	Ĺ	*INS = (T,T$_i$)
(a) ⇒				*		*	**
(b)				*		*	***!

Third, Dagaare not only tolerates [L]-L sequences, but creates them freely in complex expressions. This further supports the hypothesis that [T]-T does not count as an OCP violation. In (73), penultimate stress attracts the lexical L tone and the initial syllable receives [L] by default. The resulting [L]-L sequence thus does not violate the OCP.

(73)

		OCP	*SPR$_i$ = (T$_i$,TBU)	H́	*TLESS = (TBU,T)	Ĺ	*INS = (T,T$_i$)	*SPR = (T,TBU)	[H́]	[Ĺ]
(a) ⇒				*			**		*	*
(b)				*		*!	**			*
(c)				*		*!	*	*		*

Another example comes from H tone suppression where the toneless root *pọg-* 'woman' is assigned a default [L] even when a lexical L follows.

(74) *pọ́g-ọ́ + tọ̀ọ̀-rị́ → pọ̀g-tọ̀ọ̀-rị́* woman-far.away-SG

		OCP	*SPR$_i$ = (T$_i$,TBU)	H́	*TLESS = (TBU,T)	Ĺ	*INS = (T,T$_i$)	[H́]	[Ĺ]	[L]
(a) ⇒	pọ̀g- tọ̀ọ̀- rị́ L L H ↑ L$_i$			*			**	*	*	
(b)	pọ́g- tọ̀ọ̀- rị́ H L H ↑ L$_i$			*			**	*	*	!*

Unfortunately, the analysis does not generalize to longer words where [H] is suppressed only in the last root syllable, a problem we share with the DISSIMILATION ANALYSIS. Thus, the descriptive generalization "no [H] tones on the TBU left of a N+A juncture" remains an explanatory challenge.

(75) bádẹ́r-ị́ + fá-á → bádẹ̀r-fá-á spider-bad-SG

3.5 *L–L

Finally, we have solved an outstanding problem in the analysis of several Gur languages (at least Dagaare, Dagbane and Moore): the systematic absence of L-toned nominals longer than one syllable. Thus, nouns like **sàrà*, **sàkàrà* etc. are systematically missing. Consider **sàrà*. The following possibilities arise:

1. The word is lexically toneless: /sara/. Being disyllabic, the word receives penultimate stress and a derived [H] tone. Result: *sárá*.

2. The word has a single lexical L tone: /sara + L/. Due to penultimate stress, the tone gets linked to the first syllable and the second syllable becomes [H] by polarity. Result: *sàrá*.

3. There are two lexical L tones, one on each syllable, prelinked or otherwise. In this case, the OCP interpolates a [H] tone. Result: *sǎrà*.

There is thus no way to derive a noun like **sàrà*. The analysis correctly predicts the possibility of L-toned monosyllables such as *bà* 'they' which are unstressed and for this reason receive a default [L].

4 Conclusion

In this paper, we have described yet another language with both stress and tone. However, the theoretical significance of the Dagaare facts goes beyond this discovery. We have shown that several processes distinguish between lexical tones and derived tones and that this distinction can be given a straightforward nonderivational interpretation in terms of Correspondence Theory. In a sense, lexical tones occupy the middle ground between stress and derived tones. Like stress, lexical tones do not spread, but shift to metrically strong positions and there is typically only one lexical tone per word. Derived tones are more tone-like in that they dissimilate, spread and do not undergo metrically motivated shifts. Also, given the traditional idea that lexical tones are "earlier" than derived tones, the Dagaare facts are compatible with the following famous conjecture:

> I know of no facts that would contradict a weaker universal principle [...] that if the tonal phenomena in a language are governed by both kinds of rules [tone rules and accent rules, AA/AB], the accent reduction rules occur earlier in the grammar than the assimilations and dissimilations. If this conjecture is correct, then [...] it will be possible to speak of a language as having a pitch accent system up to some point in the ordering of its rules and having a tonal system from that point in the rules on. Languages could then be classified according to how early in their grammars the point occurred at which they became tone languages (McCawley 1970)

While many African tone languages seem to yield to analyses in terms of lexical or metrical accents, privative H tones, and other reduced systems, Dagaare has proved surprisingly rich with its stressed vs. unstressed syllables, lexical vs. derived tones and high vs. low tones. However, while conceptually independent, the three dimensions interact in a way which conforms to our expectations based on better known languages. In particular, stress attracts lexical tones as in many African tone systems and high tones as in many stress systems. We have also derived the puzzling phenomenon of tonal polarity from the interaction of penultimate stress and lexical tones and shown that tonal polarity and downstep are both OCP effects and only occur in connection with lexical tones.

Three kinds of tonal constraints have been posited:

1. Tone–TBU constraints. These simple and uniform constraints strive for a transparent one-to-one mapping between tones and TBUs. Many central tonal phenomena such as association, spreading, floating, tonelessness, contour formation, insertion and deletion follow. Different rankings yield a set of possible tone languages. Among other things, the system predicts that spreading and floating vs. toneless TBUs and contours should co-occur as default options.[17]

2. Stress-to-tone constraints. In addition to pure configurational constraints, the distribution of tone refers to properties of TBUs (stressed, unstressed) and tones themselves (H, L). We proposed H́ > Ĺ > [H́] > [Ĺ] as the tonal preference hierarchy for stressed syllables.

3. OCP. The proper understanding of this principle continues to be the subject of active debate (Myers 1994, Leben 1996). For us, the OCP is crucial for downstep and tonal polarity. Our main conclusion was that in Dagaare the OCP is sensitive to the lexical/derived distinction.

We conclude by cross-classifying our predictions by tonal class and syllable structure. The four empty cells seem accidental gaps.

(76)

	(CVV) CV.V	CV.CV	CVV.CV CVC.CV	CV.CVV	CV.CV.V
toneless	[H] fá.á bad-SG	[H] pọ́.gọ́ woman-SG	[H] kụ́l.lị́ river-PL	[H] kụ́.láá river-SG	[H]
H	H [L] dá̠.à̠ beer-SG	H [L] yí.rì house-SG	H [L] nụ́ọ́.rị̀ mouth-SG	H [L] ẹ́.bàà crocodile-SG	[L] H [L]
L	L [H] sà.á father-SG	L [H] wì.rí horse-SG	L [H] vị̀ẹ̀.lị́ good-PL	L [H] kpò.lúú termite-SG	[L] L [H] vị̀.là.á good-SG
H-H	H [L] H	H [L] H zú.ꜝrí head-PL	H [L] H ị́ị́.ꜝlị́ horn-SG	H [L] H pị́.ꜝrụ́ụ́ sheep-SG	H [L] H [L]

Appendix

	Singular		Plural	
(a)	dànkyíní	wall-SG	dànkyímé	wall-PL
	dàkụ́r-áá	male name-SG	dàkụ́r-rị́	male name-PL
	kùnkú-ní	tortoise-SG	kùnkú-mó	tortoise-PL
	kụ̀máásị́	Kumasi-SG (name of a city)	kụ̀máásị́-rị́	Kumasi-PL
(b)	sákị̀-rị̀	bicycle-SG	sákị̀-ẹ̀	bicycle-PL
	tábụ̀l-ị̀	table-SG	tábụ̀l-ọ̀	table-PL
(c)	bádẹ́r-ị́	spider-SG	bádẹ́r-ẹ́ẹ́	spider-PL
	bángyị́r-áá	latrine-SG	bángyị́r-rị́	latrine-PL
	tákór-ó	window-SG	tákór-rí	window-PL
	kómmí-rúú	tomato-SG	kómmí-é	tomato-PL
	gbátír-ụ́ụ́	kind of plant-SG	gbátír-ẹ́ẹ́	kind of plant-PL
	símí-é	Bambara beans-PL		
	sọ́wọ́l-ọ́	kind of food-SG	sọ́wọ́l-ẹ́ẹ́	kind of food-PL
(d)	ànkàráà	Accra (name of a city)	–	–
	sìpìrîi	aspirin	–	–
	àyọ̀póì	seven-SG	àyọ̀pónnì	seven-PL
	dàgàr-áà	beam-SG	dàgár-rị̀	beam-PL
	dàgáá-rị̀	Dagaare speaker-SG	dàgáá-bà	Dagaare speaker-PL
	lèzárè	twenty-SG	lèzẹ́ẹ̀	twenty-PL
	dị̀ndọ́rị̀	door-SG	dị̀ndọ́ẹ̀	door-PL
	fị̀ntị́lè	lamp-SG	fị̀ntị́llị̀	lamp-PL
	kọ̀nọ́-rị̀	farming-SG	kọ̀nọ́-ẹ̀	farming-PL
	nọ̀ọ̀tị́-rị̀	shoe-SG	nọ̀ọ̀tị́ẹ̀	shoe-PL
	sàkụ́ụ́-rị̀	school-SG	sàkụ́-ẹ̀	school-PL
	kàrànsụ́-nị̀	kerosine-SG	kàrànsụ́-mọ̀	kerosine-PL
	sìtímè	steamer-SG	sìtímè-rí	steamer-PL
	bìrígyì	bridge-SG	bìrígyì-rí	bridge-PL
	dèmók(ị́)ráásị̀	democracy-SG	dèmók(ị́)ráásị̀-rị́	democracy-PL
(e)	fúmì-ní	needle-SG	fúmì-é	needle-PL
(f)	bógtì	bucket-SG	bógtì-rí	bucket-PL
	bụ́ọ́sụ̀	bus-SG	bụ́ọ́sụ̀-rị́	bus-PL
	kọ́pụ̀	cup-SG	kọ́pụ̀-rị́	cup-PL
	sẹ́ẹ́tị̀	shirt-SG	sẹ́ẹ́tị̀-rị́	shirt-PL
	t(ụ̀)rọ́zẹ̀	trousers-SG	t(ụ̀)rọ́zẹ̀-rị́	pairs of trousers
	wáákyị̀	watch-SG	wáákyị̀-rị́	watch-PL
	bọ́lọ́ntị̀	belt-SG	bọ́lọ́ntị̀-rị́	belt-PL
			bọ́lọ́ntị̀ẹ	belt-PL
	wálánsị̀	wireless set-SG	wálánsị̀-rị́	wireless set-PL
	lát(ị́)rị́kị̀	electricity-SG	lát(ị́)rị́kị̀-rị́	electricity-PL

Notes

*An early version of this paper was presented at the the Stanford Phonology Workshop, December 5th, 1995. We especially thank Edward Flemming, Vivienne Fong, Brett Kessler, Paul Kiparsky and Will Leben for comments. All errors remain our responsibility.

[1] The spelling variant *Dagaari* is common in the literature. The dialect described in this paper is the Central dialect spoken in and around Jirapa, northwestern Ghana. The native speaker judgments are those of the second author. An overview of the structure of Dagaare is given in Bodomo (1997). Of other sources, we want to mention especially Kennedy's (1966) fieldnotes which constitute a brief, but valuable guide to the basic phonology of the Central dialect. Related languages/dialects of which phonological descriptions exist include Dagara (Delplanque 1983), Wúlé (Pénou-Achille 1982), Dagbane (*Dagbani*) (Wilson and Bendor-Samuel 1969, Hyman 1993, Olawsky 1996) and Moore (Kenstowicz et al. 1988). In 1960, the number of Dagaare speakers was estimated to be 205,000 (Wilson and Bendor-Samuel 1969). Kennedy (1966) reports 201,680 speakers in Ghana and an additional 90,000 in Upper Volta (Burkina Faso). More recent figures include 311,000 in Ghana and 190,000 in Burkina Faso (Grimes 1988) and 423,200 (Grimes 1992). The latest estimate is 1,000,000 and over (Bodomo 1997). This figure includes both Ghanaian and Burkina Dagaaba.

The standard orthography does not represent tone at all. For us, V́ = H tone, V̀ = L tone, /i, e, o, u/ = [+ATR], /ị, ẹ, ọ, ụ/ = [−ATR]. The vowel /a/ is [−ATR], but as it does not have a [+ATR] counterpart we simply write /a/ (without the dot). Underscore /a̲/ indicates nasalization.

[2] The systematic absence of LL monotones only holds of nominals. Among verbs, LL is the hallmark of certain paradigms: *bọ̀ngị̀* 'to know', *gọ̀llị̀* 'to go around', *ìrì* 'to get up', *fị̀ẹ̀* 'to whip', *ògì* 'to vomit'. Even the derivational relationship between nouns and verbs is sometimes expressed tonally as LH (polarity) vs. LL:

(77)	nàá	chief, rich person	nàà	to get rich, important
	mùú	dumb person	mùù	to get dumb
	nụ̀ọ́	sweet, sweetness, joy	nụ̀ọ̀	to grow fat
	tị̀ẹ́	tree	tị̀ẹ̀	to support
	wị̀ẹ́	farm, clearing	wị̀ẹ̀	to cut, slide open

We note the following caveats: (i) The nominalizing suffix *-Ùng* '-ness' is inherently L. Combined with a L root, this yields L–L as in *vị̀ẹ̀l-ụ̀ng* 'good-ness'; (ii) The word *tọ̀ọ̀rị̀–tọ̀bọ̀* 'tobacco', apparently from the French *tabac* needs a special account; (iii) Finally, Kennedy (1966, 43) cites the forms *bànà* 'lizards' and *pà:rè* 'bottom'. In the dialect we are describing, these words are pronounced *bọ̀nnị́* and *párị́*.

The data also show another peculiar characteristic of Dagaare morphology. The same suffix (e.g. *-rI*) may mark either singular or plural depending on the stem. Thus, we have *kùù-rí* hoe-SG *kù-é* hoe-PL, but *tị̀-ẹ́* tree-SG *tị̀ị̀-rị́* tree-PL. Even more strikingly, the same word may behave differently in geographically adjacent dialects: *pìì-rí* rock-SG *pì-é* rock-PL (Central dialect), *pì-é* rock-SG *pìì-rí* rock-PL (Southern dialect).

[3] This ignores recent loans such as *sẹ́ẹ́tị̀* 'shirt' and *tẹ́ẹ́sị̀* 'test'.

[4] One compound type prefixes a CV-root to a word. Some of the following examples come from Kennedy (1966, 44):

(78)	(a)	lá|bí-rì	small axe-SG	<	lá-rị̀ + bí-rì	axe-SG + seed-SG
		ní|mí-rì	eye-SG	<	níN-è + bí-rì	face-SG + seed-SG
		só|bí-rì	path-SG	<	só-rì + bí-rì	road-SG + seed-SG
	(b)	bì|nyóg-$^{!}$ró	child snatcher	<	bí-é + nyóg-$^{!}$ró	child-SG + snatch-IMPF
		bì|túú-ró	child follower	<	bí-é + tùù-ró	child-SG + follow-IMPF

We note that while adjacent lexical H tones usually induce intervening downstep, here we have *lá|bí-rì* instead of **lá|$^{!}$bí-rì*. The tonal perturbations in (b) also remain unanalyzed. The tonal phonology of Dagaare compounds awaits further study. An assortment of long words, both simple and compound, can be found in the appendix.

[5] The Dagaare pattern is exactly the opposite of Bantu (Goldsmith 1988). Proto-Bantu was most probably a free tone language where all the possible tone patterns were attested in disyllables: HH, HL, LH, LL. Later, the contrast between HL and HH was neutralized in many of its descendants, presumably a reflex of Meeussen's Rule (HH → HL) which has precisely this effect synchronically (Goldsmith 1988, 84). Dagaare on the other hand retains the HL vs. HH contrast whereas the LH vs. LL contrast is absent.

[6] Pulleyblank defends a subtle variant of the dissimilation analysis couched in Lexical Phonology. According to him, the polarizing Margi clitics are underlyingly H, but [+extratonal]: if they occur next to H, they are deleted by Floating H Deletion (an OCP-related rule), followed by default tone (L) insertion. Next to L, the H tone surfaces as is. Interestingly, Pulleyblank (p. 210) notes that the root tone never spreads onto the polarity suffix, not even when the suffix is sandwiched between root and another suffix. His explanation is that "subject clitics are exceptions to bracket erasure and that tone-spreading does not cross boundaries post-lexically." However, he needs to assume that in the first and third person subject clitics, bracket erasure does apply (p. 211). There are thus two parts to the explanation (p. 212): (i) extratonality; (ii) failure of bracket erasure. If Margi is at all like Dagaare, we could perhaps account for this behavior by saying that lexical tones do not spread.

[7] The final [H] is optionally suppressed, yielding *sàá sàà* 'father's father', *sàá sàà vị̀l-àà* 'father's good father' and *sàà vị̀l-àá sàà* 'good father's father'.

[8] It deserves to be noted that Kennedy (1966, 46) does not transcribe downstep after -$^{!}$H suffixes although he does transcribe downdrift after L toned suffixes; in everything else we fully agree with his transcriptions.

[9] We note the following V-initial words which are not generated by the proposed template: *à* 'definite article', *àbóó* 'which', *ane* 'and', *ámẹ̀* 'these', *áná* 'they', *ăng* 'who', *àwólà* 'how many' (grammatical markers, pronouns); *áyì* '2', *átà* '3', *àyọ̀póì* '7' (numerals); *ammesiere* 'excellent!', *ábà* 'oh!', *àị́* 'no!' (interjections); *ị̀* 'to do', *éng* 'I'; *ụ̀* 'he/she/it', *ụ́ná* 'he/she/it, emph.', *óó* 'yes'. While most of these words are clearly semantically special, there are some V-initial nouns and verbs as well (e.g. *ị́ị́$^{!}$lị́* 'horn'). C-initiality thus seems a tendency at best.

[10] In Dagara, similar segmental restrictions are observed: "Enfin, la plupart des oppositions interviennent à l'initiale, du fait de la distribution lacunaire de nombreux phonemes, elle-même due aux nombreuses neutralisations intervenant au niveau du mot" (Delplanque 1983, 50). From the related Wúlé, we even have one native speaker report of first syllable accent: "Indépendemment de la nature des schèmes tonals, la première syllabe CV- du "mot phonologique" Wúlé est toujours accentuée. Cet accent met en valeur CV- par rapport à -V ou à -CV, il joue donc un rôle culminatif" (Pénou-Achille 1982, 378-9).

Kennedy's segmental co-occurrence restrictions are perhaps too strong. In addition to the ONSET$_2$s listed by Kennedy, we have found instances of /b/, /y/ and /t/: *dọ́.bọ́* 'men', *á.yì* '2', *á.tà* '3'. Recent loans are even more permissible: *kó.pù* 'cup' *ngmŏr.fò* 'gun', *bì.rí.sì* 'brick', *t(ụ̀)rọ́.zẹ̀* 'trousers', *wáá.kyị̀* 'watch', *bì.rí.gyì* 'bridge', *lá.tị́.rị́.kị̀* 'electricity'. Similarly, words like *bààl-bá* 'sick person-PL' show that the /gr, gl/ restriction, while perhaps representative, does not hold perfectly even in the native vocabulary.

[11] One possible analysis of the A/A′ and B/B′ distinction is that both syllabifications, CV.V and CVV, are phonologically permitted, but morphology selects one over the other as follows: (i) Assume that the singular suffix /-UU$_{acc}$/ bears a lexical accent which attracts stress; If penultimate stress (= a syllabic trochee at the right edge) is an inviolable constraint, we derive the syllabification *kpà.r-ụ́.ụ̀*; (ii) In *kpò.l-úú*, the (different) suffix /-UU/ is unaccented. Given that only roots and accented suffixes are stressable, we derive initial stress.

[12] The marker *zá̱à̱* 'exactly past yesterday' does not have a corresponding "weak" member.

[13] Both universals may be violated in specific conditions. Examples from Dagaare include apocope (see section 2.5) in cases like *wóg-ì* → *wôg-* tall-SG. Here, the H part of the contour is a lexical tone, the L part a derived polarity tone. In this case, an input TBU has been suppressed on the surface, a special situation which occurs variably in postlexical phonology. The solution is to distinguish between input TBUs and output TBUs. As for floating derived tones, consider downstep: H [L] H. Here the specific condition is the high-ranking OCP.

[14] Our constraints are easily translatable into McCarthy and Prince's system:

(79) MAX(T,TBU) = For all T, there's at least one TBU. = *FLOAT
DEP(T,TBU) = For all TBU, there's at least one T. = *TONELESS
INTEGRITY(T,TBU) = For all T, there's at most one TBU. = *SPREAD
UNIFORMITY(T,TBU) = For all TBU, there's at most one T. = *CONTOUR
MAX(T_i,TBU) = For all T_i, there's at least one TBU. = *FLOAT_i
DEP(T_i,TBU) = For all TBU, there's at least one T_i. = *TONELESS_i
INTEGRITY(T_i,TBU) = For all T_i, there's at most one TBU. = *SPREAD_i
UNIFORMITY(T_i,TBU) = For all TBU, there's at most one T_i. = *CONTOUR_i
MAX(T_i,T) = For all T_i, there's at least one T. = *DELETION
DEP(T_i,T) = For all T, there's at least one T_i. = *INSERTION
INTEGRITY(T_i,T) = For all T_i, there's at most one T. = *FISSION
UNIFORMITY(T_i,T) = For all T, there's at most one T_i. = *FUSION

(T,TBU) = *SPREAD & *FLOAT
(TBU,T) = *CONTOUR & *TONELESS
(T_i,TBU) = *SPREAD_i & *FLOAT_i
(TBU,T_i) = *CONTOUR_i & *TONELESS_i
(T_i,T) = *DELETION & *FISSION
(T,T_i) = *INSERTION & *FUSION

[15] Independent evidence for default [L] in Dagaare comes from the optional postlexical process of vowel insertion which breaks up consonant clusters. The epenthetic vowel gets its tone by spreading from the tone on the left, if any, else [L] by default.

(80)	(a)	bóg.tì	∼	bó.g[ó].tì	‘bucket’	
	(b)	bọ̀r.fọ́	∼	bọ̀.r[ị̀].fọ́	‘English’	
	(c)	mǎl.kị̀	∼	mà.l[ị́].kị̀	‘angel’	
	(d)	trọ́.zẹ̀	∼	t[ụ̀].rọ́.zẹ̀	‘trousers’	default [L]

As it stands, our analysis does not predict the rightward spreading of lexical tones. The data suggests that *Spread$_i$ ranks lower in postlexical phonology, permitting the spreading of lexical tones. The remaining question is why leftward spreading is blocked in favor of default [L]-insertion. So far, directionality of spreading has been of no substantial consequence. The examples at hand may show that directionality is not generally reducible to tone–TBU and stress–tone constraints. For a recent discussion, see Zoll (1996).

[16] Type *yírì* (= Class B) is simply the mirror image of Class A and is derived analogously.

[17] Of these constraints, we did not discuss two: *Deletion = *Fission = (T$_i$,T) = “For every input tone, there is exactly one corresponding output tone” and *Contour$_i$ = *Toneless$_i$ = (TBU,T$_i$) = “For every TBU, there is exactly one corresponding input tone”. To our knowledge Dagaare never deletes lexical tones, thus *Deletion = *Fission is undominated. The constraint *Contour$_i$ = *Toneless$_i$ requires that every TBU have a lexical tone instead of a derived one. If undominated, this constraint would among other things force the spreading of lexical tones, an unwelcome consequence. In Dagaare, this constraint ranks low enough to be invisible.

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