Tones and Features

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Phonetic and Phonological Perspectives

edited by

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Preface

The papers in this volume are all concerned with two current topics in phonology: the treatment of features, and the treatment of tone. Most of them grew out of a conference at the University of Chicago's Paris Center in June of 2009 which was organized by friends and colleagues of Nick Clements in tribute to decades of contributions that he had made to the field of phonology, both in the United States and in France. Nick's work served as a natural focus for the discussions and interactions that resulted in the papers that the reader will find in this book. We, the editors, would like to say a bit about Nick's career and his work in order to set the context.

1. G. N. Clements

Nick was an undergraduate at Yale University, and received his PhD from the School of Oriental and African Studies, University of London, for a dissertation on the verbal syntax of Ewe in 1973, based on work that he did in the field. In the 1970s, he spent time as a post-doctoral scholar at MIT and then as a faculty member in the Department of Linguistics at Harvard University. Throughout this period he published a series of very influential articles and books on areas in phonological theory, a large portion of which involved linguistic problems arising out of the study of African languages. His work in this period played an essential role in the development of autosegmental phonology, and his work in the 1980s, when he was a professor of linguistics at Cornell University, was crucial in the development of many of the current views on features, feature geometry, sonority, and syllabification. He worked closely with students throughout this time—including one of us, Elizabeth Hume—at Cornell. He also co-wrote books with several phonologists (Morris Halle, Jay Keyser, John Goldsmith) and collaborated on many research projects.

In 1991, Nick moved to Paris, where he and his wife, Annie Rialland, worked together on projects in phonetics, phonology, and many other things, both linguistic and not. Visiting Nick in Paris became an important thing for phonologists to do when they had the opportunity to come to Paris. Over the next twenty years or so Nick continued to work selflessly and generously

with students and more junior scholars, and was widely sought as an invited speaker at conferences.

Nick passed away a few months after the conference, late in the summer of 2009. Many of his friends (and admirers) in the discipline of phonology had been able to express their admiration for his contributions through their papers and their kind words at the time of the conference in June. This book is offered as a more permanent but equally heartfelt statement of our affection and respect for Nick's work in phonology and in linguistics more broadly.

2. Tone

The proper treatment of tonal systems has long been an area of great activity and curiosity for phonologists, and for several reasons. Tonal systems appear exotic at first blush to Western European linguists, and yet are common among languages of the world. The phonology of tone is rich and complex, in ways that other subdomains of phonology do not illustrate, and yet each step in our understanding of tonal systems has shed revelatory light on the proper treatment of other phonological systems. At every turn, tonal systems stretch our understanding of fundamental linguistic concepts: many languages exhibit tonal contrasts, in the sense that there are lexical contrasts that are physically realized as different patterns of fundamental frequency distributed globally over a word. But from a phonological point of view, words are not unanalyzable: far from it—they are composed in an organized fashion from smaller pieces, some mixture of feet, syllables, and segments. Breaking a pitch pattern (when considering an entire word) into pieces that are logically related to phonological or morphological subpieces (which is ultimately ninety percent of a phonologist's synchronic responsibility) has proven time and time again to be an enormous challenge in the arena of tone. One of the classic examples of this challenge can be found in Clements and Ford's paper (1979) on Kikuyu tone. In Kikuyu, the surface tone of each syllable is essentially the expression of the previous syllable's tonal specification. Each syllable (often, though not always, a distinct morpheme) thus has an underlying – we are tempted to say, a logical—tone specification, but that specification is realized just slightly later in the word than the syllable that comprises the other part of the underlying form. Morphemes in such a system show utter disregard for any tendency to try to be realized in a uniform way across all occurrences; tones seem to assert their autonomy and the privileges that come with that, and use it to produce a sort of constant syncopation in the beat of syllable against tone.

Is tone, then, different from other phonological features? This question is directly posed by three papers in this volume, that by Nick Clements and colleagues, that by Larry Hyman, and that by David Odden. Each is written with the rich background of several decades of research on languages – largely African tone languages, at least as far as primary research is concerned, but also including the fruits of research done on Asian languages over decades as well. In the end, Clements, Michaud, and Patin conclude that tonal features may well be motivated in our studies of tonal systems, but the type of motivation is different in kind from that which is familiar from the study of other aspects of phonology. Hyman, for his part, is of a similar conviction: if tones are analyzed featurally in the ultimate model of phonology, it is not a step towards discovering ultimate similarity between tone and every other phonological thing: tone's diversity in its range of behavior keeps it distinct from other parts of phonology. David Odden's chapter also focuses on the motivation for tonal features. However, his focus is on the types of evidence used to motivate a given feature. Along these lines, he argues that tonal features, like other phonological features, are learned on the basis of phonological patterning rather than on the basis of the physical properties of the sounds (for related discussion, see Mielke 2008).

Goldsmith and Mpiranya's contribution addresses not features for tone, but rather one particular characteristic of tone that keeps it distinct from other aspects of phonology: tone's tendency to shift its point of realization (among a word's syllables) based on a global metrical structure which is erected on the entire word. This is similar to the pattern we alluded to just above in Kikuyu, but in Kinyarwanda, certain High tones shift their autosegmental association in order to appear in weak or strong rhythmic positions: a bit of evidence that rhythmicity is an important organization principle of tonal assignment, in at least some languages, much like that seen in accent assignment and rarely, if ever, seen in other aspects of a phonological system.

The theme of rhythmicity is continued in the paper by Annie Rialland and Penou-Achille Somé. They hypothesize that there is a relationship between the linguistic scaling in Dagara-Wulé, as manifested in downstep sequences, and the musical scaling in the same culture, as found in an eighteen key xylophone. They suggest that downstep scaling and xylophone scaling may share the property of being comprised of relatively equal steps, defined in terms of semitones.

3. Features

The hypothesis that the speech chain can be analyzed as a sequence of discrete segments or phonemes, themselves decomposable into a set of

phonological features, has been at the core of almost a century of research in the sound structure of human language. By virtue of their contrastive nature, phonological features function as the ultimate constitutive elements of the sound component in the sound-to-meaning mapping, while, being both restricted in number at the individual language level and recurrent across languages, their intrinsic characteristics are often associated with general properties of human anatomy and physiology. Apart from being distinctive, phonological features appear to be economical in the way they combine to construct phoneme systems and to express, individually or in combination, the regularity of alternating sound patterns, both historically and synchronically.

It was discovered by Stevens (1972) that small articulator movements in specific areas of the articulatory space may lead to large acoustic changes, whereas, in other regions, relatively large movements lead to only minor acoustic variations. Stevens' quantal model of distinctive features forms the theoretical background of the study by Dogil and his colleagues, who discuss the function of subglottal resonances in the production and perception of diphthongs in a Swabian dialect of German. It is observed that Swabian speakers arrange their formant movements in such a way that the subglottal resonance region is crossed in the case of one diphthong and not the other.

In Stevens' model, the defining acoustic attributes of a feature are a direct consequence of its articulatory definition. The relation between articulation and acoustics is considered to be language-independent, although a feature may be enhanced language-specifically to produce additional cues that aid in its identification. As required by the naturalness condition, phonological features relate to measurable physical properties. Therefore, to the extent that features can be shown to be universal, it is logical to ask what the defining categories of a given feature are that account for the full range of speech sounds characterized by it. This problem is explicitly addressed in the chapter by Ridouane, Clements, and Khatiwada, who posit the question of how [spread glottis] segments are phonetically implemented, and propose a language-independent articulatory and acoustic definition of this feature. Also following the insights of Stevens' quantal theory, Vaissière elaborates a phonetic notation system based on the combination of acoustic and perceptual properties for five 'reference' vowels and discusses its advantages over Jones' articulation-based referential system of cardinal vowels. Kim and Park address the issue of how the opposition between the Korean fricatives /s, s'/ is best characterized in phonetic terms. From their acoustic data they conclude that the most important parameter that distinguishes these sounds is frication duration, which is significantly longer in /s'/ than in /s/. They

propose that this difference is best expressed by reference to the feature [tense].

Discovering the smallest set of features able to describe the world's sound patterns has been a central goal of phonological theory for close to a century, leading to the development of several different feature theories. The chapter by Mielke, Magloughlin, and Hume compares the effectiveness of six theories to classify actually occurring natural and unnatural classes of sounds. They show that a version of Unified Feature Theory (Clements and Hume 1995) with binary place features, as suggested by Nick Clements in 2009, performs better than other proposed theories.

Another important topic in feature research concerns the relation between the feature structure of phonological representations and phonological processes or constraints. How are segments, morphemes or words represented in terms of their feature composition, and which features pattern together in phonological processes and bear witness to their functional unity? Hallé and Adda-Decker study the latter question by examining whether voice assimilation in French consonant clusters is complete or partial. They show that, of the acoustic parameters involved in the assimilation process, voicing ratios change categorically, whereas secondary voicing cues remain totally or partially unaffected. They propose to describe voicing assimilation in French as a single-feature operation affecting the [voice] feature. Rubach addresses the question whether palatalized and velarized consonants should be treated as complex or as simplex segments in terms of their geometrical representation. Looking at Bulgarian data, he concludes that palatalization as well as velarization on coronals and labials are represented as separate secondary articulations. In his study on mid-vowel neutralizations in Brazilian Portuguese, Wetzels argues for a gradient four-height vowel system for this language. The interaction between vowel neutralization and independent phonotactic generalizations suggests that vowel neutralization cannot be represented as the simple dissociation from the relevant contrastive aperture tier, but is best expressed by a mechanism of marked-to-unmarked feature substitution. McCarthy's paper provides a detailed discussion of how vowel harmony should be accounted for in Optimality Theory. Since proposals for dealing with vowel harmony as embedded in parallel OT make implausible typological predictions, he proposes a theory of Serial Harmony that contains a specific proposal about the constraint that favors autosegmental spreading within a derivational 'harmonic serialism' approach to phonological processes.

In addition to the authors noted above and the participants at the 2009 Paris symposium, we would like to acknowledge others who contributed

to this tribute to our friend and colleague, Nick Clements. The University of Chicago generously provided its Paris Center where the symposium was held, and we would like to thank Françoise Meltzer and Sebastien Greppo, Director and Administrative Director of the Paris Center, respectively, for their invaluable assistance in organizing the event. We are also grateful to Deborah Morton of The Ohio State University Department of Linguistics for editorial help in preparing the manuscripts for publication, and to Julia Goldsmith for her assistance in creating the index. Likewise, our appreciation extends to the editorial staff at Mouton de Gruyter, including Julie Miess, and the late Ursula Kleinhenz for her enthusiastic support of this project.

John A. Goldsmith, Elizabeth Hume, W. Leo Wetzels

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1. The representation and nature of tone

Do we need tone features?

G.N. Clements, Alexis Michaud, and Cédric Patin

Abstract. In the earliest work on tone languages, tones were treated as atomic units: High, Mid, Low, High Rising, etc. Universal tone features were introduced into phonological theory by Wang 1967 by analogy to the universal features commonly used in segmental phonology. The implicit claim was that features served the same functions in tonal phonology as in segmental phonology. However, with the advent of autosegmental phonology (Goldsmith 1976), much of the original motivation for tone features disappeared. Contour tones in many languages were reanalyzed as sequences of simple level tones, calling into question the need for tonal features such as [±falling]. Processes of tone copy such as L(ow) > H(igh) / __ H(igh) were reinterpreted as tone spreading instead of feature assimilation. At about the same time, a better understanding of downstep emerged which allowed many spurious tone levels to be eliminated. As a result, in spite of the vast amount of work on tone languages over the past thirty years, the number of phenomena that appear to require tone features has become significantly reduced, raising the issue whether the notion of tone features is at all useful. This paper first reviews the basic functions for which segmental features have been proposed, and then examines the evidence that tone features are needed to serve these or other functions in tone languages. The discussion focuses successively on level tones, contour tones, and register, building on examples from Africa and Asia. Our current evaluation of the evidence is that tone features, to the extent that they appear motivated at all, do not serve the same functions as segmental features.

1. Introduction

In this introduction, we review criteria that are commonly used in feature analysis in segmental phonology, and suggest that these criteria have not, in general, been successfully extended to tonal phonology.

Some important functions of features in segmental phonology are summarized in Table 1.[1]

Table 1. Some common functions of features in segmental phonology

Function		example (segments)
distinctive	distinguish phonemes/ tonemes	/p/ and /b/ are distinguished by [±voice]
componential	define correlations (sets distinguished by one feature)	[–voiced] p t c k [+voiced] b d ɟ g
classificatory	define natural classes (rule targets, rule contexts)	[–sonorant] sounds are devoiced word-finally
dynamic	define natural changes (such as assimilation)	obstruents become [+voiced] before [+voiced] consonants

It is usually held, since the work of Jakobson, Fant and Halle (1952), that one small set of features largely satisfies all functions. We have illustrated this point by using the feature [±voiced] in the examples above. It is also usually believed that each feature has a distinct phonetic definition at the articulatory or acoustic/auditory level, specific enough to distinguish it from all other features, but broad enough to accommodate observed variation within and across languages. In this sense, features are both "concrete" and "abstract".

With very few exceptions, linguists have also maintained that features are universal, in the sense that the same features tend to recur across languages. Thus the feature [labial] is used distinctively to distinguish sounds like /p/ and /t/ in nearly all languages of the world. Such recurrence is explained by common characteristics of human physiology and audition.[2]

Although all the functions in Table 1 have been used in feature analysis at one time or another, the trend in more recent phonology has been to give priority to the last two functions: classificatory and dynamic. We will accordingly give these functions special consideration here.

Feature theory as we understand it is concerned with the level of (categorical) phonology, in which feature contrasts are all-or-nothing, rather than gradient. Languages also have patterns of subphonemic assimilation or coarticulation which adjust values *within* given phonological categories. Such subphonemic variation does not fall within the classical functions of features as summarized in Table 1, and it should be obvious that any attempt to extend features into gradient phenomena runs a high risk of undermining other, more basic functions, such as distinctiveness.

Traditionally, rather high standards have been set for confirming proposed features or justifying new ones. The most widely-accepted features have been founded on careful study of evidence across many languages. Usual requirements on what counts as evidence for any proposed feature analysis include those in (1).

(1) a. *phonetic motivation*: processes cited in evidence for a feature are phonetically motivated.
b. *recurrence across languages*: crucial evidence for a feature must be found in several unrelated languages.
c. *formal simplicity*: the analyses supporting a given feature are formally and conceptually simple, avoiding multiple rules, brackets and braces, Greek letter variables, and the like.
d. *comprehensiveness*: analyses supporting a given feature cover all the data, not just an arbitrary subset.

Proposed segmental features that did not receive support from analyses meeting these standards have not generally survived (many examples can be cited from the literature).

The case for tone features, in general, has been much less convincing than for segmental features. One reason is that much earlier discussion was vitiated by an insufficient understanding of:

- "autosegmental" properties of tone: floating tones, compositional contour tones, toneless syllables, etc.
- downstep: for example, ꜜH tones (downstepped High tones) being misinterpreted as M(id) tones
- intonational factors: downdrift, final lowering, overall "declination"
- contextual variation, e.g. H(igh) tones are often noncontrastively lower after M(id) or L(ow) tones

As a result, earlier analyses proposing assimilation rules must be reexamined with care. Our experience in the African domain is that most, if not all, do not involve formal assimilation processes at all.

A second reason, bearing on more recent analysis, is that the best arguments for tone features have often not satisfied the requirements shown in (1). Feature analyses of tonal phenomena, on close examination, very often prove to be phonetically arbitrary; idiosyncratic to one language; complex (involving several rules, Greek-letter variables, abbreviatory devices, etc.);

and/or noncomprehensive (i.e. based on an arbitrary selection of "cherry-picked" data).

A classic example in the early literature is Wang's celebrated analysis of the Xiamen tone circle (Wang 1967; see critiques by Stahlke 1977, Chen 2000, among others). Wang devised an extremely clever feature system which allowed the essentially idiosyncratic tone sandhi system of Xiamen to be described in a single (but highly contrived) rule in the style of Chomsky & Halle 1968, involving angled braces, Greek letter variables, etc. Unfortunately, the analysis violated criteria (1a–c), viz. phonetic motivation, recurrence across languages, and formal simplicity. As it had no solid crosslinguistic basis, it was quickly and widely abandoned.

The following question can and should be raised: when analyses not satisfying the criteria in (1) are eliminated, do there remain any convincing arguments for tone features?

2. The two-feature model

Though there have been many proposals for tone feature sets since Wang's pioneering proposal (see Hyman 1973, Anderson 1978), recent work on this topic has converged on a model which we will term the Two-Feature Model.

In its essentials, and abstracting from differences in notation and terminology from one writer to another, the Two-Feature Model posits two tone features, one dividing the tone space into two primary registers (upper and lower, or high and low), and the other dividing each primary register into secondary registers. The common core of many proposals since Yip [1980] 1990 and Clements 1983[3] is shown in (2). This model applies straightforwardly to languages that contrast four level tones.

(2)

	top	high	mid	low
register	H	H	L	L
subregister	h	l	h	l

We use the conventional terms "top", "high", "mid", and "low" for the four tones of the Two-Feature Model in order to facilitate comparison among languages in this paper. The model outlined in (2) analyzes these four tones into two H-register tones, top and high, and two L-register tones, mid and low. Within each of these registers, the subregister features, as we will call them, divide tone into subregisters; thus the top and high tone levels are

assigned to the higher and lower subregisters of the H register, and the mid and low tones are likewise assigned to the higher and lower subregisters of the L register.

The Two-Feature Model, like any model of tone features, makes a number of broad predictions. Thus:

- attested natural classes should be definable in terms of its features
- natural assimilation/dissimilation processes should be describable by a single feature change
- recurrent natural classes and assimilation/dissimilation processes which cannot be described by this model should be unattested (or should be independently explainable)

We add two qualifications. First, more developed versions of the Two-Feature Model have proposed various feature-geometric groupings of tone features. We will not discuss these here, as we are concerned with evidence for tone features as such, not for their possible groupings. Second, there exist various subtheories of the Two-Feature Model. Some of these, such as the claim that contour tones group under a single Tonal Node, have been developed with a view to modeling Asian tone systems (most prominently those of Chinese dialects), while others were proposed on the basis of observations about African languages. Again, we will not discuss these subtheories here except to the extent that they bear directly on evidence for tone features.

3. Assimilation

As we have seen, much of the primary evidence for segmental features has come from assimilation processes in which a segment or class of segments acquires a feature of a neighboring segment or class of segments, becoming more like it, but not identical to it. (If it became identical to it we would be dealing with root node spreading or copying rather than feature spreading).

We draw a crucial distinction between (phonological) assimilation, which is category-changing, and phonetic assimilation, or coarticulation, which is gradient. A rule by which a L tone acquires a higher contextual variant before H in a language with just two contrastive tone levels, L and H, is not phonological. In contrast, a rule L $\rightarrow$ M in a language having the contrastive tone levels L, M, and H is neutralizing and therefore demonstrably category-

changing. As we are concerned here with phonological features, we will be focusing exclusively on phonological assimilation.[4]

Now when we look through the Africanist literature, an astonishing observation is the virtual absence of clear cases of phonological assimilation in the above sense. The vast number of processes described in the literature since the advent of autosegmental phonology involve shifts in the alignment between tones and their segmental bearing units. Processes of apparent tone assimilation such as L → H / __ H are described as tone spreading rather than feature assimilation.

One apparent case of assimilation that has frequently been cited in the recent literature proves to be spurious. Yala, a Niger-Congo language spoken in Nigeria, has three distinctive tone levels: H(igh), M(id), and L(ow). This language has been described as having a phonological assimilation rule by which H tones are lowered to M after M or L (Bao 1999, Yip 2002, 2007, after Tsay 1994). According to the primary source for this language, Armstrong 1968, however, Yala has no such rule. Instead, Yala has a downstep system by which any tone downsteps a higher tone: M downsteps H, L downsteps H, and L downsteps M.

Downstep is non-neutralizing, so that, e.g. a downstepped H remains higher than a M. Yala is typologically unusual, though not unique, in having a three-level tone system with downstep, but Armstrong's careful description leaves no doubt that the lowering phenomenon involves downstep and not assimilation.[5]

Our search through the Africanist literature has turned up one possible example of an assimilation process. Unfortunately, all data comes from a single source, and it is possible that subsequent work on this language may yield different analyses. However, as it is the only example we have found to date, it is worth examining here.

Bariba (also known as Baatonu), a Niger-Congo language spoken in Benin (Welmers 1952), has four contrastive tone levels. We give these with their feature analysis under the Two-Feature Model in (3). (Tone labels "top", "high", "mid", and "low" are identical to those of Welmers, but we have converted his tonal diacritics into ours, as given in the last line.)

(3)		top	high	mid	low
	register	H	H	L	L
	subregister	h	l	h	l
		a̋	á	ā	à

By a regular rule, "a series of one or more high tones at the end of a word becomes mid after low at the end of a sentence" (Welmers 1952, 87). In

rule notation, this gives $H_1 \rightarrow M$ / L __ $]_S$. Examples are given in (4a–b) (alternating words are underlined):

(4) a. ná bɔ̀rá buā ‘I broke a stick’ (bɔ̀rā ‘a stick’)
b. ná bóó wá ‘I saw a goat’ / ná bìì wā ‘I saw a child’

Example (4a) illustrates one condition on the rule: the target H tone of /bɔ̀rá/ in ‘I broke a stick’ occurs after L, as required, but does not occur sentence-finally, and so it does not lower; in the second example (‘a stick’), however, both conditions are satisfied, and H lowers to M. (4b) illustrates the other condition: the target H tone of /wá/ in ‘I saw a goat’ occurs sentence-finally, but does not occur after a L tone, and so it does not lower; in the second example (‘I saw a child’), both conditions are satisfied, and the H tone lowers as expected.

Considering the formal analysis of this process, it is obvious that the Two-Feature Model provides no way of describing this assimilation as spreading. Consider the LH input sequence as analyzed into features in (5):

(5)

	low	high
register	L	H
subregister	l	l

We cannot spread the L register feature from the L tone to the H tone, as this would change it to L, not M. Nor can we spread the l subregister feature from the L tone to the H tone, as this would change nothing (H would remain H).

Other analyses of the Bariba data are possible, and we briefly consider one here, in which what we have so far treated as a M tone is reanalyzed as a downstepped H tone.[6] There is one piece of evidence for this analysis: according to Welmers’ data, there are no M-H sequences. (Welmers does not make this observation explicitly, so we cannot be sure whether such sequences could be found in other data, but for the sake of argument we will assume that this is an iron-clad rule.) We can see two straightforward interpretations for such a gap. One is that M is a downstepped H synchronically, in which case any H following it would necessarily be downstepped. The other is that M is synchronically M, as we have assumed up to now, but has evolved from an earlier stage in which M was !H (see Hyman 1993 and elsewhere for numerous examples of historical *!H > M shifts in West African languages). The absence of M-H sequences would then be a trace of the earlier status of M as a downstepped H.

Looking through Welmers' description, we have found no further evidence for synchronic downstep in the Bariba data. If Bariba were a true downstepping language, we would expect iterating downsteps, but these are not found in the language. Welmers presents no sequences corresponding to H !H !H, as we find pervasively in classic downstep systems; we would expect that if the second of two successive M tones were produced on a new contrastive lower level in some examples, Welmers would have commented on it. Also, M does not lower any other tone, notably the top tone. A downstep analysis would therefore have to be restricted by rather tight conditions. In contrast, if M is really M, the only statement needed is a constraint prohibiting M-H sequences, which accounts for all the facts.

We conclude that Bariba offers a significant *prima facie* challenge to the Two-Feature Model, while admitting that further work on this language is needed before any definitive conclusion can be drawn.

4. Interactions between nonadjacent tones

We have so far examined possible cases of interactions between adjacent tones. A particularly crucial question for the Two-Feature Model concerns the existence of interactions between *nonadjacent* tones. We show the Two-Feature Model again in (2):

(2)

	top	high	mid	low
register	H	H	L	L
subregister	h	l	h	l

This model predicts that certain nonadjacent tones may form natural classes and participate in natural assimilations. In a four-level system, *top* and *mid* share the feature *h* on their tone tier, and *high* and *low* the feature *l*. Thus, under the Two-Feature Model we expect to find interactions between top and mid tones, on the one hand, and between high and low tones, in the other, in both cases skipping the intermediate tone. A few apparent cases of such interactions were cited in the early 1980s, all from African languages, and have been cited as evidence for the Two-Feature Model, but no new examples have been found since, as far as we know. Reexamination of the original cases would seem to be called for.

A small number of African languages, including Ewe and Igede, have alternations between non-adjacent tone levels. We will examine Ewe here, as it has often been cited as offering evidence for the Two-Feature Model

(Clements 1983, Odden 1995, Yip 2002). We will argue that while the alternations between nonadjacent tones in Ewe are genuine, they do not offer evidence for a feature analysis, either synchronically or historically.

The facts come from a rule of tone sandhi found in a variety of Ewe spoken in the town of Anyako, Ghana, as originally described by Clements 1977, 1978. While most varieties of Ewe have a surface three-level tone system, this variety has a fourth, extra-high level. We will call this the "top" level consistent with our usage elsewhere in this paper. These four levels are characterized in the Two-Feature Model in the same way as the other four-level systems discussed so far (see 2 above).

The tone process of interest was stated by Clements 1978 as follows. Whenever an expected M tone is flanked by H tones on either side, it is replaced by a T(op) tone, which spreads to all flanking H tones except the very last. Examples are shown in (6).

(6)

/ēkpé	+	mēgbé/							→	ēkpḗ mḗgbé
'stone'		'behind'								'behind a stone'
/àtyíkē	+	dyí/							→	àtyíkḗ dyí
'medicine'		'on'								'on medicine'
/gā	+	hǒmē	+	gā̋	+	áɖé/	→	gà hòmḗ gā̋ ǎɖé		
'money'		'sum'		'large'		INDEF		'much money'		
/nyɔ́nūví	+	á	+	wó	+	vá/	→	nyɔ̋nű-ví ā́ wő vá		
'girl'		DEF		PL		'come'		'the girls came'		

In the first example, the M tone of the second word /mēgbé/ 'behind' shifts to T since it is flanked by H tones. The second example shows that this sandhi process is not sensitive to the location of word boundaries (but see Clements 1978 for a discussion of syntactic conditions on this rule). In the third example, the targeted M tone is borne by the last syllable of /hǒmē/ 'sum'; this M tone meets the left-context condition since the rising tone on the first syllable of /hǒmē/ consists formally of the two level tones LH (see Clements 1978 for further evidence for the analysis of contour tones in Ewe into sequences of level tones). The fourth example shows the iteration of T spreading across tones to the right. This rule must be regarded as phonological since the Top, i.e. extra-high, tones created by this process contrast with surface high tones at the word level:

(7)

/nú	+	nyā	+	lá/	→	nű-nyā́-lá
'thing'		'wash'		AGENT		'washer (wo)man'
/nú	+	nyá	+	lá/	→	nú-nyá-lá
'thing'		'know'		AGENT		'sage, scholar'

In Clements' original analysis (1983), as recapitulated above, the tone-raising process involves two steps, both invoking tone features. First, the H register feature spreads from the H tones to the M tone, converting it into T. Second, the h subregister feature of the new T tone spreads to adjacent H tones, converting them into T tones (the last H tone is excluded from the spreading domain). It is the first of these processes that is crucial, as it gives evidence for tone assimilation between nonadjacent tone levels – prime evidence for the Two-Feature Model.

The analysis we have just summarized is simple, but it raises a number of problems. First, there is no apparent phonetic motivation for this process: not only does it not phonologize any detectable natural phonetic trend, it renders the location of the original M tone unrecoverable. Second, no other phonologically-conditioned raising process of this type has come to light; this process appears to be unique to Anyako Ewe, and is thus idiosyncratic. Third, though the analysis involves two rules, there is in fact no evidence that two distinct processes are involved; neither of the hypothesized rules applies elsewhere in the language. (Top tones arising from other sources do not spread to H tones.) Thus, the rule seems arbitrary in almost every respect. Notably, it does not satisfy the first three criteria for feature analysis as outlined in (1).

Are other analyses of these data possible? We will consider one here that draws on advances in our knowledge of West African tonal systems in both their synchronic and diachronic aspects. More recent work on tone systems has brought to light two common processes in West African languages. First, H tones commonly spread onto following L tone syllables, dislodging the L tone. This is a common source of downstep. Schematically, we can represent this process as H L H → H H ! H. Second, by a common process of H Tone Raising, H tones are raised to T before lower tones. Thus we find H → T / __ L in Gurma (Rialland 1981) and Yoruba (Laniran & Clements 2003).

There is some evidence that such processes may have been at work in the Ewe-speaking domain. Clements 1977 observes that some speakers of western dialects of Ewe (a zone which includes Anyako Ewe) use nondistinctive downstep. Welmers 1973: 91 observes *distinctive* downstep in some dialects, and observes that the last H preceding a downstep + H sequence is "considerably raised".

Accordingly, we suggest a historical scenario in which original H M H sequences underwent the following changes:

(8)	Processes	result
	introduction of nondistinctive downstep	H M ! H
	H spread, downstep becomes distinctive	H H ! H
	H raising before downstep, rendering it nondistinctive	H T ! H
	loss of downstep	H T H
	T spreads to all flanking H tones but the last	T T T

In this scenario, there would have been no historical stage in which M shifted directly to T. Any synchronic rule M → T would have to conflate two or three historical steps.

Inspired by this scenario, we suggest an alternative analysis in which M Raising is viewed as the "telescoped" product of several historical processes. In a first step, all consecutive H tones in the sandhi domain are collapsed into one; this is reminiscent of a cross-linguistic tendency commonly referred to as the Obligatory Contour Principle (see in particular Odden 1986, McCarthy 1986). The final H remains extraprosodic, perhaps as the result of a constraint prohibiting final T tones in the sandhi domain. Second, H M H sequences (where M is singly linked) are replaced by T: see Table 2.

Table 2. A sample derivation of 'the girls came', illustrating the reanalysis of M Raising as the product of several historical processes.

nyɔ́nūví a wó vá H M HH H H	underlying representation
nyɔ́nūví á wó vá H M H (H)	1. OCP(H), subject to extraprosodicity (no overt change)
nyɔ́nű ví ǎ wő vá T (H)	2. replacement of H M H by T

This analysis is, of course, no more "natural" than the first. We have posited a rule of tone replacement, which has no phonetic motivation. However, it correctly describes the facts. Crucially, it does not rely on tone features at all.

Ewe is not the only African language which has been cited as offering evidence for interactions among nonadjacent tone levels. Perhaps the best-described of the remaining cases is Igede, an Idomoid (Benue-Congo,

Niger-Congo) language spoken in Nigeria (see Bergman 1971, Bergman & Bergman 1984). We have carefully reviewed the arguments for interactions among nonadjacent tone levels in this language as given by Stahlke 1977 and find them unconvincing. In any case, no actual synchronic analysis of this language has yet been proposed (Stahlke's analysis blends description and historical speculation). Such an analysis is a necessary prerequisite to any theoretical conclusions about features.

In sum, examining the evidence from natural assimilations and predicted natural classes of tones, the Two-Feature Model appears to receive little if any support from African languages. Confirming cases are vanishingly few, and the best-known of them (Ewe) can be given alternative analyses not requiring tone features. We have also described a potential disconfirming case (Bariba). Perhaps the most striking observation to emerge from this review is the astonishingly small number of clearly-attested assimilation processes of any kind. Whether this reflects a significant fact about West African tonology, or merely shows that we have not yet looked at enough data, remains to be seen.

5. Register features in Asian languages

The concept of register has long been used in studies of Asian prosodic systems, with agreement regarding several distinct points. Specialists agree that Asian prosodic systems give evidence of register at the diachronic level: the present-day tonal system of numerous Far Eastern languages results from a tonal split conditioned by the voicing feature of initial consonants that created a 'high' and a 'low' register (Haudricourt 1972). The question we will raise here is whether register features in the sense of the Two-Feature Model are motivated at the synchronic level. In view of a rather substantial literature on this topic, this question might seem presumptuous were it not for our impression that much of the evidence cited in favor of register features suffers from the same shortcomings that we have discussed in the preceding sections in regard to African languages.

To help organize the discussion, we begin by proposing a simple typology of East Asian tone languages, inspired by the work of A.-G. Haudricourt 1954, 1972, M. Mazaudon 1977, 1978, M. Ferlus 1979, 1998, E. Pulleyblank 1978, and others. This is shown in Table 3.

Each "type" is defined by the questions at the top of the table. The first question is: Is there a voiced/voiceless contrast among initial consonants? In certain East Asian languages, mostly reconstructed, a distinctive voicing

Table 3. A simple typology of East Asian tone languages, recognizing 4 principal types

	voicing contrast among initials?	distinctive phonation registers?	distinctive tone registers?	examples
Type 1	+	–	–	Early Middle Chinese (reconstructed)
Type 2	–	+	–	Zhenhai
Type 3	–	–	+	Cantonese (see below)
Type 4	–	–	–	most Mandarin dialects; Vietnamese; Tamang

contrast is postulated in initial position (e.g. [d] vs. [t], [n] vs. [n̥]). This contrast transphonologized to a suprasegmental contrast in the history of most languages; it is preserved in some archaic languages (e.g. some dialects of Khmou). The second question is: are there distinctive phonation registers? By "phonation register" we mean a contrast between two phonation types, such as breathy voice, creaky voice, and so on. Phonation registers usually include pitch distinctions: in particular, in languages for which reliable information is available, breathy voice always entails lowered pitch, especially at the beginning of the vowel. Various terms have been proposed for distinctive phonation types, including "growl" (Rose 1989, 1990). Phonetically, phonation register is often distributed over the initial segment and the rhyme. In this sense, phonation register can usually be best viewed as a "package" comprising a variety of phonatory, pitch, and other properties, and it may sometimes be difficult to determine which of these, if any, is the most basic in a linguistic or perceptual sense. The third question is: are there distinctive tone registers? The putative category of languages with two distinctive tone registers consists of languages that allow at least some of their tones to be grouped into two sets (high vs. low register), such that any tone in the high register is realized with higher pitch than its counterpart(s) in the low register. In languages with distinctive tone registers, any phonation differences between a high-register tone and its low-register counter-part must be hypothesized to be derivative (redundant with the register contrast).

The typology set out in Table 3 is synchronic, not diachronic, and is not intended to be exhaustive. Further types and subtypes can be proposed, and some languages lie ambiguously on the border between two types. Interestingly, however, successive types in this table are often found to

constitute successive stages in historical evolutions. Also, since voicing contrasts are typically lost as tone registers become distinctive, there is no direct relation between consonant voicing and tone; this fact explains the absence of a further type with a voicing contrast and distinctive tone registers.

It should be noted that only type 3 languages as defined above can offer crucial evidence for a phonologically active tone register feature. Such evidence could not, of course, come from Type 1, 2 or 4 languages, which lack (synchronic) tone registers by definition.

In our experience, clear-cut examples of type 3 languages – "pure" tone register languages – are not easy to come by. Some alleged type 3 languages prove, on closer study, to be phonation register languages. In others, the proposed registers are historical and are no longer clearly separated at the synchronic level. Most East Asian languages remain poorly described at the phonetic level, so that the typological status of many cannot yet be determined. The small number of clear-cut type 3 languages may be due in part to insufficient documentation, but it could also be due to the historical instability of this type of system, as suggested by Mazaudon 1988.[7] The defining properties of type 3 languages are the following:

1. no voicing contrast in initials
2. no phonation register
3. distinctive high vs. low tone registers, as schematized below:

	melodic type 1	melodic type 2	melodic type 3	etc.
high register	Ta	Ta	Ta	…
low register	Tb	Tb	Tb	…

In each column, Ta is realized with higher pitch than Tb (some tones may be unpaired).

As a candidate type 3 language we will examine Cantonese, a member of the Yue dialect group spoken in southern mainland China. This language is a *prima facie* example of a type 3 language as it has no voicing contrast in initial position, only marginal phonation effects at best, and a plausible organization into well-defined tone registers. Our main source of data is Hashimoto-Yue 1972, except that following Chen 2000 and other sources, we adopt the standard tone values given in the *Hanyu Fangyin Zihui*, 2nd ed. (1989).

There are several ways of pairing off Cantonese tones into registers in such a way as to satisfy the model of a type 3 tone language. The standard

pairings, based on Middle Chinese (i.e. etymological) categories, are shown in (9).

(9)

	I	II	III	IVai	IVaii
high register	[53]~[55]	[35]	[44]	[5q]	[4q]
low register	[21]~[22]	[24]	[33]	[3q]	

The [53]~[55] variants are conditioned by individual and morphosyntactic variables (Hashimoto-Yue 1972: 178–180, who considers the high falling variant [53] as underlying). Of course, this particular set of pairings has no analytical priority over any other in a purely synchronic analysis. The implicit assumption is that these are the most likely to form the basis of synchronic constraints and alternations. These pairings (as well as the alternatives) satisfy our third criterion for a Type 3 language. However, we have been unable to find any phonetic studies that confirm the pitch values above, which are partly conventional.

The crucial question for our purposes is whether or not Cantonese "activates" register distinctions in its phonology. That is, is there evidence for a feature such as [±high register] in Cantonese in the form of rules, alternations, etc.? Contrary to some statements in the literature, Cantonese has a rather rich system of tonal substitutions and tone sandhi, and two of these phenomena are particularly relevant to this question.

Cantonese tonal phonology is well known for its system of "changed" tones. According to this system, some words, mostly nouns, are produced with the changed tones 35 or (less productively) 55, instead of their basic lexical tones. This shift is usually associated with an added component of meaning, such as 'familiar' or 'opposite' (Hashimoto-Yue 1972: 93–98). Some examples are shown in (10).

(10)

replacement by 35:	replacement by 55:
魚 ˇy:^{21} → ˇy:^{35} 'fish'	阿姨 A:^{44} ǐi:^{21} → A:^{44} ǐi:^{55} 'aunt'
李 leǐ^{23} → leǐ^{35} 'plum'	長 ts^{h}œŋ^{21} 'long' → ts^{h}œŋ^{55} 'short'
緞 ty:n^{22} → ty:n^{35} 'satin'	遠 ˇy:n^{23} 'far' → ˇy:n^{55} 'near'
計 kɐǐ^{33} → kɐǐ^{35} 'trick'	衫 sA:m^{53} → sA:m^{55} 'clothes'

A feature-based analysis of the changed tones is possible, but requires a complex analysis with otherwise unmotivated "housekeeping" rules (see Bao 1999: 121–127, for an example).

A more interesting source of evidence for a register feature comes from a regular rule of tone sandhi which Hashimoto-Yue describes as follows (1972: 112): "a falling tone becomes a level tone if followed by another tone that begins at the same level, whether the latter is level or falling". She states the following rules:

(11) 53 → 55 / __ 53/55/5
21 → 22 / __ 21/22

Some examples follow:

应该 ɪŋ^{53} kɔ:i ^{53} → ɪŋ^{55} kɔ:i ^{53} 'should, must'
麻油 mA:^{21} ɛu^{21} → mA:^{22} ɛu^{21} 'sesame oil'

Let us consider the analysis of these alternations. A rather simple analysis is possible under the Two-Feature Model, if we allow Greek-letter variables or an equivalent formal device to express the identity of two feature values, as in (12):

(12) register tier [α register] [α register]
/\ /
subregister tier h l h …
↓
h

This rule states that the low component of a falling tone shifts to high, provided it is followed by a tone beginning with a high component and that both tones belong to the same register. This analysis makes crucial use of both register features and subregister features, assigned to separate tiers. It correctly describes both cases.

A notable aspect of this rule, however, is that it describes alternations among variants of the same tone. That is, as we saw in (11), [53] and [55] are variants of the same tone, as are [21] and [22]. The rules are therefore "subphonemic", raising the question of whether they are phonological in the strict sense – that is, category-changing rules – or gradient phonetic rules. In the latter case, they would not constitute evidence for tone features, since features belong to the phonological level (see our introductory discussion). To make a clear case for a phonological alternation we would need a set of alternations between contrastive tones, such as [53] ~ [35] and [21] ~ [24]. Thus, in spite of the rather elegant analysis that can be obtained under the Two-Feature Model, these facts do not make a clear-cut case for features.

We know of no other alternations that support a feature-based analysis of Cantonese tones. However, certain static constraints described by Hashimoto-Yue (110–111) are most simply stated in terms of a low register feature, and possibly in terms of the level/contour distinction, if [53] and [21] are taken to be underlying[8] (Roman numerals refer to the categories in (9)):

- unaspirated initial consonants do not occur in syllables with the low-register I and II tones ("contour" tones?)
- aspirated (voiceless) initial consonants do not occur in syllables with the low-register III and IV tones ("level" tones?)
- zero-initial syllables do not occur with low-register tones

These constraints, which are clearly phonological, might be taken as evidence for a low-register feature. However, static constraints have never carried the same weight in feature analysis as patterns of alternation, the question being whether they are actually internalized as phonological rules by native speakers.

We conclude that Cantonese does not offer a thoroughly convincing case for tone features. The interest of looking at these facts is that Cantonese represents one of the best candidates for a type 3 language that we have found.

We have also surveyed the literature on tone features in other Asian languages. Up to now, we have found that arguments for tone features typically suffer from difficulties which make arguments for a register feature less than fully convincing:

- evidence is often cited from what are actually Type 2 or 4 languages
- very many analyses do not satisfy the criteria for feature analysis outlined in (1)

One reason for these difficulties, in the Chinese domain at least, is the long history of phonetic evolution that has tended to destroy the original phonetic basis of the tone classes. This has frequently led to synchronically unintelligible tone systems. As Matthew Chen has put it, the "vast assortment of tonal alternations… defy classification and description let alone explanation. As one examines one Chinese dialect after another, one is left with the baffling impression of random and arbitrary substitution of one tone for another without any apparent articulatory, perceptual, or functional motivation" (Chen 2000, 81–82).

The near-absence of simple, phonetically motivated processes which can be used to motivate tone features contrasts with the wealth of convincing

crosslinguistic data justifying most *segmental* features. This may be the reason why most tonologists, whether traditionalist or autosegmentalist, have made little use of (universal) features in their analyses. As Moira Yip has tellingly observed, "Most work on tonal phonology skirts the issue of the features" (Yip 2007, 234).

6. Why is tone different?

Why is it that tones do not lend themselves as readily to feature analysis as segments?

We suggest that the answer may lie in the monodimensional nature of level tones:

- *segments* are defined along many intersecting phonetic parameters (voicing, nasality, etc.); such free combinability of multiple properties may be the condition *sine qua non* for a successful feature analysis
- *tone levels* (and combinations thereof) are defined along a single parameter, F0; there is no acoustic (nor as yet, articulatory) evidence for intersecting phonetic dimensions in F0–based tone systems

The latter problem does not arise in phonation-tone register systems, in which phonation contrasts are often multidimensional involving several phonetic parameters (voicing, breathy voice, relative F0, vowel quality, etc.), and can usually be identified with independently-required segmental features.

Given the monodimensional nature of level tones, it is difficult to see how a *universal* tone feature analysis could "emerge" from exposure to the data. Unless "wired-in" by "Universal Grammar", tone features must be based on observed patterns of alternation, which, as we have seen, are typically random and arbitrary across languages. In contrast, patterns based on segmental features, such as homorganic place assimilation, voicing assimilation, etc., frequently recur across languages (see Mielke 2008 for a description of recurrent patterns drawn from a database of 628 language varieties).

7. Conclusion

We have argued that the primitive unit in tonal analysis may be the simple tone level, as is assumed in much description work. Tone levels can be directly

interpreted in the phonetics, without the mediation of features (Laniran & Clements 2003). Tone levels are themselves grouped into scales. (The issue whether *all* tone systems can be analyzed in terms of levels and scales is left open here.)

Although this paper has argued against universal tone features, it has not argued against *language-particular* tone features, which are motivated in some languages. We propose as a null hypothesis (for tones as for segments) that features are not assumed unless there is positive evidence for them. (For proposed language-particular features in Vietnamese, involving several phonetic dimensions, see Brunelle 2009.)

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Notes

1. Another theoretically important function, namely *bounding* (defining the maximum number of contrasts), will not be discussed here.
2. Some linguists have maintained that features are innate in some (usually vaguely-defined) sense. However, recurrence across languages does not entail innateness, which is an independent hypothesis; for example, some current work is exploring the view that features can be developed out of experience (Mielke 2008). This issue is peripheral to the questions dealt with in this paper and will not be discussed further here.
3. Yip 1980 originally proposed two binary features called [±upper register] and [±raised]. However, since the development of feature-geometric versions of this model (Bao 1999, Chen 2000, and others), these have tended to be replaced by H and L, or h and l.
4. In a broader sense of the term "phonology", any rule, categorical or gradient, which is language-specific might be regarded as phonological. This indeed was the view of Chomsky & Halle 1968, though it is less commonly adopted today.
5. The facts of Yala are summarized in Anderson 1978 and Clements 1983.
6. We are indebted to Larry Hyman for e-mail correspondence on this question.
7. Mazaudon's Stage B languages correspond approximately to our type 3 languages.
8. However, we have not seen convincing evidence for taking either of the alternating tones [53]~[55] or [21]~[22] as basic.

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Rhythm, quantity and tone in the Kinyarwanda verb

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1. Introduction

In this paper, we discuss the some aspects of the tonology of the verbal inflectional system in Kinyarwanda. There is a considerable amount of literature on tone in Kinyarwanda and in Kirundi (for example, Sibomana 1974, Coupez 1980, Mpiranya 1998, Kimenyi 2002), two languages which are so similar that the two can be considered dialects of a single language. We have benefited from previous analyses of both languages, and especially from work done in collaboration with Firmard Sabimana (see Goldsmith and Sabimana 1985) and with Jeanine Ntihirageza, both linguists and native speakers of Kirundi. Nonetheless, the focus in the present paper is Kinyarwanda, which is the native language of one of the present authors (FM). We wish to emphasize that even restricting ourselves to the material discussed below, there are some differences between Kirundi and Kinyarwanda, and while the differences are small, they are significant. Despite the considerable work that exists already on the tone of the verbal system, a number of important questions – even basic ones – remain relatively obscure, and we hope that the present study will contribute to a better understanding of them. We plan to present a more comprehensive account of the tonology of the verbal system in the future. We use the following abbreviations:

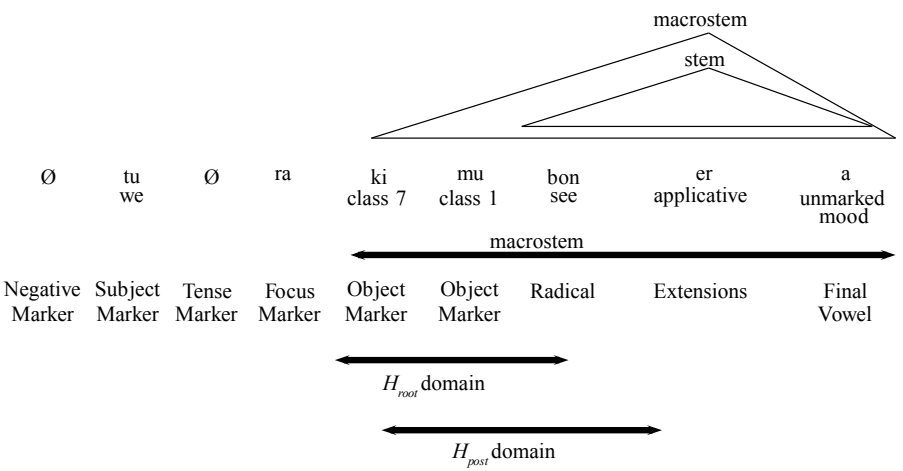
SM	Subject marker
TM	Tense marker
FOC	Focus marker
OM	Object marker
FV	Final vowel
inf	Infinitive marker
B	Basic (underlying) tone

Our goal has been to develop a formal account of tone which is as similar as possible to the analysis of tone in the other Bantu languages that are reasonably closely related. But the fact is that despite our bias in this regard,

the analysis that we present here is quite different from what we expected, and from those proposed for nearby Bantu languages. In keeping with some earlier analyses, our account leans heavily on postulating metrical structure established from left to right, needed in order to account for the shifting and spreading of high tone. But the most surprising aspect of this analysis is that there is no general tonology of the verbal High tone as such: each High tone has a behavior that is directly tied to its morphological status or origin, and the shift of High tone occurs both towards a metrically Weak and a metrically Strong position, depending on the morphological status of the High tone in question, a fact that we did not expect, and that we were, in retrospect, biased against.

We will begin by sketching the overall analysis in general terms, and we describe the conclusions which we have reached. The motivation and justification will be presented over the course of the paper, and indeed, our reasons for formulating the generalizations as we do may not be entirely clear until the data is seen in detail.

1. The general structure of the Kinyarwanda verb is similar to that found in a range of familiar, and relatively closely related, Bantu tone languages; see Figure 1, where we present an schema of the Bantu verb – one that is incomplete, but sufficiently detailed for our present purposes.



tu-ra-ki-mú-bónera ‘we will see it for him’

Figure 1. Verbal structure tone windows

2. Some morphemes have underlying tones and others do not.
3. There is a High/Low tonal contrast among the verb roots, although there is no evidence that what we might call Low toned verb roots bear a Low tone as such; they are best analyzed as bearing no tone. Speaking of a High/Low tonal contrast is a matter of convenience.
4. There is no lexical tonal contrast among the subject markers. In most environments, the Subject Marker (*SM*) appears on a low tone, the result of no tone associating with it. In a few environments, a High tone is associated with the Subject Marker.
5. There is a suffixal high tone, a suffixal morpheme which we indicate as H_{post}, that appears in certain morphological environments. When there are no Object Markers in the verb, the suffix H_{post} appears on the second syllable of the stem, but when there are OM prefixes, it appears further to the left. For specialists in historical or comparative Bantu tone, this tone is especially interesting. Its behavior is quite different from the verbal suffix High tone, or tones, that we observe in closely related Bantu languages. In particular, it is common to find a High tone that appears on the mora that follows the first mora of the verb radical, and in those languages in which there is a tonal contrast among the verb radicals, this High tone typically appears when the verb radical is Low (or toneless). This tone, however, never appears shifted to a position earlier in the word, as far as we are aware. In addition, there is a distinct High tone that is associated with the Final Vowel in a number of verbal patterns, such as the subjunctive. This difference does not naturally carry through to the Kinyarwanda system, as far as we can see at the present time.
6. There is a leftward shift of High tone in some cases that appears to be rhythmically motivated. If we group moras into groups of two from left to right, then it is natural to label one as strong and one as weak, even if the choice is a bit arbitrary. We label these feet as trochees (Strong-Weak). H_{root} shifts leftward to a Strong position; H_{post} shifts leftward to a Weak position: this is the conclusion that we mentioned just above that was surprising, and it will become clearer when we consider some specific examples.
7. Kinyarwanda is relatively conservative among the Bantu languages in maintaining a vowel length contrast, and it appears to us to be impossible to avoid speaking of moras in the analysis of the prosodic system. However, not all moras show the same behavior, and in some cases, the second mora of a long vowel acts differently than the mora of a short syllable in a weak position. That much is perhaps not