

## Tone in African Languages

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African tone systems have played a major role in phonological theory thanks to research on autosegmental phonology by Africanist such as Clements, Goldsmith and Leben. Spread and shift of tone, floating tones and tone melodies, and downstep are well-documented properties of African tone, manifesting the fact that tones owe little allegiance to the segments realizing them. See Leben (1973), Goldsmith (1976), Clements & Ford (1979), Odden (1995) for general overviews of African tone and autosegmental phonology.

Controversies arise over whether certain languages are tonal, for example Somali (Hyman 1981), and some tonal systems are referred to a typological midpoint in a continuum between tone (e.g. Ewe) and stress (e.g. Swahili), termed pitch-accent. The primary objection to the idea that languages like Somali are tonal is that they differ from Chinese, which has become the tonal archetype in the literature. Insofar as the identifying property of so-called pitch accent languages is that tonal structure is simple and contrast is limited, this overview considers languages like Somali, Luganda and Kinga to be proper tone languages, albeit with more restrictions on tone than found in Kru languages. See Pulleyblank (1986), Odden (1999), Hyman (2001), Downing (2004) for discussion of “accent”.

### 1. Levels and contours: the primitives of tone

The most basic question about tone is, what *is* tone? By assumption, it is a featural object, like [i]. Analogous to the question “what are the possible vowels”, one can ask about the inventory of tones.

#### 1.1. Levels

Tone is primarily the contrastive use of pitch in grammar and lexicon, including movement from level to level. The first question is, what are the fundamental pitch levels? The simplest systems have a two-way contrast between higher and lower pitch, H and L,<sup>1</sup> and the majority of African languages fall into this category. Gur, Atlantic, Mande, Dogon, Nilo-Saharan, Chadic, and Cushitic languages usually have two levels; Bantu languages are almost universally two-level. Three-level languages are not rare, but they are a distinct minority. Examples of 3-level languages are Angas, Peki Ewe, Ebira, Ga’anda, Kasem, Kotoko, Kpelle, Logo, Mbay and Yoruba. Languages with four tone levels are much less common, and include Bariba, Anlo Ewe, Grebo, Igede, Kamba and Wobe. Five levels are quite rare, occurring in Benchnon and the Santa dialect of Dan, and only Chori is reported to have six.

Terminology and notations for tone vary. In two-tone systems, tones are usually termed H and L, transcribed  $\acute{v}$ ,  $\grave{v}$ , though also  $\acute{v}$ ,  $v$  or rarely  $v$ ,  $\grave{v}$ . Three-level systems are usually analysed via the terms H, Mid (M) and L notated variously as  $\acute{v}$   $v$   $\grave{v}$ ,  $\acute{v}$   $\bar{v}$   $\grave{v}$  or  $\acute{v}$   $\acute{v}$   $\grave{v}$ . Terminology and nota-

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<sup>1</sup> There is a further distinction within two-level languages between equipollent – H vs. L – and privative – H vs.  $\emptyset$  or rarely L vs.  $\emptyset$  – analyses. Mande languages are typically analysed as opposing H and L, whereas most Bantu languages are treated as contrasting H and toneless.

tion for 4-level systems is quite variable, ranging over terms such as High, Mid, Low, Superhigh (SH), Superlow (SL), Top, Raised, Upper Mid, Mid-H, Mid-L. Terminology and transcription are normalized as follows:

(1)	2-level	H = $\acute{v}$	L = $\grave{v}$		
	3-level	H = $\acute{v}$	M = $\bar{v}$	L = $\grave{v}$	
	4-level	SH = $\grave{v}$	H = $\acute{v}$	L = $\grave{v}$	SL = $\ddot{v}$
	5,6-level:	integers			

A further complication to the notion of tone level is the phenomenon of downstep and upstep, discussed in section 3. Integer notation is used when the point is specific pitch, given downstep.

## 1.2. Contours

In some languages (Shona, Kipare, Mbololo Taita, Miya), syllables are either H or L, without phonological rising or falling tones, which involve  $F_0$  movement from level to level. Kotoko has the 3-tone system H M L, but no contour tones. Many languages have phonological contour tones. Some allow contour tones only on long syllables, for example Hausa and many Bantu languages (Tachoni, Dembwa Taita) have just falling tone (F) and only on long syllables. Kaficho has one lexical contour (Addo 1999, Theil 2007), rising (R) restricted to long syllables,<sup>2</sup> and Didinga, Khoekhoegowap and Kimatuumbi<sup>3</sup> have rising and falling tone, again only on long vowels. Nara (Dawd & Hayward 2002), which has only H and L on monomoraic syllables, has rising and falling contours on long syllables and tritonal R-F on trimoraic (XVVC) syllables.<sup>4</sup> In these languages, short syllables can only have level tone. Languages like Tachoni which limit tones to one-per-mora are “contourless” in the moraic sense, but from the syllabic perspective, they allow contours. In contrast, Miya has long vowels but no R or F, and Tachoni still has only one of the expected contours on long vowels.

Many languages have contours on short vowels, thus Gen and Temne have H, L, R and F tones; Angas has 3 tone levels and the 4 rising and falling contours which do not end with M tone; Benchnon (Wedekind 1983) has 5 levels but only one contour, a 4-3 rising tone. These languages lack long syllables. The Santa dialect of Dan (Bearth & Zemp 1967, Flik 1977), which has 5 levels and contrastive length, allows one short contour (2-3 fall) but 5 long contours (rises 3-2, 3-1 and falls 1-5, 2-5, 3-5), way fewer than the 20 possible contours. On short vowels, Guéré (Paradis 1983) which has 4 tone levels only allows L-SL and H-SL falling tones and SL-L, SL-SH and L-H rising tones, but has no significant restrictions on tone on long vowels and diphthongs.<sup>5</sup> Closely related Wobe (Bearth & Link 1980) which has long syllables and 4 level tones has at least 3 rising tones and 4 falling tones on short vowels, but no obvious restrictions on sequences of tones on long syllables.

<sup>2</sup> Falling tones are also allowed on heteromorphemic vowel sequences.

<sup>3</sup> Unusually, long level-H vowels are not allowed.

<sup>4</sup> Interestingly, there is no locational contrast within the syllable: tones map 1-to-1 left-to-right, allowing trimoraic LHH, HLL but not LLH, HHL.

<sup>5</sup> Paradis treats all long vowels and long diphthongs as disyllabic.

A few languages have tritonal complexes – R-F (Kenyang, Mende, Kono, Wobe, Lomongo, Nara) and F-R (Lomongo). Kenyang allows rising and falling tones on long and short vowels, but has R-F only on long vowels, and as noted above, Nara allows R-F only on trimoraic syllables. Inventory restrictions on contours may thus separately limit the sequence of tones in a syllable, as well as the number of tones per mora.

It has long been recognised that contour tones analytically decompose into sequences of levels, where F is a sequence HL, R is a sequence LH, and so on. This many-to-one mapping is widely discussed in the autosegmental literature, which draws support from the ease with which it formally identifies this unity.

$$(2) \quad \begin{array}{ccc} \text{H} & \text{L} & \\ | & | & \\ \text{b} \acute{\text{a}} & \text{b} \grave{\text{a}} & \end{array} = \begin{array}{c} \text{H L} \\ \vee \\ \text{b} \hat{\text{a}} \end{array} \quad \begin{array}{ccc} \text{L} & \text{H} & \\ | & | & \\ \text{b} \grave{\text{a}} & \text{b} \acute{\text{a}} & \end{array} = \begin{array}{c} \text{L H} \\ \vee \\ \text{b} \check{\text{a}} \end{array}$$

Two facts supporting this treatment of contours are melodic parallelism and tone preservation. Melodic parallelism is where words with different numbers of syllables have the same abstract tone pattern, realized differently due to how tones compress onto single vowels in shorter words. In Bobo (Morse 1976), plural and singular nouns have parallel tone patterns, so contours are found in the singular which has one TBU, but in the plural each vowel has a distinct level tone.

(3)	lũ	lĩā	‘cold’
	zḍ	zḍē	‘fishnet’
	yḍ	yḍrè	‘soul’
	sḍ	sāmā	‘person’
	pḍ	pāgā	‘forked stick’

Tone preservation refers to the situation where vowels merge into one which preserves all of the tones, creating contour tones, illustrated in (4) with the well-known case of Lomongo.

(4)	H+L → F	mpùlú ìné	→	mpùjwîné	‘these birds’
	L+H → R	là bónà	→	lǒnà	‘with the baby’
	H+R → F-R	bàlóngá bǎkáé	→	bàlóngǎkáé	‘his blood’
	L+F → R-F	fàkàlà ḍtswà	→	fàkàlḍtswà	‘Fakala comes in’

## 2. Tone Features

The evidence for decomposing contour tones into sequences of level specifications on a single unit is so strong that the decomposition is typically taken for granted, though see Bearth & Link (1980), Newman (1986). The fundamental question of how to analyze tones is, what are the appropriate features for describing tone levels?

A widely adopted theory is that proposed by Yip (1980), terminologically modified by Pulleyblank (1986), which divides tone space into upper and lower registers, subdividing regis-

ters by distinguishing raised versus non-raised tones. Accordingly, tones are assigned feature values as follows.

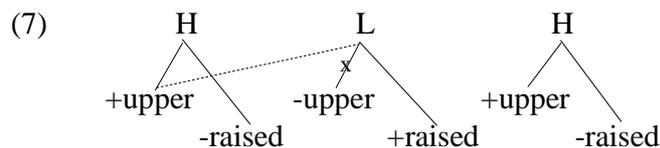
(5)		SH	H	L	SL
	upper	+	+	-	-
	raised	+	-	+	-

The only conclusive evidence for feature assignment is whether it describes tonal groupings: any theory can identify “all tones” or “a specific tone”. A test of a theory requires rules identifying a proper subset of tones, so tone features can only be tested in a language with at least three levels. The presumption is that if tones {A,B} are targetted to the exclusion of {C,D} (for example {A,B} trigger some change which {C,D} do not), then {A,B} have in common some feature which {C,D} lack. Convincing evidence most likely will come from a language with 4 levels. Weaker evidence is partial-assimilation evidence, where A assimilatorily changes to B in the context of C: A takes on some properties of C, but not all properties.

An assimilatory argument for (5) comes from Anlo Ewe (Clements 1978), which raises L to SH when surrounded by H. Other processes spread SH to H syllables, and lower phrase-final SH.

(6)	àkplò mègbé → àkplò mègbé	‘behind a spear’
	èkpé mègbé → èkpé mègbé	‘behind a stone’

Strikingly, L goes “in the direction” of the surrounding H, but overshoots that target. The process is described formally by (7), which assigns the upper-register feature borne by H to L (which are the [+raised] tone of the lower register), making them raised tones in the upper register, i.e. SH.



Further support for the model is that it allows a coherent characterization of a morphosyntactically conditioned tone raising in Igede (Bergmann 1971), where suffixed verbs raise SL to L and H to SH. The underlying tones are [-raised], contrasting in the register feature [upper], and become [+raised], effecting a one-step shift from SL to L and H to SH.

3-level languages can easily be described: the problem is the ambiguity of possible specifications for three tones. There are four specification patterns, where two of the three tones act together, excluding the third.

(8)	a.	H M L	b.	H M L	c.	H M L	d.	H M L		
	upper	+	+	-	+	+	-	+	-	-
	raised	+	-	+	+	-	-	-	+	+

Support for (d) exists in Sara Mbay, where H becomes L when preceded by H and followed by M (Keegan 1997 and p.c.), i.e. [-raised] H takes on the [-upper] register of M, becoming L.

- (9)     $\text{síndá-gē} \rightarrow \text{síndàgē}$             ‘horses’                     $\text{súú-gē} \rightarrow \text{sùù-gē}$             ‘spiders’  
         $\text{m-ódá-ī} \rightarrow \text{módī}$                     ‘I touch you’  
        (single H in  $\text{m-ndá-ī}$  ‘I hit you’ unaffected)

It is not self-evident that the process is assimilation, so under analysis (a) this can be treated as dissimilation of [+upper] in H to [-upper] L before [+upper,-raised] M. Under analysis (c) the process could be dissimilation of [+raised] which H and M have in common – this creates otherwise nonexistent [+upper,-raised] tone which can be corrected with a structure-preserving readjustment to [-upper]. Finally, it is difficult to rule out on empirically-justified theoretical grounds a statement of this process as a formally arbitrary feature change, e.g. under analysis (b) [+upper,+raised]  $\rightarrow$  [-upper,-raised] / [+upper,+raised]  $\rightarrow$  [+upper,-raised]. Since the elements involved in the process are single tones, the question of what unites tones does not arise.

An example involving two triggering segments is assimilatory raising in Mbui (Hyman & Schuh 1974) whereby L becomes M before M and H.<sup>6</sup>

- (10)     $\text{nì-búú} \rightarrow \text{nī-búú}$             ‘breast’                     $\text{nì-sōŋ} \rightarrow \text{nī-sōŋ}$             ‘tooth’  
         $\text{nì-kùò}$                             ‘four’

This can be expressed as spread of [+upper] in analysis (b) and spread of [+raised] in analysis (c), but recall that analysis (b) entailed an arbitrary feature change for Mbay. Analysis (d) – the one which enabled an assimilatory account of Mbay – is the one analysis where H and M have no features in common. The only analysis possible under analysis (a) is an arbitrary feature change. In comparing these languages, we see that Mbay tones are best analyzed under feature-assignment (d), but Mbui is best analyzed under assignments (b) and (c) – meaning that there is no universal mapping between inventory and analysis. Rather, the featural analysis must be discovered by seeing how tonemes group under phonological rules.

More problematic is the tonology of the Ali associative construction (Bradshaw 1998), whereby  $N_1$  raises its tone by one level, so that L becomes M and M becomes H, triggered presumably by a floating tone morpheme.

- (11)     $\text{zù} + \text{ASSOC} + \text{yé}r\grave{e} \rightarrow \text{zū} \text{yé}r\grave{e}$             ‘buffalo head’  
         $\text{gbá}l\grave{a} + \text{ASSOC} + \text{yà} \rightarrow \text{gbá}l\grave{a} \text{yà}$             ‘his bone’  
         $\text{nū} + \text{ASSOC} + \text{kpánà} \rightarrow \text{nú} \text{kpánà}$             ‘jar mouth’  
         $\text{sālā} + \text{ASSOC} + \text{tè} \rightarrow \text{sálá} \text{tè}$             ‘body hair’

No analysis using (5) expresses the notion “raises one step”.

<sup>6</sup> Mupun (Frajzyngier 1993) has an conceptually-similar assimilatory lowering rule whereby H becomes M after L and M.

Some 4-level languages superficially have a worst-case problem in that 3 out of 4 tones act as a class. In Bariba, L becomes SL after SL when followed by SH, H or L – no feature can identify the set SH, H, L. But the reason why SL does not participate in the triggering class is that SL independently becomes SH when surrounded by SL tones, thus SL-L # SL simply does not exist. In Boko, verbal SH becomes H when surrounded by lower tones (H, L, SL).

- (12)     $\text{\textcircled{a}}\text{\textcircled{l}}\text{\textcircled{e}}\text{\textcircled{ }}\text{\textcircled{n}}\text{\textcircled{ }}\text{\textcircled{p}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{p}}\text{\textcircled{a}}$     ‘he is stoning them’  
           $\text{\textcircled{a}}\text{\textcircled{l}}\text{\textcircled{e}}\text{\textcircled{ }}\text{\textcircled{w}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{p}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{p}}\text{\textcircled{a}}$     ‘he is stoning monkey’  
           $\text{\textcircled{f}}\text{\textcircled{o}}\text{\textcircled{ }}\text{\textcircled{k}}\text{\textcircled{p}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{m}}\text{\textcircled{a}}$     ‘greet them!’  
           $\text{\textcircled{?}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{k}}\text{\textcircled{p}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{w}}\text{\textcircled{a}}$     ‘give him a yam’  
           $\text{\textcircled{f}}\text{\textcircled{o}}\text{\textcircled{ }}\text{\textcircled{k}}\text{\textcircled{p}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{w}}\text{\textcircled{a}}$     ‘greet him!’  
           $\text{\textcircled{z}}\text{\textcircled{u}}\text{\textcircled{ }}\text{\textcircled{k}}\text{\textcircled{p}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{w}}\text{\textcircled{a}}$     ‘give him a cow’  
           $\text{\textcircled{m}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{z}}\text{\textcircled{o}}\text{\textcircled{l}}\text{\textcircled{e}}$     ‘I sat down’  
           $\text{\textcircled{m}}\text{\textcircled{i}}\text{\textcircled{ }}\text{\textcircled{z}}\text{\textcircled{o}}\text{\textcircled{l}}\text{\textcircled{e}}\text{\textcircled{ }}\text{\textcircled{o}}$     ‘I didn’t sit down’  
           $\text{\textcircled{m}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{b}}\text{\textcircled{i}}\text{\textcircled{i}}$     ‘I will shine it’  
           $\text{\textcircled{m}}\text{\textcircled{a}}\text{\textcircled{ }}\text{\textcircled{b}}\text{\textcircled{i}}\text{\textcircled{ }}\text{\textcircled{z}}\text{\textcircled{a}}$     ‘I will shine it far’

Similarly, Fe’Fe’ Bamileke SL becomes L before any higher tone (SH, H, L) – SL-SL does not change. In these cases, the excluded tone is identical to the target tone, and the generalization can be restated as applying unless before or adjacent to an identical tone. Identification of an identical tone can be reduced to a representational distinction in autosegmental theory, by presuming that adjacent identical tones fuse into one multiply-associated tone (examples from Boko).<sup>7</sup>

- (13)               SH    SL            L    SH            L    SH → H    SL  
                     /    |            |    /            |    |            |  
                     ? a   kp a   w a            f o   kp a   m a            f o   kp a   w a

Given such a representation, SH-lowering can be stated simply as lowering a singly-linked SH in phrase-medial position, a condition not met in the case of SH before SH. Thus such data do not necessarily pose a problem for the concept of featurally-defined natural classes.

Kikamba provides evidence for grouping SH and SL together, which is impossible under the standard theory, and supports a feature [extreme] characterizing highest and lowest tones.

- (14)
- |         | SH | H | L | SL |
|---------|----|---|---|----|
| H       | +  | + | - | -  |
| extreme | +  | - | - | +  |

<sup>7</sup>

An alternative approach is the constrained algebraic theory of Reiss (2003) where rules may explicitly state featural identity relations or their negation, thus in Boko lowering SH if surrounded by non-identical tones, and in Bamileke SL raises before a non-identical tone. Evidence for “higher” or “lower” tones distinct from reference to “non-identical” tone would in principle be a case where a rule refers to SL followed by L, H, SH but also L followed by H, SH, that is, a probative rule would have to involve more than one input tone. A rule referring to L followed by H, SH is insufficient, since the class H, SH is easily referred to as the [+upper] class.

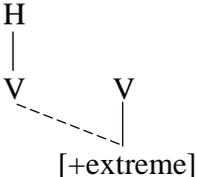
Evidence is a rule raising H to SH before SL. See Roberts-Kohno (2000) for additional details of Kikamba tone. Infinitives have a final SL, which spreads to the second mora of a long penult. Verbs are also lexically differentiated as to whether their first root mora has an underlying H versus L.

- (15) L verbs kò-kòn-à ‘hit’ kò-kòlòk-à ‘stir’  
           kò-kèèl-à ‘strain’ kò-sitàäk-à ‘accuse’  
 H verbs kò-kélàkèly-à ‘tickle’ kò-kóòlòk-à ‘advance’  
           kò-kétèk-à ‘occur’ kò-tálàäng-à ‘count randomly’

Whenever H comes before SL, that H becomes SH, which spreads to a final SL vowel.

- (16) kò-tál-à ‘count’ kò-kóòly-à ‘ask’ kò-tw-à ‘pluck’  
 /kòtálä/ /kòkóòlyä/ /kò-twá ’

Raising H to SH before SL is easily comprehensible as (17) if the language employs a feature [extreme] grouping SH and SL together.

- (17) 

The previously-mentioned rule of Bariba whereby SL becomes SH when surrounded by SL is now easily understood as dissimilation of L to H, retaining underlying [+extreme].

These examples illustrate problems that linguistic theory has faced in reaching firm conclusions regarding featural analysis of tones: evidence can only support a model given well-justified primary theoretical principles, and to the extent that such principles are controversial, the potency of such data for adjudicating the correct set of tonal features is lessened. The presumption that there even exists a single universally-applicable set of features is a venerable yet controversial assumption (Morén 2003, Blaho 2008, Odden 2011).

An obvious problem for featural analysis is that two binary features only allow a four-way contrast in levels, yet five-way contrasts do exist. Benchnon presents a 6-way minimal pair involving 5 levels and one (rising) contour.

- (18) kar<sup>5</sup> “clear” kar<sup>4</sup> “broad leaf” kar<sup>3</sup> “to be round”  
       kar<sup>2</sup> “wasp” kar<sup>1</sup> “pudenda” kar<sup>23</sup> “game played with stones”

This language along with Santa Dan lacks phonological processes elucidating the analysis of contrasts, only showing the need to add some feature.

The most challenging language is Chori (Dihoff 1976), with 6 tone levels. According to Dihoff, only tones 1, 4, 6 are required in underlying contrasts of major word classes (nouns and verbs). Nevertheless, all 6 levels play a role in the grammar. Levels 2, 3 and 5 generally derive

by rule, or are limited to certain grammatical constructions. Levels 3, 5 can derive from compression of two tones onto a single syllable in connected speech (1+6 → 3, 2+6 → 5).

- (19) kel<sup>2</sup> gha<sup>2</sup> di<sup>1</sup> [ŋa<sup>1</sup> a<sup>6</sup>] ~ kel<sup>2</sup> gha<sup>2</sup> di<sup>1</sup> [ŋa<sup>3</sup>]  
 ‘his wife gave it to him’  
 ŋa<sup>1</sup> gos<sup>1</sup> sub<sup>2</sup> [mba<sup>2</sup> a<sup>6</sup>] ~ ŋa<sup>1</sup> gos<sup>1</sup> sub<sup>1</sup> [mba<sup>5</sup>]  
 ‘he bought the mushroom (non-emph)’

Level 2 may derive from a partial tone assimilation rule raising 4 to 2 before 1.

- (20) mi<sup>1</sup> bzar<sup>1</sup> [nap<sup>1</sup>] ke<sup>6</sup> a<sup>2</sup> ‘I touched this branch’ [nap<sup>1</sup>] ke<sup>1</sup> ‘this is a branch’  
 mi<sup>1</sup> bzar<sup>1</sup> [fɛb<sup>4</sup>] e<sup>6</sup> a<sup>2</sup> ‘I touched this cockroach’ [fɛb<sup>2</sup>] e<sup>1</sup> ‘this is a cockroach’  
 mi<sup>1</sup> bzar<sup>1</sup> [nyagh<sup>6</sup>] e<sup>2</sup> a<sup>1</sup> ‘I touched this cow’ [nyagh<sup>6</sup>] e<sup>1</sup> ‘this is a cow’

Levels 2, 3, 5 also play a role in the system of grammatical tone. The underlying /1,4,6/ contrast in verbs is subject to inflectionally-governed modifications. In the present tense, /1/ becomes [6] after a 3s subject, and /4, 6/ become [3] after a 1s subject.

- |      |   |   |          |
|------|---|---|----------|
| (21) | 3sg subj  | 1sg subj  | gloss    |
|      | na <sup>6</sup> a <sup>2</sup> <u>fa</u> <sup>6</sup>   | mi <sup>6</sup> i <sup>2</sup> <u>fsa</u> <sup>1</sup>  | cooking  |
|      | na <sup>6</sup> a <sup>2</sup> <u>tsep</u> <sup>4</sup> | mi <sup>6</sup> i <sup>2</sup> <u>tsep</u> <sup>3</sup> | writing  |
|      | na <sup>6</sup> a <sup>2</sup> <u>dur</u> <sup>6</sup>  | mi <sup>6</sup> i <sup>2</sup> <u>jur</u> <sup>3</sup>  | catching |

Similarly, in the past completive object focus form /1/ becomes [2] and /4, 6/ become [5], regardless of subject. The tone of the subject pronoun varies according to tense, so the 1s pronoun /mi/ in the past habitual has tone 2. Analysis of Chori in light of contemporary theory would be enlightening, and important for the theory of tone.

### 3. Downstep and upstep

Downdrift and downstep complicate the study of tonal inventories. Downdrift refers to recursive automatic lowering of the pitch of H separated from the previous H by L. In Karanga Shona [hàvázàkázòndíbikírà] ‘they haven’t ever cooked for me’, after the first H, each H is pronounced at a lower level than the previous H, rendered numerically as [hà<sup>3</sup>vá<sup>1</sup>zà<sup>4</sup>ká<sup>2</sup>zò<sup>5</sup>ndí<sup>3</sup>bì<sup>6</sup>kí<sup>4</sup>rà<sup>7</sup>] – the level of L tones also decreases, perhaps at a lesser rate. This global process of tone-register lowering is phonemically transparent, so lowered H appears if and only if it is preceded by a L-toned vowel. In principle, one might be led analytically astray by the fact that the language presents very many systematically-used pitch levels and wrongly conclude that the language has a dozen or more tone levels, but ordinary phonemicization methods quickly yield a simpler system with just two distinctive levels and a recursive phonetic interpretation of those two levels. It is an interesting question how a theory of phonetics accounts for this process (see Schachter & Fromkin 1969, Fromkin 1972, Clifton 1976 for early proposals; Clements 1983 for an autosegmental-metrical theory), but since there is a bidirectional mapping between phonological representation

with just H and L and the continuous physical realization, downdrift need not concern phonological theory.

Some languages have this effect without overt L, that is, global lowering may be contrastive. Often these facts are analyzed – incorrectly, it turns out – in terms of an additional Mid level, for example in Efik and Igbo (Green 1949) or Twi (Christaller 1875). Efik has been analyzed as having 3 tone levels based on the minimal pair [ǒbǒŋ] ‘mosquito’, [ǒbōŋ] ‘chief’, [ǒbòŋ] ‘piece of cane’. Such data give prima facie evidence for a three-level system. As observed by Winston (1960), the properties of supposed M are very peculiar. It only exists distinctively after H and M: it does not exist unless there is at least one preceding H, and is an allotone of H after L. It conditions phonetic variants of subsequent H in a complex fashion. M of the syllable [nyoŋ] in (22b) causes the following Hs in [édí ú] to have a special lowered variant – the pitch of a string of H syllables after M becomes identical to the pitch of M-toned [nyōŋ]. Likewise, M of [dī] in (c) conditions the lower-variant pitch on following [ú]. (22d) shows that M itself lowers when preceded by M, and lowering is cumulative, so M of [nyoŋ] in (22d) causes all subsequent tones to lower by one step, and that of [di] causes further lowering.

- (22) a. èkéŋ<sup>1</sup> é<sup>1</sup>dí<sup>1</sup> ú<sup>1</sup>fòk      ‘it was Ekeng came to the house’  
 b. èkpé<sup>1</sup>nyōŋ<sup>2</sup> é<sup>2</sup>dí<sup>2</sup> ú<sup>2</sup>fòk      ‘it was Ekpenyong came to the house’  
 c. èkéŋ<sup>1</sup> é<sup>1</sup>dī<sup>2</sup> ú<sup>2</sup>fòk      ‘Ekeng came to the house’  
 d. èkpé<sup>1</sup>nyōŋ<sup>2</sup> é<sup>2</sup>dī<sup>3</sup> ú<sup>3</sup>fòk      ‘Ekpenyong came to the house’

Explaining Efik by reference to Mid tones necessitates proliferating tone variants – M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub> etc. The distribution of these tones is restricted so H<sub>1</sub> never appears immediately after any M; H<sub>2</sub> only appears after M<sub>1</sub> or H<sub>2</sub>; H<sub>3</sub> only appears after M<sub>2</sub> or H<sub>3</sub>. A simple generalization is being missed: M and H define a pitch ceiling which subsequent tones cannot exceed, and M is distinct from H only in lowering that pitch ceiling.

The key is recognizing the identity of this ceiling-defining and lowering property of “M”, and the lowering effect of downdrift: dowstep is simply contrastive downdrift. Winston combines the phonemic tone levels H and M, introduces a register-lowering operator “downstep”, notated <sup>1</sup>, and significantly simplifies the description of Efik tone. The realization of H and L tones is computed relative to a local register value which decreases whenever downstep occurs. Accordingly, (22d) is phonologically [èkpé<sup>1</sup>nyóŋ é<sup>1</sup>dí úfòk]. It follows that H cannot be higher than M because M is H, simply one that occurs right after downstep.

Downstep is usually restricted to 2-level languages, but a few 3-level languages have downstep. Yala Ikom (Armstrong 1968) has 3 levels plus downstep affecting H and M, thus H<sup>1</sup>H and M<sup>1</sup>M are found. In Ga’anda (Ma Newman 1971), both floating M and L cause downdrift of H, though M tone itself is not downstepped (M<sup>1</sup>M appears to not exist). Languages with more than 2 tone levels are important for understanding the nature of downstep, since they raise the question of possible phonetic equivalence of H<sup>1</sup>H and HM. In Ga’anda and Yala Ikom, it is reported that the second tone in H<sup>1</sup>H is higher than in HM, thus <sup>1</sup>H is phonetically distinct from M.

The degree of pitch drop characterized by downstep is subject to language-specific variation, and a small number of languages have total downstep, where the sequence T<sub>i</sub>T<sub>j</sub> is identical to T<sub>i</sub><sup>1</sup>T<sub>j</sub> (T<sub>i</sub> being the tone which is one step higher than T<sub>j</sub>). Kikuyu (Clements & Ford 1981) and Pāri (Andersen 1988) are two-level languages with total downstep: H<sup>1</sup>H is phonetically identical

to HL, the difference between the sequences being that when placed before L, pitch drops again after H<sup>1</sup>H, and cannot rise above the level of <sup>1</sup>H. In contrast, pitch does not drop when HL is placed before L, and pitch does rise to the level of H when H is placed after HL. Babanki, which has three surface levels, is reported to have total downstep so that the drop in H<sup>1</sup>H is said to be phonetically identical to that in HM – however, M in Babanki has a very restricted distribution and is only followed by H (Hyman 1979), so the phonetic equivalence of H<sup>1</sup>H and HM cannot be unambiguously tested. The 4-level language Bwamu (Riccitelli 1965) has total downstep which can be both contrastive<sup>8</sup> and also automatic – SH is subject to automatic downstepping after H and L (not SL), but the level of all tones decreases after downstep.

- (23) ò<sup>4</sup> mò<sup>3</sup> ! dá<sup>2</sup> sí<sup>2</sup> wá<sup>2</sup> ! bá<sup>3</sup> gá<sup>3</sup> wá<sup>3</sup> ná<sup>5</sup> ! máá<sup>4</sup> sèè<sup>6</sup> ! máá<sup>5</sup> yí<sup>6</sup> ! bín<sup>6</sup> tää<sup>9</sup>  
 “He saw the soldiers’ shirts which cannot be washed there, didn’t he?”

Typically, downstep only exists between H tones, so LH will not contrast with L<sup>1</sup>H, nor would L<sup>1</sup>L contrast with LL. Utterance-initial H does not usually contrast with !H. Unusual languages are attested, however. Dschang Bamileke contrasts LL vs. L<sup>1</sup>L, LH vs. L<sup>1</sup>H, as well as utterance-initial H vs. !H; finally, it contrasts single- and double-downstep (Hyman & Tadadjeu 1976).

- (24) tónj                    ‘call yesterday conditional’  
 !kónj                    ‘like yesterday conditional’  
 à kè tónj sónj        ‘if he called a bird’  
 à kè tónj !mó        ‘if he called a child’  
 à kè tónj !sónj       ‘he called a bird’  
 à kè tónj !!mó       ‘he called a child’

Another language reported to have double-downstep is Kumam (Hieda 2010).

The opposite process where tone register is raised, upstep (notated <sup>i</sup>), is reported in a few languages. Recursive phonemic upstep is only reported in one Mesoamerican language, Acatlan Mixtec. As noted by Hyman (1993), upstep in Engenni, Mankon, and Cahi Rimi have the peculiar property that upstep cannot follow upstep without an intervening re-setting of pitch register. Engenni has automatic upstep of H before L, resulting in the alternation [mì móní wó] ‘I saw you’, [mì móní <sup>i</sup>wó bhèè] ‘I did see you’, and it also has phonemic upstep when a L-toned vowel elides between H syllables, as in /ó dí<sup>i</sup>rè é<sup>i</sup>dà/ → [ó <sup>i</sup>dír é<sup>i</sup>dà] ‘she will cook beans’. Pre-L [é<sup>i</sup>] is not automatically raised – it already is raised because of the preceding raised syllable. A crucial property of downstep distinguishing it from an additional tone level is recursivity, i.e. successive unbounded pitch-lowering. African languages with assumed phonemic upstep all appear to lack that crucial diagnostic of global register shift, and it is possible to analyze upstep in terms of a derived SH plus, in languages like Engenni, progressive assimilation of H to SH after SH.

It is controversial how downstep should be formally represented. The traditional view connects downdrift and downstep, positing that downstep is the surface result of floating L be-

<sup>8</sup> Riccitelli briefly mentions a number of contexts where non-transparent downstep occurs, for example H downsteps after long level H; under certain circumstances, H assimilates SH from the plural suffix -wá which causes downstepping before another assimilated-H noun.

tween Hs, thus phonologically speaking, downstep *is* a floating L.<sup>9</sup> This is well-motivated in many cases, e.g. Ngizim, Twi, Bambara, Ga, Tiriki. A minor problem with the floating L analysis is that in some cases, downstep exists without downdrift (Kikuyu, Dschang, Bwamu), where the phonetic process must identify only floating tones as triggering register lowering. The second problem is that in some languages, downstep automatically emerges when Hs are concatenated. Shambaa illustrates this: any time a word ending with H is placed before a word beginning with H, downstep always appears.

- (25)    ηgó!tó                    ‘sheep’                    dú           ‘only’                    ízafá   ‘they died’  
          ηgó!tó ’dú ’ízafá   ‘only sheep died’

This leads to a competing analysis of downstep, where H<sup>1</sup>H is represented as two separate H tones but HH is represented as a single multiply-linked H.

- (26)
- |   |   |
|---|---|
| $\begin{array}{c} \text{H} \\ \diagdown \quad \diagup \\ \eta \text{ w } \acute{\text{a}} \quad \text{n } \acute{\text{a}} \\ \text{‘child’} \end{array}$ | $\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{n g } \acute{\text{o}} \text{ ' t } \acute{\text{o}} \\ \text{‘sheep’} \end{array}$ |
|---|---|

See Odden (1982), Bickmore (2000) for such analyses, and Paster & Kim (2011) for defense of the floating L analysis. The main weakness of the H-concatenation theory is that such analyses often require ad hoc rules of tone fusion combining separate H autosegments – the situation in Kishambaa where concatenation of H robustly yields downstep turns out to be unusual, and more languages are like Namwanga which requires multiple fusion rules. The H-concatenation theory cannot be a universal representation of register lowering, given languages like Dschang where downstep is contrastive in contexts such as L(‘)H and where double-downstep contrasts with single downstep. It is possible that both models are correct, so some languages have automatic register lowering when identical tonal autosegments are concatenated, and others have a floating tone entity. While many languages present evidence that downstep is an ordered and movable entity, no language seems to present direct evidence that downstep and linked L act together in triggering phonological processes.

#### 4. What tones do that is special

As a featural object, tones do what other featural objects do – they change by assimilation, dissimilation, and contextually neutralize. Tone is also special in certain ways. Tone-spread commonly comes in two varieties, iterative vs. local, whereas assimilatory segmental harmony rules apply as long as their structural descriptions are satisfied. Tones can also move from place to place, and can define multi-element grammatical ‘melodies’ imposed on a string.

<sup>9</sup> Unusually, downstep in Pári is triggered by floating H.

#### 4.1. Local versus Long-distance Assimilation and Shift

A common tonal process is unbounded tone spread, illustrated in (27) with Shambaa data, where H spreads rightwards through a word to (excluding) the final vowel.<sup>10</sup>

- (27) kùghòshòà                    ‘to do’  
       nǐ kúghóshóà                ‘it is to do’  
       kùghòshòàghòshòà        ‘to do repeatedly’  
       kùchíghóshóághóshóà      ‘to do it repeatedly’

This process is formally parallel to well-known vowel harmony. Unlike vowel harmony, tone spreading is often restricted to spreading just once, a process termed “Tone Doubling”. The Ikorovere dialect of Makua (Cheng & Kisseberth 1979) illustrates this. In the negative perfect, H is assigned to the second stem vowel (underlined), and spread to the following non-final vowel.

- (28) àkì-t<sup>h</sup>ùk<sup>h</sup>álè            ‘I have not tied’                    àkì-lòkót<sup>h</sup>álè    ‘I have not picked up’  
       àkì-lòkótáninhè    ‘I have not picked up (plural)’    àkì-màálfhàlè    ‘I have not silenced’

A related process which is unusual from the perspective of other features but not unusual in tone is tone shift, a process whereby a tone moves from one underlying or phonologically-derived position to another. An example of ‘local’ shift is found in Jita (Downing 1996), where H shifts to the following non-prepausal syllable. The underlying H of /bón/ remains *in situ* when its syllable is the penult. When (L-toned) suffixes are added, H moves one syllable rightward.

- (29) òkùbónà            ‘to hit’  
       òkùbonírà        ‘to hit for’  
       òkùbónánà       ‘to hit e.o’  
       òkùbònírànà     ‘to hit for e.o’

An unbounded shift to the penult is found in Zigua (Kenstowicz & Kisseberth 1990), illustrated with the H-toned verb root /ón/ ‘see’, whose tone shifts to the penult of the following noun.

- (30) màlàpùlà:pù            ‘scrubbing instrument’  
       nàònà màlàpùlá:pù    ‘I see a scrubbing instrument’

Segmental features such as rounding, vowel height and nasality do not shift, indicating that tone is special.

#### 4.2. Melodies

The concept of tone melody which can be abstracted away from the segments realising the tones was an essential argument for autosegmental theory. The classical melody is that of Mende,

<sup>10</sup> The source of the H tone is underlined in the examples below.

which is said to restrict tone patterns to just five types, whose realisation (especially the distribution of contours) depends on stem length.<sup>11</sup>

(31)	H	háwámá	‘waistline’	pé <sup>́</sup> lé	‘house’	kó	‘war’
	L	kpàkàlì	‘tripod chair’	bè <sup>̀</sup> lè	‘trousers’	kpà	‘debt’
	HL	félàmà	‘junction’	ngí <sup>́</sup> là	‘dog’	mbû	‘owl’
	LH	ndàvùlá	‘sling’	nà <sup>̀</sup> vó	‘money’	mbă	‘rice’
	LHL	nìkí <sup>́</sup> lì	‘groundnut’	nyà <sup>̀</sup> hâ	‘woman’	mbằ	‘companion’

The unity of the LHL pattern is graphically evident in (32).

(32)	L H L	L H L	L H L
		/	\ \
	n i k i l i	n y a h a	m b a

Melodies are especially prominent in and well-motivated by systems of verbal inflection, where tone changes frequently are a part of tense-aspect inflection. (33) illustrates three tense-related melodies in Tiv. Roots lexically have H or L on the first syllable, and remaining tones are supplied by a grammatical melody.<sup>12</sup>

(33)	<i>General Past (L)</i>			
	vá	‘come’	dzà	‘go’
	úngwà	‘hear’	vèndè	‘refuse’
	yévèsè	‘flee’	ngòhòrò	‘accept’
	<i>Past Habitual (H)</i>			
	vá	‘come’	dzá	‘go’
	úngwá	‘hear’	vèndé	‘refuse’
	yévésé	‘flee’	ngòhóró	‘accept’
	<i>Recent Past (HL)</i>			
	vá	‘come’	dzá	‘go’
	úngwá	‘hear’	vèndé	‘refuse’
	yévésè	‘flee’	ngòhóró	‘accept’

The general rule for distributing the tone melody is that the first tone of the melody goes to the second stem vowel – the first vowel lacking an underlying tone specification – and the second tone if any goes to the third vowel.

Bantu languages are particularly rich with melodic patterns marking verb tense inflections. One example is (Karanga) Shona. In lieu of a melodic tone, L stems only have L, and H stems have H on the first three syllables.

<sup>11</sup> Mende words do not actually exhibit only these 5 patterns: see Dwyer (1978).

<sup>12</sup> Tiv has no contour tones so L is eliminated when combined with H tones, thus predicted past habitual *dză* becomes [dzá] and general past *vă* becomes [vá].



Melodic patterns are also common in Adamawa-Ubangian languages. The Ngbaka dialect of Henrix et al. (2007) has 3 melodic tones added to roots, and the dialect of Englund (1963) has six melodies SH-L\*, SL-SH, SH\*, final L, initial L, and H. Verbs in Mbodòmò (Boyd 1997) have no lexical tone, and receive one of three melodies determined by tense-aspect inflection, as is also true of Tupuri. Similar tonal melodies associated with tense-aspect are found in Gur languages, Grebo, and also occur in Chadic languages (Kotoko, Muyang, Dangla), as well as in Nilo-Saharan (Mbay).

#### 4.3. Segmental influences

It is particularly common to find phonological tone changes conditioned by the distinction between voiced and voiceless consonants, as discussed in Bradshaw (1999). An example is the modification in Suma of the imperfective melodic H, which spreads to the left but not to a vowel after a voiced obstruent.

- (37) ǒúk ‘applaud’      fǒdí ‘stir briskly’      níkírí ‘exaggerate’  
 bǒm ‘be blind’      búsí ‘be bland’      zíkídí ‘delay’

Voiced obstruents are the most likely to trigger L-tone behavior. Voiced sonorants behave variably, for example one rule in Ewe pertaining to imperative tone includes sonorants in the set of tone-lowering segments, whereas the depressor effect in Suma is triggered only by voiced obstruents. Almost universally, implosives behave as non-depressors, except in Zina Kotoko where they are non-depressors for lowering of H to M, but depressors for the lowering of M to L. A synchronically very unusual segmental influence on tone is found in Tupuri (Odden 2011), where imperative verbs alternate when the first vowel is non-high between H and SL, determined by the initial consonant (SL after depressors, H otherwise) as in [dà] ‘want’ versus [há] ‘give’, but the tone is uniformly SH when the first vowel is high ([hík] ‘dry’, [dúk] ‘vomit’).

### 5. Summary

Despite substantial progress made in describing tone in African languages over the past 40 years, there remain many unanswered questions about tone, primarily because of the lack of thorough descriptions of tone systems. Simple questions such as the maximum number of tone levels in languages or how tone levels pattern in terms of class behavior cannot be confidently answered, since languages relevant to testing theories are most often vastly under-studied. Such a lack of knowledge does not signal serious impediments to research into African tone systems: on the contrary, it indicates that there are innumerable opportunities, because something so simple as the discovery of a 4-level language implies the possibility of finding substantive evidence bearing on how tones group into natural classes.

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