

METRICAL DEPENDENCIES IN TONE ASSIGNMENT

by

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B.A., University of Michigan
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ABSTRACT

This thesis presents metrical analyses of tone assignment (tone shift, tone insertion, tone spread) in four Bantu languages of Tanzania. A constrained metrical system of rules and parameters (Halle and Vergnaud 1987) is introduced and applied to these languages in order to explain a variety of long-distance tone phenomena. The metrical analysis reduces these phenomena to a set of local operations within an autosegmental theory of phonology.

Along with the introduction to metrical theory (Chapter One), a theory of tone and morphology for the Bantu languages is sketched out and illustrated by partial analyses of Kimatuumbi and Ci-Ruri (Chapter Two). Fuller analyses of Digo (Chapter Three) and Sukuma (Chapter Four) follow, building on the theoretical devices which were developed for the analyses of Kimatuumbi and Ci-Ruri. Metrical structure is shown to play a profound role in the tonology of these languages.

The study concludes by drawing out the theoretical implications of the previous analyses, with particular attention to the typology of tone-accent interactions.

Thesis Supervisor: Dr. Morris Halle
Title: Institute Professor (Linguistics)

Acknowledgements

James Matthew Barrie tells us that for several days after his first book was published, he carried it about in his pocket and took surreptitious peeks at it to make sure the ink had not faded. Surely such an *anstig* chap would never survive the age of the word-processor, when one can fit a year's work on a 3½ inch disk, ready to be obliterated at any moment by a solar flare or the caprice of Boston Edison. Now that my dissertation is done, I think that – unlike Barrie – I shall not look at it for a month or more. If it should start to fade in the meantime, I hope only that this page of acknowledgements survives, since anything of merit I have to say in the other 300+ pages is derivable from the people who helped me to say it.

I knew already a year ago that I would be thanking Morris Halle for badgering me to come see him more often, and here I am doing it. Morris has been the consummate committee chair in the way that he has kept tabs on me, encouraged me, cajoled me, gone to bat for me, and fought with me. It was both unsettling and reassuring to find Morris phoning me on a Saturday morning to discuss a draft which I had given him the day before. He regularly had suggestions, kudos, references – and a demand to see a revised draft on Monday. My intellectual debt to Morris is very great, and I am grateful to him for always giving me the time to run it up a little more.

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In a very real sense, an MIT dissertation is the product of all four years of study here. Thanks, therefore, are in order to many more people: to the members of my generals committee – Ken Hale, Jay Keyser, and Donca Steriade; to John Goldsmith and Nick Clements for teaching a great course on the structure of Bantu at the 1987 Stanford Linguistic Institute; to John Huehnergard for his Semitics courses at HDS. Even more gratitude is due Donna Jo Napoli and Van Parunak; they made me a linguist. I owe a lot to classmates and friends who helped me in a variety of ways which I cannot enumerate here: Jennifer Cole, Kate McCreight, Betsy Sagey, Betsy Ritter, Doug Saddy, Tova Rapoport, Maggie Browning, Kelly Sloan, Bao Zheming, Li Yafei, Betsy Klipple, Viviane Deprez, Harry Leder, Lori Holmes, Kate Kearns, Tom Fisher, Jonathan and June Watt, and Chris and Carol Wright.

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My gratitude and love go to all my friends at the First Reformed Presbyterian Church of Cambridge. Above all, thanks to my family for their love and support: this thesis is dedicated to them.

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A wise man of old once said, "It is the glory of God to conceal a thing, but the honour of kings is to search out a matter." Who in the field of linguistics does not share my gratitude for the royal honour of searching out the deep questions of language? What can compare with the excitement of finally seeing the way Sukuma tonology works, or of finding at last the spin to put on a particular argument? I am thankful for four years of study in what must be the most regal academic discipline. The aforementioned wise man perhaps learned that proverb from his father, who was not only a king, but also a poet. Certain lines from King David's pen have come into to my mind over and over again since my very first month at MIT. These words might well be the anthem of everyone who studies those workings of the human mind which we call "language."

אודך על כי נוראות נפליחי
נפלאים מעשך
ונפשי ידעת מאד

[I will praise thee [O LORD]; for I am fearfully and wonderfully made]
[marvellous are thy works; and that my soul knoweth right well—Psalm 139.14]

The study of His works in the gift of language have inspired me to praise Him, the only true Word from the beginning who was with God and was God. It is my humble hope that the reader will find some inspiration also.

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"Phonology is a precise science, as precise as the most fastidious precision could desire. It is based on truth, it is buttressed by law."

John Clark, Manual of Linguistics, 1893.

'There's a million ways to wiggle.'

**Morris Halle, Morphology class,
February 27, 1986.**

Introduction

Solving a problem like Sukuma

It has been said that a central task of the phonologist is to understand adjacency. Most phonological processes display strict locality requirements: one sound affects a neighboring sound, as with palatalization, nasalization, or compensatory lengthening. Or, one sound takes on a feature in a certain local environment, as with English stop aspiration or German rime devoicing. One finds, on the other hand, no phonological processes such as, "devoice the final consonant if the word begins with a vowel," or "metathesize the first and last velars in a word."

The more formidable challenges for an explanatory theory of phonology, then, have been sound processes which affect elements that seem to be non-adjacent. Vowel harmony is one example. How is it that the features of one vowel are able to affect the features of another vowel when there is an intervening consonant? Infixation is another example of an operation which seems to defy requirements of adjacency. How does the grammar "know" where to put the infix with respect to the edge of the word?

Recent advances in the field of generative phonology have uncovered the truly local nature of operations such as vowel harmony and infixation. Specifically, autosegmental theory (Goldsmith 1976) and underspecification theory (Steriade 1987), along with notions of feature geometry (Sagey 1986), have all contributed to our understanding of how adjacency must be defined for certain types of phonological processes.

This dissertation investigates another sort of seemingly non-local operation, namely, the movement of tones in a variety of Bantu languages of Tanzania. High tones in these languages can travel great distances (in phonological terms), crossing strings of phonemes of arbitrary length, it appears. Digo and Ci-Ruri, for example, regularly display tone shifts of up to six syllables, and even longer movements are possible in principle.

The goal of this study is to describe and explain these long-distance tone assignments; the tack to be taken is the redefinition of such tonal operations as local operations, operations between adjacent elements. In particular, I attempt to define phonological "next-ness" with the primitives of metrical theory. Other recent advances in phonology are also exploited in the analysis: end-based domains (Selkirk 1986), Bantu word structure (Myers 1987), and Tone-Accent Attraction (Goldsmith 1987).

In the languages under consideration, it is rarely difficult to isolate the tonal characteristics of each morpheme. For example, in the pair of Digo finite verb forms below, it is clear that the High tone of the penultimate vowel in the second form is due to the word-initial subject marking morpheme /a-/ of the present tense.

ni-na-onjerez-a	'I am adding to'
a-na -onjeréz-a	'he is adding to'

All of the morphemes in the first form bear a phonetic Low tone; the presence of the High tone in the second form can only be due to the different subject prefix. The pairs above are quite representative; the present tense

/a-/ subject prefix is undoubtedly the source of the High tone (cf. Kisseberth 1984).

In the preceding example the High tone of /a-/ has travelled rightward to a morpheme which is four syllables away. The distance of movement is not fixed at four syllables, however: the High tone of /a-/ can travel one, two, or three syllables to the right, as the following data show.

<u>a-na</u> -zungumúz-a	'he is conversing'
<u>a-na</u> -píg-a	'he is beating'
<u>a-na-ra</u> gíz-a	'he is ordering'

Also in Ci-Ruri phonology High tones make long pilgrimages. For example, the object marking prefix /li-/ 'it' contributes a High tone to a verb, much like the /a-/ prefix of Digo. The High tone of /li-/ travels to the end of the verb and beyond: in the example below the High tone of the /li-/ object prefix has shifted to the first syllable of the following noun phrase.

o-ku-Ba- <u>lí</u> -sorotor-er-a lí-Bui	'to pull out the stone for them'
cf. li-Bui	'the stone'

In isolation the noun phrase bears no phonetic High tone; the High tone which it bears in the infinitival phrase is due to the /li-/ verbal prefix. In this case the High tone of the object prefix has travelled six syllables rightward, all the way into another word.

Similar tone shifts are found in Sukuma, yet another Tanzanian tone language. The High tone of the verb stem /bon-/ 'to see' can travel zero, one, two, or three syllables rightward, even into another word.

a- <u>bón</u> -e	banhú	'let him see people'
a-ka- <u>bon-á</u>	mi-úbu mi-táale	'he saw a big sp. of tree'
a-ka- <u>bon-a</u>	áma-hagala	'he saw the tree forks'
a-ka- <u>bon-a</u>	ma-hágala	'he saw tree forks'

The High tone associated to the first vowel of the nominal stem /kologoma/ can appear four or five syllables rightward in another word.

mi- <u>kologoma</u>	mi-doto	'wet mkologoma trees'
mi- <u>kologoma</u>	mi-dóto	'wet mkologoma trees'

How do the High tones in Sukuma, Ci-Ruri, and Digo find the correct (non-adjacent) vowel to land on? What sort of road sign guides them in their eastward travels? I defend the thesis that abstract metrical markers determine the movement of High tones.

To recapitulate, Tanzanian tone languages show a striking array of tone movements. Tones shift from one vowel to another vowel which is not in the following syllable. These processes are fully regular and can be described systematically; the problem for phonological theory is to develop a parsimonious explanation for these long-distance tone assignments. The present study offers a metrical solution to the problems in Sukuma, Digo, Ci-Ruri, and Kimatuumbi; the long-distance tone phenomena prove to be local operations under a metrical interpretation.

Chapter One

The Elements of Metrical Theory

1.0 The goal of the present work

The central thesis of this work is quite simple: metrical structure rules, such as are familiar from the grammar of English and other European languages, play a role in the determination of intonation contours in certain languages traditionally classified as "tone languages". This is by no means a new idea: work as early as McCawley 1970 and Goldsmith 1981 suggested that the typological distinction between "tone languages" and "stress languages" was misleading. In fact, there is a large and growing literature which argues for accentual approaches to tonal phenomena, in large part due to John Goldsmith's 1976 dissertation on the autosegmental nature of tone systems.

That two Bantu languages are the focus of this dissertation is no novelty: previous work on tone-and-accent studies in generative grammar has focused almost exclusively on Bantu languages. The two languages discussed below, Digo and Sukuma, are chosen for a particular reason, however. The complexity of their tonal systems lies somewhere between Swahili on the one hand, which obviously employs metrical structure to determine the (penultimate syllable) placement of high tone, and the Grassland Bantu languages on the other hand, in which a given vowel may bear as many as ten different surface tones (cf. Spreda 1986). The following analyses of Digo and Sukuma, together with previous research in

tonology, help establish a typology of metrical tone systems. The kind of analytical tools acquired in the study of the "easier" tone languages such as Digo, Sukuma, and Kimatuumbi may prove useful in deciphering the grammars of the most complex and confusing tone systems, both those of Western Africa and even of Meso-America.

The minor thesis of the present work – that rules of tone manipulation apply in the phrase-level phonology, after the rules of metrical structure construction – is also not an idea original to the author. This notion was articulated for Japanese by McCawley in 1970. The intuitive basis of this idea is that languages which employ metrical structure in their grammars have the same "division of labor" as does English in the determination of tonal contours. Metrical rules apply at the word-level and sometimes at the phrase-level of the phonology; later phrasal rules give a tonal interpretation to the metrical structure which has been constructed earlier in the derivation. The claim here is not that all tone languages have an underlying metrical structure (although that idea is worth pursuing). Rather, the claim is that grammars which parse sound strings into metrical constituents have a universally predetermined ordering of metrical rules and tonal rules.

Thus, the correct typological distinction is not one of tone vs. accent languages, but rather one of metrical vs. non-metrical languages (if the latter in fact exist). Metrical languages subdivide into those like English on the one hand which do not have tones (High/Low) specified in lexical entries, and those like Digo and Sukuma on the other hand, which do include tone features in underlying forms of words:

But if the leading ideas of this dissertation are familiar proposals in phonological theory, what is the contribution of this work to linguistics?

My goal is to bring theories of tone-accent interaction in line with a constrained theory of metrical structure (such as is found in Halle and Vergnaud 1987, Hammond 1988, Hayes 1981). I hope that a greater depth of explanation for tonal phenomena can be achieved by framing tonal theories in terms of the more familiar components of constrained metrical theories (with such rules as Stress Erasure, Clash Deletion, binarity or unboundedness, etc.). The analyses to follow are demonstrations of the various notions mentioned above, worked out more or less for entire tone systems, rather than for a small part of a tonal grammar (say, the associative construction). The intended contribution of this thesis to linguistic theory is the synthesis – worked out exhaustively and in detail – of the ideas of a number of researchers, showing that taken together these ideas help the language learner (and the linguist) decipher the complex tone rules of particular languages.

1.1 Why suspect metrical structure in Bantu?

At first blush it might seem like an exercise in quixotic reductionism to try to impose metrical theory on the grammars of Bantu languages. After all, the distinction between tone languages and accent languages, though difficult to state formally¹, has nonetheless proven useful in the characterization of language types and should not be blithely discarded. Metrical theories have traditionally found a place in the analysis of stress assignment in various Indo-European, Austronesian, and American languages. Grammarians of the Bantu languages often state explicitly, however, that such languages have no stressed vowels, and that all vowels have the same intensity (albeit on different pitches). It might seem a bit ethnocentric, then, to assume that metrical systems are found in every spot on the globe.

Nevertheless, there is a growing body of evidence in phonological research to suggest that metrical systems participate in many more processes of speech production than stress assignment alone. Evidence of this sort merits inclusion in the present discussion, since it helps to demonstrate the wider utility of metrical structure in domains of phonology other than stress assignment. In particular, we will consider next the successes of metrical theory in the analysis of reduplication and vowel shortening processes.

¹See Hyman 1978 for one proposal.

1.1.1 Reduplication in Yidinŷ and Manam

McCarthy and Prince 1986 (M&P '86) offer a detailed theory of the role which prosodic structures (syllables, feet, minimal words) play in morphological operations. In particular, they discuss examples of reduplication from many languages in which the copied string is longer than a single segment or syllable. One such case is Yidinŷ (Australia), which has a reduplicative verbal prefix.

(1) Yidinŷ verbal reduplication

mulari	mula-mulari	'initiated man' (M&P 35)
kintalpa	kintal-kintalpa	'species of lizard'
kalamparaa	kala-kalamparaa	'March fly'

The reduplicated string in Yidinŷ cannot be characterized in terms of a certain number of segments (i.e. consonants and vowels; hereafter abbreviated as 'C' and 'V'). In the first and third examples the copied string is four segments long (CVCV), whereas in the second example the copied string is five or six segments long (CVCVC or CVCCVC, depending on how one analyzes the structure of the nasal-obstruent cluster [nt]).² Why are only four segments copied in the first and third examples? This is not so because there is no fifth segment to be copied: one could conceivably generate the form *mular-mulari. This shows that the reduplicative operation is not simply counting segments. The correct generalization for

²McCarthy and Prince 1986 rehearse arguments from Nash 1979 for treating nasal-consonant clusters such as [nt] or [mp] as prenasalized stops in this language, not as clusters of two consonants.

Yidinŋ is that the first two syllables of the word are copied and prefixed to the word.

A similar – but not identical – reduplicative operation takes place in Manam. Manam reduplication differs from Yidinŋ in two ways: first, the copied string is suffixed to the word, not prefixed; and second, the copied string is two moras long, not two syllables.

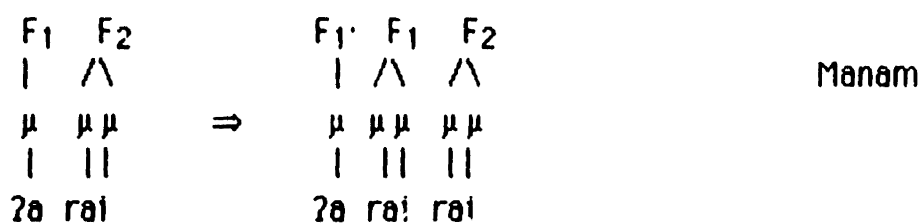
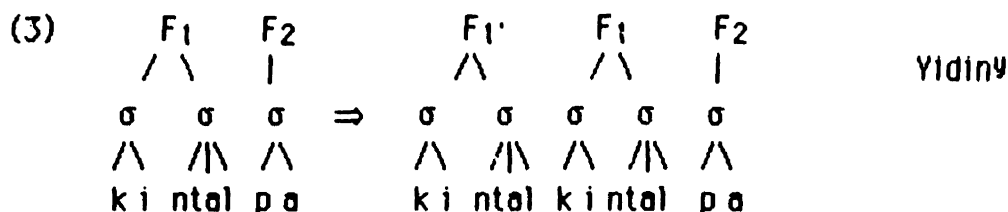
(2) Manam

salaga	salaga-laga	'long'	(M&P '86, 39)
moita	moita-ita	'knife'	
ʔarai	ʔarai-rai	'species of ginger'	
laʔo	laʔo-laʔo	'go'	
malaboŋ	malabom-boŋ	'flying fox'	
ʔulan	ʔulan-laŋ	'desire'	

Again in Manam, one cannot express the reduplication operation by referring to the number of segments copied. Copied strings take all possible shapes: CVCV, VCV, CVV, and CVC. Instead, the correct generalization is that the last two moras (and their associated onsets) constitute the string to be suffixed.

McCarthy and Prince 1986 conclude that morphological operations such as reduplication do not have the ability to count up segments. Rather, morphological operations are most accurately stated in terms of higher level prosodic structures. That is, an operation such as reduplication may affix a single unit of structure – foot or syllable, for example – to a word. The condition that only single prosodic units may be operated upon prohibits one from stating operations in terms of multiple units, such as two syllables or three moras. For example, the reduplications of Manam and

Yidinŷ must be stated as the affixation of a binary (bimoraic or bisyllabic) foot to the word, not as the affixation of two syllables or moras.³



The difference between reduplication in the two languages (besides the direction of affixation) is that Yidinŷ builds binary feet over syllables, whereas Manam builds binary feet over moras. This is a well-established parameter of metrical theory (see below).⁴

Evidence for the presence of binary foot structure in Manam is found in the placement of stress. Stress in Manam usually falls on the penultimate mora (M&P '86).

- | | | |
|-----|----------|--------------|
| (4) | siŋába | 'bush' |
| | soʔái | 'tobacco' |
| | lúnta | 'moss' |
| | malabónŋ | 'flying fox' |

³F' is the abbreviation for the category 'Foot', 'μ' for 'mora'.

⁴In fact, a third difference between these languages is the direction of foot construction: right to left for Manam, but left to right for Yidinŷ. This will be explicated in the next section.

This fact supports the theory that Manam words are parsed into metrical constituents consisting of bimoraic feet: stress falls on the first mora of the final foot. It is this final foot which is copied in Manam reduplication.

Reference to metrical constituents allows for a simple statement of reduplication in Manam and YidinꞀ – simpler than a purely segmental approach.

1.1.2 Vowel length in Yidinŷ

Returning to the Australian language Yidinŷ, we find there an unusual process of vowel lengthening. The data below come from Hayes 1980, which are taken in turn from work by R. M. W. Dixon. The analysis to follow is a simplification of the theories offered in Hayes (1980, 197-f.) and Halle and Vergnaud (1987, 221-224).

There are four sources of long vowels in Yidinŷ. Three suffixes induce vowel lengthening: the antipassive suffix, the "going" aspectual suffix, and the "coming" aspectual suffix.

- (13) /wujaba/ --> wujaba:-dŷi-ŋ 'hunt-antipassive-past'
 /wawa/ --> wawa:-dŷi-ŋ 'sae-antipassive-past'

A second source of long vowels is the segment /y/ when it occurs in syllable-final position. This segment is deleted after the vowel /i/, triggering at the same time the lengthening of /i/: /galbiy/ 'catfish' surfaces as [galbi:].

A third source of long vowels is the lexicon: certain vowels must be treated as underlying long vowels, as for example the long vowels in durgu: 'mopoke owl-absolutive', galambara: 'march fly-abs.', and wara:buga 'white apple tree-abs.'. There is no other explanation for the length of these vowels other than to posit that they are lexically specified as such.

The fourth source of long vowels is a rule of penultimate lengthening. This rule lengthens a vowel in the penultimate syllable of a word, but only upon the unusual condition that the word contain an odd number of syllables. Consider the contrast in even- and odd-syllabled words below.

1.1.3 Meta-linguistic considerations

It has been shown above that metrical structure plays a role in a number of phonological processes and not only in stress assignment. One could multiply examples of metrical dependencies in morphological operations, vowel harmony, and other segmental processes. One might find it somewhat surprising, then, if there were no interaction between metrical structure and tonology.

But this argument for metrical dependencies in tone assignment is rather a preliminary one: it merely clears away certain initial scepticisms towards the reasonableness of extending metrical approaches to tone. Nevertheless, there are at least two stronger arguments to be made for the attempt to import "stress" into African languages.

The first comes from the nature of Universal Grammar. By Universal Grammar I mean the set of linguistic principles, heuristics, parameters, concepts, definitions, and assumptions with which every human is endowed by virtue of being human. The dictates of Universal Grammar guide learners of a language to the proper (albeit unconscious) formulation of the structure of their native language, as well as the means by which this structure – of sounds, words, phrases, and discourses – relates to other forms of learned or innate knowledge (i.e., the "real world").

Since Universal Grammar is by definition the genetic legacy of every speaker of the world's thousands of languages, one would expect to find in every language certain constant properties derivable from the nature of Universal Grammar. Such properties are the universals of Universal Grammar. By a "universal", I do not mean the sort of statistical tendencies that emerge from the very useful surveys by such renowned linguists as

Joseph Greenberg or Ian Maddieson. Rather, I mean the exceptionless universals that motivate notions such as the geometry of phonological features, proposed by G. N. Clements and E. Sagey. These linguists have hypothesized a structural representation for phonological segments which derives the fact that certain features of segments cluster together for the purposes of phonological operations, whereas others do not. For example, the features of tongue height and backness spread together in certain assimilations of adjacent sounds, but the features of nasality and roundness do not work together in any like fashion in any language. This universal of natural language is captured as such in the theory of Universal Grammar by positing a certain hierarchical arrangement of the features of phonological theory (cf. Sagey 1986).

Likewise in the theory of syntax, certain theories have attained some level of explanation by positing that Universal Grammar has particular syntactic dictates for all languages. One example is the theory of Case in Government and Binding theory. Not every language displays morphological marking for syntactic case on noun phrases. German, for example, shows a distinction among four cases in noun phrases and pronouns: nominative, accusative, genitive, and dative. English on the other hand only shows a nominative/accusative distinction with certain pronouns. Nonetheless, the fact that some languages do make use of case distinctions leads the theoretician to hypothesize that "Case" is a primitive of syntactic theory.⁵

⁵This sort of supposition is not uncommon. Consider, for example, the Latin case system as explained by most traditional grammars. Second declension nouns show a phonetic difference between the nominative and vocative cases: Marcus (est nauta) vs. O Marce!. This distinction does not show up in the other declensions; one form is used for both nominatives and vocatives. Nonetheless, grammarians do not therefore claim that the vocative case exists in Latin only in the second declension. Rather, they claim that there is a vocative form in the other noun declensions, but that it is phonologically identical to the nominative.

That is to say, language learners do not need to figure out the place of Case in the grammar of their language: the learner rather is "programmed" to expect the existence of Case-marking for any given language, even if that language shows no case distinctions in surface forms.

Case-marking, then, is an abstract universal feature of every natural language's grammar. Even when Case-marking does not show up in the surface structure of a language, it plays a role in the syntactic derivations of sentences in the language (as in English). The notion of abstract Case, for instance, has been employed to explain the tight strictures on word order in English (in contrast to a language such as Warlpiri – see Alexander 1989).

This leads us back to the question of metrical structure. Metrical rules are found in the grammars of many languages from very different language families. Thus, it is natural to assume that metrical parsing of sound strings is a universal property of human grammar. That is, language learners do not "discover" the use of metrical schemes in the grammar of their language; rather, they presume the existence of metricality in the language at hand. The constraints on metrical structure assignment are such that the number of potential metrical schemes for any given languages is finite, even small. It is the task of the learner simply to identify the salient features of the language which reveal the metrical scheme.

Given this view of metrical structure – that it is one of the universal properties of language – the phonologist is obliged to approach any particular language in a certain way. The phonologist should expect to find concrete manifestations of abstract metrical parsings, if not in the stress patterns of the language, then in the morphology or segmental phonology – or in the tonology. Furthermore, the linguist has a set of tools to bring to bear on the analysis of the abstract metrical schemes of a new language.

These are the tools of metrical parsing discovered in the course of research on previously studied languages. Some of these tools (i.e. rules and parameters) are catalogued below. Of course, some languages may employ metrical parsing in a rather trivial and uninteresting way. Why this should be so is a matter for students of language change and language typology.

This, then, is one positive argument for suspecting the presence of metrical dependencies in tone assignment: to wit, the ubiquity of metrical systems in the world's languages suggests that metrical parsing is a property of Universal Grammar, an abstract property with concrete consequences in every human language, even in the Bantu languages.

A second argument in defense of metrical approaches to tone languages comes from considerations of learnability. Tone systems are some of the most complex components of a language, as any tonologist will attest. There has not infrequently been difficulty merely in describing the patterns of certain tonal constructions, to say nothing of actually providing a theoretical explanation for the tone patterns. The theory of autosegmental phonology defended by John Goldsmith in his 1976 dissertation was a profound conceptual advance in the theory of tonology. Many problems related to learnability remain, nonetheless.

Consider the situation from the point of view of the language learner. Linguists posit the presence of universal abstract constituencies, relations, and categories which the learner brings to the task of figuring out the syntax of the language. In fact, it is difficult to conceive of a person learning a language without some such pre-conceived notions. One cannot directly argue that the same situation obtains in the learning of tone patterns. That is, it cannot be derived as a theorem that one must posit metrical structures in order to decipher the tone system of a language. At

best one can simply demonstrate the utility of such a device in the analysis of a given language. Again, it cannot be proved mathematically that a tone system is unlearnable apart from a metrical approach: instead, one must try to show the relative simplicity of description attained by using metrical schemes of analysis.⁶ That is the goal of the present work.

The question of learnability and Universal Grammar will be taken up again in the last chapter.

⁶The reader is advised to pay heed to the word "relative" in this clause. I cannot claim that the analyses to follow will be simple (according to any a priori notion of simplicity, whatever that might be). Indeed, the metrical analyses I offer in the following chapters are still very complex (perhaps unlearnably so). Nonetheless, I do claim that the metrical approach is simpler than any non-metrical one which suggests itself in the present paradigm of phonological theory.

1.2 What is metrical structure?

One can find in the literature various notions of what metrical structure is. It is not within the scope of this work to present a survey of the different conceptions of metrical structure. I limit the discussion below to the conception of metrical structure which is employed throughout this work, touching on competing notions only for the sake of clarification of my own conception. A full discussion of metrical structure (as conceived in this work) is to be found in An Essay on Stress by Morris Halle and Jean-Roger Vergnaud (1987).

To start, metrical structure is not identical to phonetic stress. That is, metrical prominence (i.e. head of a metrical foot) must not be construed as acoustic prominence. An asterisk '*' in a metrical grid is not short-hand for such features as [+increased volume], [+high pitch], [+intensity], or however one might define "stress" in a phonetic description. Metrical structure is not "stress" in this sense. Rather, phonetic stress is calculated off of metrical structure, much in the same way that consonant mutations (devoicing, lenition) are calculated off of syllable structure. Yet metrical structure, like syllable structure, is an abstract phonological construction with no direct phonetic correlates.

In fact, it is most appropriate to introduce metrical structure by referring to other sorts of abstract structure by which linguists represent elements of speech. Consider syntactic structures, for example. It is (almost) universally accepted that an adequate theory of syntax must recognize the existence of constituents, commonly called phrases. For examples, the sentence in (17) is made up of a number of smaller constituents.

(17) [the dog] [ate [chapter 3 [of my thesis]]]

The major divisions of sentence (17) are the subject noun phrase [the dog] and the predicational verb phrase [ate chapter 3 of my thesis]. The verb phrase is composed moreover of the verb and the object noun phrase [chapter 3 of my thesis]; the object noun phrase in turn is composed of a noun and the prepositional phrase [of my thesis]. The prepositional phrase in turn is composed of a preposition and the noun phrase [my thesis].

These various constituents – the noun phrases and verb phrase – all have “heads”. Very loosely, the heads of the noun phrases are the nouns and the head of the verb phrase is the verb. Syntactic heads contribute various features to the constituent of which they are the heads, features such as category or number or gender, etc. They are, in a sense, the most “prominent” element of their respective constituents.

Note, however, that the notions “constituent” and “head” are separable notions. It is possible for a constituent to be a constituent without having a head. Examples of such exocentric, or headless constituents are idioms, such as the congratulatory phrase ‘Good for you’. This phrase is not adjectival (like ‘good’), prepositional (like ‘for’), or nominal (like ‘you’). It has rather the function of a proposition, such as “I approve of you”. The phrase has no syntactic head, yet it forms a single constituent. One likewise finds derived words which have no heads, but clearly act as a single constituent (viz., a word): ‘man-o-war’, ‘hotdog’, ‘ne’er-do-well’.

Just as strings of words can be parsed into syntactic constituents (with heads), strings of phonemes can be parsed into constituents of

²See Di Sciullo and Williams 1987 for further discussion of headship and constituency.

various types. One such abstract parsing is syllable structure construction, whereby consonants and vowels are grouped into headed constituents according to certain parametrized rules. Metrical constituents are yet another sort of abstract structure imposed on strings of phonemes. Just as syntactic constituencies are used to calculate barriers to government or binding domains, and just as syllabic constituencies are used to determine metrical feet, so metrical constituencies are used to calculate stress assignment, reduplication, and so forth.

Syntactic constituents are constructed according to a small, well-defined set of parameters: e.g., are heads left-peripheral or right-peripheral in the phrase? Metrical constituents are likewise constructed according to a small set of parameters.

- (18) Some parameters of metrical structure assignment:
 - a. What units are metrically significant:
 - vowels, rime elements, syllables?
 - b. Are constituents right- or left-headed?
 - c. In which direction are constituents calculated:
 - right to left, or left to right?
 - d. Are constituents bounded or unbounded in size?
 - e. Do some elements have special status:
 - as heads (heavy syllables, long vowels)?
 - as extrametrical (peripheral elements)?

These are the questions which the language learner must answer in order to discover the metrical scheme of his native language. Let us turn now to illustrations of these options.

1.3 The elements of metrical structure

Although I have claimed above (and will demonstrate below) that metrical structure assignment is formally distinct from stress assignment, I will appeal almost exclusively to stress phenomena from various languages to illustrate the workings of metrical structure rules. This is a natural move to make, given that there is a larger and better understood body of evidence for the workings of metrical structure in stress assignment than in other prosodic or morphological operations. Metrical theory developed from endeavors to understand stress patterns in language, and only recently has the theory been extended to explain phenomena such as reduplication.

This history of metrical theory has biased the terminology somewhat. Thus, it is common to speak of a syllable with idiosyncratic metrical prominence (headship) as being a "stressed" syllable, although, properly speaking, stress is the phonetic interpretation given to said syllable by virtue of the fact that it is metrically prominent. This (inconsistent) use of terminology is pointed out below. No confusion need result from this usage.

1.3.1 Metrically significant units

The desideratum of linguistic theory is finding a system for representing speech phenomena which is simple yet illuminating. Various representations have been proposed for metrical structures: tree, lollipops, and asterisks are familiar to many phonologists. The system of representation chosen for this work is taken from Halle and Vergnaud's 1987 compendium of stress assignment analyses. This system represents

the notions "constituent" and "head" discussed above in a way that is both simple and predictive.

Some simple English words allow a good entry-point for the discussion of metrical representations. Following Halle 1989 (who in turn follows Liberman 1974), let us say that stressed syllables in English are syllable which are heads of metrical constituents. Words such as ápalàchicóla and mississippi have one main stress and other secondary stresses. Each stressed syllable is the head of a constituent, where constituents are marked off – as in syntactic representations – by brackets or parentheses.⁸

(19) (àpa)(làchi)(cóla) (míssi) (ssíppi)

These representations show that English metrical constituents generally consist of two syllables, and it is generally the syllable on the left which is the head of the constituent and therefore receives phonetic stress.

What the representations in (19) do not show explicitly is that metrical constituents are built of two syllables in English. Languages differ, however, in the prosodic units over which constituents are built. As shown above, Manam metrical constituents are built of two moras (or perhaps, two elements in the syllable rime).

(20)	(si) (hába)	'bush'
	(so) (háí)	'tobacco'
	(lúnta)	'moss'
	(mala) (bón)	'flying fox'

⁸The stress patterns of these two English words is somewhat anomalous in that it is penultimate; I ask the reader to permit my oversimplification of the derivation of these words for the sake of exposition.

As in English, it is the left member of a (final) constituent in Manam which receives the most phonetic stress. However, the constituents themselves are calculated in terms of moras: a single syllable containing two moras counts as an entire constituent: cf. (ʔáɪ) and (bón). If Manam metrical constituents were built in terms of syllables as in English, then one would predict the following stress assignments: *(sóʔaɪ) and *(má)(láboŋ).

Languages differ as to what sort of prosodic unit is significant for the construction of metrical feet, and the representations in (19) and (20) need to be modified to reflect this fact. Halle and Vergnaud 1987 propose the introduction of a level of structure in the representation, the metrical tier. This tier marks off metrically significant elements by associating them with an asterisk. Constituency is then marked off in terms of the asterisks.

(21)	(**)(* *)(* *)	(* *) (* *)
	a pa la chi co la	missi ssippi
	(*)(**)	(* *)(* *)
	so ʔa i	má la bóŋ

For English metrics, an asterisk is assigned to each syllable, whereas in Manam an asterisk is assigned to each element in the rime of a syllable. Constituents are then defined in terms of metrically significant elements, or asterisks, in our short-hand. For each language, then, the first rule of metrical structure assignment is the definition of the kind of prosodic unit which is metrically significant.

1.3.2 Directionality of headedness

Another way in which metrical systems differ is in whether the leftmost element or the rightmost element of a constituent is stressed. In English and Manam it is the leftmost element in the two-membered (hereafter "binary") constituent which receives the feature of phonetic stress. Weri is a language in which the rightmost element of a binary constituent is phonetically stressed. Weri is like English in that syllables are the metrically significant elements (data from Kenstowicz 1988).⁹

(22)	(* *)		(*)(* *)
	ŋin típ	'bee'	kù li pù 'hair of arm'
	(**)(**)		(*)(**)(**)
	u lù a mít	'mist'	à ku nè te pái 'times'

Again, the representation should somehow encode the difference between English and Manam on the one hand, and Weri on the other hand. This is done by marking the salient asterisk in the metrical tier in a special way, showing that it has metrical prominence, i.e., is the head of the binary constituent. Halle and Vergnaud mark the head of the constituent by adding another asterisk to the vowel.

(23)	* * *	* *	--line 1
	(* **)(** *) (** *)	(* *) (* *)	--line 0
	o pò la chi co lo	missi ssiippi	

⁹As in English and Manam, binary constituents in Weri are constructed from right to left. This is discussed directly.

* *
 (**)(* *)

u lù a mít

* * * --line 1
 (**)(* *) (** *) --line 0

à ku nè te pái

This move is somehow intuitive: if an asterisk denotes metrical prominence, then two asterisks denotes a higher degree of metrical prominence. The lowest line of asterisks, those significant for foot formation, is called "line 0". The next line up is "line 1". Many languages have degrees of metrical prominence defined at levels higher than line 1. This will not concern us for the present discussion.

It is important to note again here that the line 1 asterisk is not simply short-hand for notating a vowel with some feature of stressedness, such as [+level 1 stress]. The asterisk is not a feature like [±round] or [±continuant] are features; rather, the asterisks and brackets of metrical structure are autonomous phonological units. They exist (in theoretical terms) independently of the vowel to which they are associated. That is, if the vowel associated with a line 1 asterisk is deleted, the line 1 asterisk often persists and becomes associated with a neighboring vowel.¹⁰ Likewise, the line 1 stress mark (asterisk) may be deleted without the concomitant deletion of the associated vowel. This is not the case generally with segmental features: the deletion of the segment usually entails the deletion of every feature contained therein. Thus, elements of metrical structure, like elements of syllable structure, should not be construed as segmental features, but as distinct phonological entities.

A second parameter of metrical structure assignment, then, along with defining the metrically significant elements, is determining whether

¹⁰See Al-Mozainy, Bley-Vroman, and McCarthy 1985 for examples of asterisk persistence in connection with vowel deletion.

the constituents are left-headed or right-headed. If line 0 constituents are left-headed, then the leftmost asterisk in line 0 may receive a line 1 asterisk, and vice versa for right-headed line 0 constituents. If a constituent is unary – contains only one element – then that single element receives the line 1 asterisk, since it is trivially also the rightmost and leftmost element in the foot.

1.3.3 Directionality of constituent construction

Yet another parameter of metrical theory is the direction in which binary constituents are constructed. This question comes up in words where there is an odd number of line 0 asterisks to be grouped into binary constituents, since one asterisk will always be left over. What happens in such situations?

Let us consider the data of Weri again. The two words in the left column have an even number of syllables: for these it does not matter whether one starts with the leftmost or the rightmost syllable for the purposes of making bisyllabic feet.

(24)	*		*		*	*
	(* *)				(**)(* *)	
	ŋin tɪp	'bee'			kù li pú	'hair of arm'
	*		*		*	*
	(**)(**)				(**)(* *) (** *)	
	u lù a mít	'mist'			à ku nè te pál	'times'

The words in the right column have an odd number of syllables. In these words it becomes evident that one must start at the right end of the word and work leftward in the process of building binary constituents. If one began at the left edge of the word, the righthanded constituents would result in stress being assigned to the even-numbered syllables: **kuliúpú* and **akùnetèpál*.

(25)	*	*		*	*	*
	(* *)	(*)		(* *)	(* *)	(*)
	ku	li	pu	a	ku	ne te pál

One might suggest that constituents are built from left to right, as in (25), but that they are left-headed, not right-headed. This move, however, makes the false prediction that stress will always be on the odd-numbered syllables, counting from the beginning of the word. This is incorrect, as the words with an even number of syllables show: *nintio and *ùluómit. The correct generalization is that stress falls on the odd-numbered syllables counting from the right edge of the word. This stress pattern is generated by building binary, right-headed feet from right to left, with the results shown in (24) above.

Some languages construct constituents in the other direction, from left to right. One such language is Maranungku. In this language stress falls on odd-numbered syllables counting from the left edge of the word (data from Kenstowicz 1988).

(26)	tíralk	'saliva'
	mérepèt	'beard'
	lángkaràtetì	'prawn'
	wélepènemànta	'species of duck'

Line 0 asterisks are assigned to each syllable in Maranungku. Binary constituents of line 0 asterisks are then constructed from left to right. Constituents are left-headed: the leftmost element in each binary constituent is receives a line 1 "stress" (i.e. asterisk).

(27) * * * * * (* *)(**)(*)
 la.ngka.ra.te.ti --> la.ngka.ra.te.ti --> la.ngka.ra.te. ti -->

 * * * --line 1
 (* *)(* *) (*) --line 0
 la.ngka. ra.te. ti

Directionality of constituent construction is then a third parameter of metrical systems.

Stress falls on all odd numbered syllables counting from the beginning of the word, but the first syllable has a higher degree of stress (marked with an acute, \acute{V}) than the other stressed syllables, which have secondary stress (marked with a grave, \grave{V}). This higher degree of phonetic prominence for the first syllable indicates that the first syllable also has a higher degree of metrical prominence. This fact is notated by adding yet another asterisk to the column of asterisks over the first syllable.

*			--line 2	
*	*	*	--line 1	
(*	*)	(*	*)	--line 0
la.ngka. ra.te. ti				

The additional line 2 asterisk in Maranungku always occurs with the leftmost line 1 asterisk. This fact entails that the line 1 asterisks are grouped into a constituent which is left-headed; the line 2 asterisk is added as the head of the line 1 constituent. The full set of metrical structure rule for Maranungku is given in (29).

- (29) Maranungku metrical structure assignment
- i. Assign a line 0 asterisk to each syllable.
 - ii. Line 0 constituents are bounded and left-headed.
 - iii. Construct line 0 constituents from right to left.
 - iv. Locate the heads of line 0 constituents on line 1
 - v. Line 1 constituents are unbounded and left-headed.
 - vi. Construct line 1 constituents.¹²
 - vii. Locate the heads of line 1 constituents on line 2.

These rules apply in the following fashion.

¹²Directionality of foot construction does not matter for unbounded constituents.

line 0-- * * * * * (* *) (**) (*)
 la.ngka.ra.te.ti --> la.ngka.ra.te.ti ---> la.ngka. ra.te. ti -->
 i ii,iii iv

line 2--
 line 1-- * * * (* * *)
 line 0-- (* *)(**)(*) (* *)(**)(*)
 la.ngka. ra.te. ti --> la.ngka. ra.te. ti -->
 v,vi vii

line 2-- *
 line 1-- (* * *)
 line 0-- (* *)(**)(*)
 la.ngka. ra.te. ti

1.3.5 Extrametricality

As was shown above, some languages, like Latvian and French, have only one stressed syllable in the word no matter how many syllables are in the word. Latvian and French have the single word stress on the first and last syllable, respectively. There are other languages which resemble these languages in having only one stress per word, but which differ in having the stress on the penultimate or peninitial syllable rather than the ultimate or initial syllable.

One such language is Dakota. Stress falls on the second syllable of the word (with certain well-defined exceptions), or on the only syllable in monosyllabic forms (data from Shaw 1985, 175).

(30) Dakota

kté	'he kills'
wə-kté	'I kill'
mə-yá-kte	'you kill me'
wičhá-ya-kte	'you kill them'
o-wičhá-ya-kte	'you kill them there'

The first syllable is systematically passed over in the stress assignment algorithm, unless it is the only syllable in the word – [kté]. The second syllable is then made the head of an unbounded left-headed constituent.

Many languages have such a system in which an initial or final syllable is systematically ignored. This operation of skipping over a peripheral element is called "extrametricality": the designated syllable stands "outside" of the metrical system. Extrametrical elements are conventionally set apart by angle brackets '<>'.

Dakota grammar marks the first syllable of a polysyllabic word as extrametrical.¹³ Then a single left-headed and unbounded foot is constructed over the rest of the word.

*
* * * * (* * * *)

<0.> wí. čha. ya. kte --> <0.> wí. čha. ya. kte --> <0.> wí. čha. ya. kte

As a result of extrametricality, the second syllable receives the word stress.

Extrametricality also applies in languages which construct bounded (binary) line 0 constituents. The English word 'extrametricality' is an example of extrametricality in a binary system. The final syllable is marked extrametrical.

ex. tra. me. tri. ca. lí. <ty>

Line 0 asterisks are assigned to the remaining syllables.

* * * * *
ex. tra. me. tri. ca. lí. <ty>

Binary constituents are constructed from right to left.

(* *) (* *) (* *)
ex. tra. me. tri. ca. lí. <ty>

¹³By universal convention, extrametricality fails to apply if it would render the entire domain extrametrical, as with the monosyllable [kte]. Also by universal convention, extrametricality applies only to peripheral elements: elements not on an edge of the string cannot be marked extrametrical.

These line 0 constituents are left-headed; their heads are located on line 1.

```

*      *      *
(*    *) (*  *) (*  *)
ex. tra. me. tri. ca. li. <ty>
```

Lastly, an unbounded, right-headed constituent is constructed on line 1, with the head located on line 2.

```

*
(*      *      *  )
(*    *) (*  *) (*  *)
ex. tra. me. tri. ca. li. <ty>
```

This metrical structure is interpreted phonetically as secondary stresses on the first and third syllables, and primary stress on the fifth syllable (the antepenult): extramètricality.

Extrametricality is a well-motivated device, found in the grammars of many languages for metrical, segmental, and syllabification processes.

1.3.6 Idiosyncratic head marking

Extrametricity causes certain prosodic units to lose all metrical significance at some point in the phonology. One also finds stress patterns in which certain syllables are made more prominent than other syllables. Most often there is a relation between syllable weight and idiosyncratic stress: long vowels or heavy syllables are given special metrical status in many languages. English is one language which treats syllables with branching rimes in a special manner.

The preceding derivation of 'èxtramètricáality' above shows that the rules of English metrical structure will put the main stress on the antepenultimate (third from the end) syllable, all other things being equal (data from Halle and Vergnaud 1987, 227).

(31) jávelín Amérian oríginál
Cánada alúminum pèrsonál

Some words, however, have main stress on the penultimate syllable. The penultimate syllable in such words generally has a branching rime (i.e. long vowel or closed syllable).

(32) agénda conúndrum maríno
cerébrum ànecdótal uténsil
paréntal Àrizóna muséum

The metrical rules discussed so far for English predict that main stress should always be found on the antepenultimate syllable: the final

syllable is marked extrametrical, and then left-headed feet are constructed from right to left.

* *	(* *)	*
pa ren <tal> -->	pa ren <tal> -->	pa ren <tal>
		(* *)
		>> other rules>> *párental

The reason for the penultimate main stress is the weight of the penultimate syllable. English has a rule which assigns a line 1 asterisk to a syllable with a branching rime.

(33) Assign a line 1 asterisk to a syllable with a branching rime.

Rule (33) applies after extrametricality but before the constituent construction rules. Rule (33) in effect defines a heavy syllable as an obligatory metrical head. Because line 0 constituents are left-headed in English, this head must always be the leftmost element in its constituent.

Constituent construction is constrained by the presence of idiosyncratic heads. If normal right to left constituent construction would place the idiosyncratically stressed syllable in non-head position in the constituent, then the construction is interrupted. The obligatory head is parsed as a unary constituent, and constituent construction then proceeds as normal from that point in the string.¹⁴

¹⁴The fact that metrical rules "respect" previously assigned asterisks is formally reflected by the Faithfulness Condition (H & V 1987, 15-16).

* * * * *

parental --> extrametricality--> paren <tal> -->(33)--> pa ren <tal>

* *
(*)(*)

-->constituent const.--> pa ren<tal> --> --> paréntal

The formalism developed so far allows another conceivable means by which one can ensure that heavy penultimate syllables in English receive the main stress. Rather than positing a rule which assigns a line 1 asterisk to a specified element on line 0 (namely, one which dominates a branching rime), one could instead posit an alternative rule which inserts a left boundary bracket before the relevant line 0 asterisk.

(33') Insert a left metrical bracket before the line 0 asterisk of a syllable with a branching rime.

Rule (33') leads to the same surface form in the derivation of 'paréntal', but by a different route.

* * * * *

parental --> ex'ity--> paren <tal> -->(33')--> pa ren <tal>

(*)(*)

-->constituent const.--> pa ren<tal> --> line 1 heads-->

* * * * *

* *
(*)(*)

pa ren<tal> -->line 2 head--> pa ren <tal> --> paréntal

The first syllable of 'parental' loses its line 1 stress by a general rule of English phonology, whereby a light syllable is destressed before a stressed syllable. For this reason there is no secondary stress on the first syllable (cf. Halle and Vergnaud 1987, 238).

The notion of bracket insertion rules is a rather recent innovation in metrical theory. Halle 1988 proposed rules of bracket insertion in favor of idiosyncratic stress assignment for languages like Cairene Arabic and Yupik Eskimo. Very briefly, the reason for this proposal is the fact that some languages do not allow syllable-internal foot boundaries (where heavy syllables contain two metrically significant elements, or moras). That is, Cairene Arabic does not allow the following representation in any context for a word such as muqaatilátuhu.¹⁵

(34a)	$\begin{array}{c} * \\ (* \quad * \quad * \quad) \\ (* \quad *) (* \quad *) (* \quad *) \\ \text{mu qa} \quad \text{a ti} \quad \text{la tu} \langle \text{hu} \rangle \end{array}$	<p>--line 2</p> <p>--line 1</p> <p>--line 0</p>
	<p>= <u>*muqaatilátuhu</u></p>	

This is somewhat unexpected. The facts of Cairene stress indicate that rime elements (moras) are the units of metrical significance; the final rime is extrametrical, and binary left-headed feet are constructed from left to right (cf. Halle and Vergnaud 1987, 60-63). The line 1 constituent is unbounded and right-headed. These rules should produce the representation in (34): *muqaatilátuhu.

¹⁵In this language only the mora with highest metrical prominence receives the feature of phonetic stress; there are no secondary stresses in Cairene.

This is not the correct result, however. Stress falls on the penultimate syllable in such a word: mugaatilatúhu. Further considerations lead Halle 1988 to conclude that the problem with the representation in (34) is that a line 0 foot boundary occurs between two moras of the same syllable (qa-a). If one ensures that the two moras of the long vowel fall in the same binary foot, then foot construction proceeds as desired.

(34b)	*	--line 2
	(* * * *)	--line 1
	(*) (* *) (* *) (*)	--line 0
	mu qa a ti la tu <hu>	

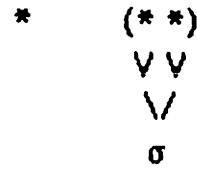
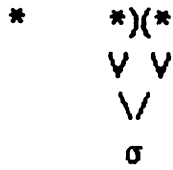
This raises the question of how one ensures that foot boundaries correspond to syllable boundaries. One could posit a rule for Cairene which assigns a line 1 asterisk to the leftmost mora in a heavy syllable; this would guarantee that the two moras of a branching rime would end up in the same left-headed binary foot. Halle (1988, 15) counters this proposal, however:

This solution implies that we might encounter a language exactly like Cairene where feet are left-headed, yet where the stress on bi-moraic syllables is assigned by rule to the right mora so that the two moras of a heavy syllable will always be in distinct feet. ... Such a language has never been encountered and should be ruled out as a matter of principle.

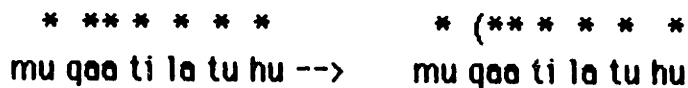
In other words, one finds languages in which tautosyllabic moras must be in the same foot (35a), but no language has been found in which tautosyllabic moras must be in different feet (35b).

(35) a. possible constraint

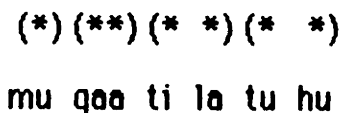
b. impossible constraint



Halle 1988 proposes that the tautosyllabic constraint (35a) should be stipulated in grammars as a rule which groups tautosyllabic moras into a foot before all other foot construction procedures. This grouping is accomplished by inserting a metrical boundary bracket in the string to coincide with a syllable boundary (before the heavy syllable).



The subsequent constituent construction rules must respect the previously assigned bracket, grouping the first mora into a unary foot and the tautosyllabic moras of the second syllable into a binary foot.



The rest of the rules derive the structure in (34b).¹⁶

I adopt the device of metrical boundary insertion for the analyses of Digo and Sukuma offered below. Sukuma is shown to resemble Cairene Arabic in having a constraint like (35a) which prohibits tautosyllabic moras

¹⁶The remaining rules of Cairene can be found in Halle and Vergnaud's discussion of Cairene (60-63).

from being in different feet. Digo is shown to have a rule which inserts a metrical boundary bracket before the last syllable of a special class of nouns.

1.3.7 Cyclicity and Stress Erasure

In this work I adopt some of the basic premises of the theory which is known as Lexical Phonology. Specifically, I assume that a pair of two-way distinctions exist for rules of the grammar.

Rules may apply in two separate levels of the grammar: word-internal rules apply only to phoneme strings within the domain of a single word; word-sequence rules apply to phoneme strings both inside and across word boundaries. This latter type of rule is also called a phrase-level rule in the present study. A rule may belong to both classes: that is, a specified rule may apply both in the word-internal component of the grammar as well as the phrase-level component.

Rules also may apply in two different manners with respect to the morphological constituency of a phoneme string. Cyclic rules apply to the innermost constituent first, and then to each subsequent constituent formed by the addition of various morphemes. That is, to a phoneme string made up of n parts (morphemes, words), a cyclic rule will apply n times, once to each subconstituent, including the whole string.

(36) String: [[[A] B] C]

Cycle 1 – rule R applies to constituent [A]

Cycle 2 – rule R applies to constituent [A B]

Cycle 3 – rule R applies to constituent [A B C]

Noncyclic rules apply only once to the entire phoneme string under consideration: morphological composition is not a factor in noncyclic rule

application.¹⁷ Cyclic rules are ordered before noncyclic rules in the grammar: this fact, in combination with the word-internal/word-sequence distinction leads to a four-way division in rules types, applying in the following order.

(37) Outline of phonological derivations:

Word-level rules

Cyclic (Rule₁, R₂, R₃, ...)

Noncyclic (Rule₄, R₅, R₆, ...)

Phrase-level rules

Cyclic (Rule₇, R₈, R₉, ...)

Noncyclic (Rule₀, R_n, ...)

In the word-level phonology there is also a distinction between two types of affixes to words/stems. An affix may either be cyclic, in which case it undergoes the cyclic set of rules, or noncyclic, in which case the affix undergoes only the noncyclic set of word-level rules. These distinctions are illustrated by ancient Greek stress below, and appear as well in the analysis of Digo in Chapter Three.

It has been found that metrical structure rules apply differently as cyclic rules than as noncyclic rules. To be precise, the cyclic application of a metrical rule causes the erasure of previously assigned metrical structure: for each cycle of the string, the metrical rules apply as if no previous metrical structure existed for the string. This behavior is known

¹⁷Interested readers should consult the following works for further exposition of the theory of Lexical Phonology: Halle and Vergnaud 1987, ch. 3, Mohanan 1982, Mascaró 1978, Kiparsky 1984.

as cyclic Stress Erasure. Noncyclic affixes, on the other hand, respect metrical structure assigned at an earlier level of the derivation.¹⁸

The operation of cyclic Stress Erasure can be illustrated from the phonology of ancient Greek; the following simplified discussion is due to Steriade 1988. Stress assignment in Greek can be summarized as follows: ignoring a final consonant, if the final syllable is heavy, stress the penult; else stress the antepenult. The Greek words in (38) illustrate this generalization. (The transcriptions are orthographic, not phonetic.)

- (38) Heavy final syllable (CVVC or CVCC)
- | | |
|---------------|-----------------------|
| astugeítoon | 'near a town' |
| oikodespótees | 'master of the house' |
| oikophúlaks | 'house-guard' |

- "Light" final syllable (CV or CVC)
- | | |
|------------|----------------------|
| epítheema | 'cover, lid' |
| parádeigma | 'pattern, example' |
| anápnēsis | 'recovery of breath' |
| ánthroōpos | 'human' |

These stress patterns are generated by the following rules of metrical structure assignment.

- (39) Ancient Greek stress rules
- i. Mark a final consonant extrametrical.
 - ii. Mark a final light syllable extrametrical.
 - iii. Assign a line 0 asterisk to every syllable.
 - iv. Line 0 constituents are binary and left-headed.
 - v. Construct line 0 constituents from right to left.
 - vi. Locate heads of line 0 constituents on line 1.
 - vii. Line 1 constituents are unbounded and right-headed.

¹⁸See Halle and Vergnaud, chapter 3, for a formal proposal of the geometry of cyclic stress assignment. See Harris 1989a for an apparent counterexample to cyclic Stress Erasure in Spanish.

- viii. Construct constituents on line 1.
- ix. Locate the heads of line 1 constituents on line 2.
- x. Delete all secondary stresses.

Derivation of these stress patterns is straightforward. Rules (39i-iii) have the following outputs.

* * * *	* *	--line 0
oi ko phu lak <s>	an throo <po<s>>	

The remaining rules apply, building constituents on lines 0 and 1, and locating heads on lines 1 and 2.

*	*	--line 2
* *	*	--line 1
(* *) (* *)	(* *)	--line 0
oi ko phu lak <s>	an throo <po<s>>	

The stress rules of (39) have the result that stress goes as far back as the antepenult if the final syllable has the shape CVC or CV, else stress falls on the penult.

Certain words do not fit into this generalization, however. Stress falls on the final syllable in some of these exceptional words (40a); in others, stress falls on the penult even though the final syllable is light, and not on the antepenult as expected (40b).

- | | | | |
|------|----|----------|------------|
| (40) | a. | hodós | 'road' |
| | | agathós | 'good' |
| | | pistós | 'faithful' |
| | | gnootós | 'known' |
| | | didaktós | 'taught' |
| | | odoús | 'tooth' |

khitoón	'tunic'
georgós	'farmer'

b.	kleeronómos	'recipient of an inheritance'
	*kleerónomos	

These unusual stress patterns are not predictable from the segmental makeup of the words; the stress of these words must simply be stipulated in their lexical entries. In the theory of metrical structure advanced here, this is accomplished by positing inherent (lexically specified) stresses in underlying representation over the appropriate vowel.

(41) underlying forms

	*		*	--line 1
a	ga	thos	klee	ro no mos

The metrical structure rules (39) must respect these lexically assigned stresses in the formation of constituents.

	*		*	--line 2
*	ga	thos	*	ro
			*	no
(a ga)	(thos)	(klee ro)	(no)	<mo<s>>

Because line 1 constituents are right-headed, the rightmost line 1 asterisk "wins." In the case of the words in (40), the rightmost line 1 asterisk is the inherent one.

The addition of certain prefixes to these words causes them to lose their idiosyncratic stresses; the stress falls in the expected place – on the penult if the final is heavy, else on the antepenult.

(42) a.	eís-hodos	'entrance'
	pan-ágathos	'absolutely good'
	á-pistos	'unfaithful'
	arí-gnootos	'well known'
	auto-dídektos	'self-taught'
	kun-ódous	'canine tooth'
	oio-khítoon	'wearing only a tunic'
	sung-géoorgos	'fellow farmer'
b.	a-kleerónomos	'not a recipient of an inheritance'

A prefixed word is treated as a word without any lexical stresses. The rules of metrical structure do not respect the lexical asterisks which were posited for these words in their unprefixated forms.

This sort of alternation is familiar from the cross-linguistic study of stress.¹⁹ Cyclic affixes "undo" metrical structure, triggering the re-application of the metrical rules to the entire domain. Non-cyclic affixes leave previously assigned metrical structure unchanged; in conjunction with non-cyclic affixes metrical rules apply only to unmetrified domains, not to the entire word.

In Greek, then, the prefixes in (42) are cyclic affixes. The concatenation of these affixes wipes out the lexically assigned line 1 asterisk of the base words.

*	
klee ro no mos	--> a + klee ro no mos
*	
a ga thos	--> pan + a ga thos

¹⁹See especially Halle and Vergnaud's (1987, ch. 3) discussion of Stress Erasure in Sanskrit.

Subsequent to Stress Erasure on the prefix's cycle, the metrical rules apply to the word, stressing the antepenult (or the penult when appropriate).

Not all affixes in ancient Greek are cyclic and stress-erasing. Derivational affixes are, but inflectional affixes are not. For example, the nominative case suffix /-s/ in words such as kleeronómos and agathós does not cause the erasure of the lexical line 1 asterisk.

*		*				
klee	ro nom	-->	klee	ro nom-o- s	-->	kleeronómos
	*		*			
a ga tho		-->	a ga tho-s		-->	agathós

Inflectional suffixes are non-cyclic and non-stress-erasing. If they were cyclic and stress-erasing, then idiosyncratic stress would never appear in any inflected word: the lexical stress would always be erased.

Although the preceding discussion of Greek stress is greatly simplified, the data in (40) and (42) show rather clearly the operation of Stress Erasure by cyclic affixes.²⁰

Cyclic Stress Erasure plays a role in the tonology of Digo, both in the word-level and the phrase-level components of the grammar.

²⁰The cyclic nature of stress-erasing affixes is found more clearly in a language like English, where the stress-erasing property of an affix correlates with other properties of cyclicity. Cf. Halle and Vergnaud, chapter 7.

1.4 Metrical structure and tone

We come now to the question of metrical structure assignment and tone assignment and the interactions of the two kinds of rules. There are a variety of positions which one might conceivably adopt for a theory of tone-metrical structure interaction.

One position is that tone assignment and metrical structure assignment are in complementary distribution. That is, if a language has rules of tone manipulation, then metrical "stress" rules do not play a role. This seems to me to be an incoherent view. Tone is a phonological feature, subject to assimilation, dissimilation, spreading, metathesis, deletion, and insertion, much like features of vowel height or roundness.²¹ There is no more reason to believe that tone excludes the presence of metricality than there is to believe that vowel harmony should do so. Both tone and vowel harmony systems concern autosegmental features and linkings, but the tier on which these operations occurs is orthogonal to a tier of metrical structure operations. One might as logically claim that tone languages are in complementary distribution with languages which employ rules of syllable structure.

Another possible view one might take is that phonetic tone contours are a direct reflection of underlying metrical structure. That is, a stressed syllable always surfaces with a phonetic High tone and a phonetic High tone always signals the presence of a phonological stress mark (asterisk). This is the view adopted, for example, by David Massamba in his treatment of tone in Ci-Ruri (Massamba 1982, 1984). By this interpretation of tone-

²¹See Pulleyblank 1986, passim, for examples of all these rules in tone assignments, as well as for discussion of the decomposition of tones into binary features (125-f.).

right sentence bracket ']' in English as short-hand for falling intonation. It is true that these abstract constituency markers do correspond in German and English to phonetic features of voicelessness and falling intonation, respectively. However, the phonetic features are calculated off of the abstract structure: the structure itself has no necessary concrete value.

The formal device '*' likewise has no necessary concrete value of [High tone] or [increased duration]. This is evident from the facts of Chamorro and Tiberian Hebrew. Chung (1983, 38) indicates that the phonology of Chamorro (Western Austronesian, Mariana Islands) interprets the most prominent syllable of the metrical structure with a phonetic Low tone, not a High tone as in many languages. "Syllables bearing primary stress have the lowest pitch in the word, the pitch rising thereafter until the end of the word. (38)" Chamorro, then, is a counterexample to the claim that the metrical asterisk corresponds to surface High tone.

The metrical asterisk also does not correlate in any direct way with surface syllable length, as is shown by Halle and Vergnaud's discussion of Tiberian Hebrew (which follows Rappaport 1984). Hebrew has a rule of Pretonic Lengthening: the syllable which is lengthened is not the stressed syllable, but rather the syllable before the stressed one. For example, underlying /malakiim/ 'kings' is stressed on the final syllable by the rules of Tiberian metrical structure (see Halle and Vergnaud 1987, 63-69), but surfaces with a long penult (and a reduced antepenult): [mɛlaakiim]. Likewise, the underlying form /katabtii/ 'I wrote' surfaces with stress on the short penultimate syllable and a lengthened antepenultimate syllable: [kaatábtii].

There is, then, no a priori reason to believe that the surface tonal contours of a language must directly reflect underlying metrical structure,

although this may be the case in some languages. As is shown in the analyses of Digo and Sukuma below, there is often no correlation between the location of surface High tones and abstract metrical asterisks. Rather, a set of rules mediates between the underlying metrical and tonal structures and the phonetic output. It is this set of rules which I label the "metrical dependencies" of tone assignment, and which are worked out in the rest of the present work.

So far I have argued that two views of tone-metrical structure interaction are inadequate, the view that there is no interaction and the view that the interaction is (trivially) direct. Another conceivable view is that a language may have rules of both tone assignment and metrical structure assignment, and that these rules are unconstrained in their interaction. That is, metrical and tonal rules may apply in any order in any component (word-level or phrase-level) of the grammar, freely interleave.¹ One might speak, then, not only of metrical dependencies in tone assignment, but also of tonal dependencies in metrical structure assignment.

This view is rejected in the present work for two reasons. First, on theoretical grounds, it is desirable to posit as constrained a theory as is tenable. The constraint argued for here is that metrical rules precede and feed tonal rules universally. This type of ordering is intended to explain the learnability of metrical tone languages. A second reason for positing the ordering hypothesis of metrics before tone is empirical: this ordering is borne out in a number of languages. In particular, the languages investigated in the present work demonstrate the ordering hypothesis. The bulk of the

metrical rules are in the word-level phonology, whereas the tone rules fall in the phrase-level phonology.²³

Admitting the tone-metrical structure ordering hypothesis into Universal Grammar leads one to surmise that language learners are specifically programmed to figure out metrical dependencies in tonology, seeing as the learner now has a special guiding principle to bring to the task. This should lead the theoretician to look for metrical dependencies in many languages, particularly where tone phenomena show tendencies toward "counting behaviour." Under this rubric I include such things as binary (and ternary) operations, systematic inertness of peripheral elements (as with extrametricality), right- or left-edge orientations, etc. If a language displays these kinds of tendencies, then I posit that the learner attempts to construct a theory of metrical dependencies before entertaining non-metrical options.

This discussion of the ordering hypothesis has been altogether abstract: the reader is referred to chapters Three and Four for a thorough working out of the hypothesis.

²³The exception to the ordering hypothesis is Meeussen's Rule in Bantu (see Goldsmith 1984b) by which a stem High tone is deleted when adjacent to a prefixal High tone. It is not entirely clear, however, whether this phenomenon is due to an ordered rule of the phonology or some principle, such as the Obligatory Contour Principle. Under the latter interpretation of Meeussen's Rule, it is not a counter-example to the ordering hypothesis.

1.5 Summary of chapters

In this first chapter the basic elements of metrical theory have been laid out, including the representation of constituents and heads, bounded and unbounded structure, weight sensitivity and idiosyncratic stresses, metrical boundary insertion, and extrametricality.

Chapter Two gives a general introduction to Bantu tone and morphology. The form of Bantu nominals and verbs is discussed, as well as the structure of Bantu phrases. In particular, the notions of Myers (1987) concerning word divisions in Bantu are presented, along with the notions of Selkirk (1986) for the derivation of end-based prosodic domains. The chapter closes with a brief sketch of previous work on tone-and-accent interaction in Bantu, with special consideration of Goldsmith's (1987) idea of tone-to-accent attraction. Partial analyses of Ci-Ruri and Kimatuumbi – two Bantu languages of Tanzania – are offered as illustrations of metrical dependencies in tone assignment.

Chapter Three outlines a theory of metrical dependencies in the tone assignment rules of Digo, another Tanzanian Bantu language. The complex system of Digo is introduced in a crab-wise fashion, working up from the less complex to the more complex tone patterns. Particular attention is given to the phrasal tonology of Digo.

Chapter Four presents a partial theory of metrical dependencies in the tonology of Sukuma, a Tanzanian Bantu language of rather a different cast from Digo. Sukuma shows the metrical operations of binary foot construction and extrametricality.

Chapter Five concludes the study by discussing some theoretical conclusions to be drawn from the previous analyses, specifically with

regard to the generative nature of tonology, the linkage of autosegmental tones to the skeletal tier, the theory of Moraic Phonology, and the typology of tone-accent interactions.

Chapter Two

The elements of Bantu tone and morphology

The goal of this chapter is to give the reader an introduction to Bantu tonology and morphology and to the theoretical framework in which the present work represents them. No attention is given to the historical phonology or tonology of Bantu: the interested reader is directed to the work of Malcolm Guthrie (1976-71).

In particular, three topics will be treated below. The representation of tones in Bantu phonology, the structure of Bantu words and phrases, and the ways in which tone and metrical structure interact in Bantu (with some review of the previous literature).

The Bantu languages are spoken in southern Africa, in a region stretching roughly from southern Nigeria to the south of Kenya and below. There are some 400-500 different Bantu languages, with total of about 100 million speakers. Bantu is a subfamily of the Niger-Kordofanian family of languages, along with the Benue-Congo subfamily and the Bantoid languages of West Africa.

2.1 Representing tones in Bantu languages

In this study tone is considered in terms of relative pitch heights, and not absolute pitch heights. That is, I am concerned not with the fundamental frequency at which a tone-bearing unit (such as a vowel) is pronounced, but with its pitch as perceived in relation to the pitch of other segments in the utterance. By the term High tone I mean a tone which is higher than certain other tones in the word; the degree to which a High tone is higher than other tones is not salient for the purpose of this investigation. This is not to say that the acoustic characteristics of tones and tone-bearing units are unimportant; quite the contrary. Rather, this study, being a phonological one, must limit its concerns to the patterns of sound in a language, and not the properties of sounds.¹

There are good reasons for abstracting over absolute pitch heights and for considering only the relative patterns of pitches. In the first place, the pitch of pronunciation for a high-toned vowel differs according to the age and gender of the speaker. Children and women tend to have higher fundamental frequencies for utterances than do adults and men, respectively. When different speakers produce the same utterance, only the pattern of tones is a constant; the actual range of pitches produced varies greatly. Also, the absolute pitch of a toneme depends often on its place in the overall utterance. Many languages show a systematic downdrift in the

¹This is parallel to the phonologist's abstraction over the varying properties of the phoneme [b] in English when it appears in various positions in a word: initially, medially, and finally. Of course, the [b] has measurably different laryngeal properties in each position. These properties are not of immediate concern for the phonologist, however. The phonologist is concerned with the fact that in every position, English [b] contrasts in speakers' perception with English [p]. It is this pattern which interests the phonologist.

fundamental frequency in the course of a long utterance. Thus, a high-toned morpheme might have a higher fundamental frequency when utterance-initial than the same morpheme when it occurs later in the utterance. A High tone late in the utterance might well be lower in frequency than a Low tone earlier in the utterance. Therefore, tone as a relative phenomenon—not absolute pitch—is the immediate subject of interest.²

This dissertation employs an autosegmental representation of tone features (such as High tone and Low tone). That is, tones are treated as entities unto themselves, distinct from the vowel which is pronounced along with the phonetic realization of a tone. The phonemic distinction between a high-toned and a low-toned low vowel [a] is not a distinction, say, between [á] and [à], parallel to the phonemic distinction between [a] and [i]. Rather, the distinction is between a low vowel [a] linked to a unit which is a High tone and one linked to a Low tone.³

(1)	[a]	vs.	[a]
	[H]		[L]

In the representation in (1) there are four autonomous phonological units: two (identical) low vowels and two tone units. Any one of these units may be deleted, but such deletion does not necessitate the deletion of the unit associated with it (formally notated by the intervening association line). If tones were simply a feature of vowels (like the features [+round] or

²These arguments and others for considering tone and not pitch for the purposes of phonological studies can be found in Kenstowicz and Kisseberth (1979, 264-f.).

³Throughout this work, H and L will be used as abbreviations for High and Low, respectively.

[+back]), one would expect that the deletion of the vowel would suffice to delete the tone feature as well. This is rarely the case, however: tones regularly survive the deletion of a vowel (in hiatus, for example) and show up in the acoustic signal on a neighboring vowel. Likewise, vowels regularly survive the deletion of an associated tone (as in Meeussen's Rule—see Goldsmith 1984b).

Phonological segments—consonants and vowels—are usually represented like beads on a string, with each segment adjacent to only two other segments or to a segment and the end of the string. Tones likewise are represented on a separate string, parallel to the segmental string.

(2) a b a k a d a b a r a
 | | | | | |
 H L H L H L

The two strings of phonological units are called "tiers", and are connected by a set of association lines (although elements on the tiers may remain unassociated as well). Metrical structure occupies another tier of its own, distinct from both the tonal and segmental tiers. Again, syllable structure occupies yet another tier.

One can conceive of a full autosegmental representation like a book held upside down by its spine: the various pages correspond to the various planes of separate tiers. The central axis of the intersecting planes is the timing, or skeletal tier. This row of "X-slots" encodes the (relative) length of segments: a long vowel is associated (by association lines) to two timing slots; a short vowel is associated with only one.

(3)	long	a	short	a
		^		
	timing tier--	X X		X

It is difficult to produce a full autosegmental representation in only two dimensions. Therefore, for the purposes of this study I generally suppress the skeletal tier, the syllable structure tier, and the line 0 tier of metrical asterisks. Representations, then, most often appear as in (4).

(4)	*	*	--line 1
	(a-na)	(togor-a)	
	H		

This is really an abbreviation for the representation in (5), where the tonal tier should be viewed as hovering above the page, with the High tone's association line perpendicular to the page. (The syllable structure tier is again suppressed.)

(5)	*	*	*	--line 1
	(* *)	(* * *)		--line 0
	H-----	x x x	x x x x x x	--timing tier
tonal				
tier		a n a	t o g o r a	--segmental tier

Note that the tone is associated with the skeletal (timing) tier, not with the segmental tier. The choice of this linking is defended ex post facto in Chapter Five. For typographical reasons I conflate the timing tier and the line 0 tier of asterisks into the segmental tier, as in (4). The unabbreviated

Although High and Low tones are given different labels, I in fact consider them simply to be opposite values of a binary feature (such as [\pm high tone]). That is, the two tones have the same composition, and differ in the way that the features [+round] and [-round] differ, not in the way that [+round] and [+back] differ. That High and Low are simply opposite values of the same feature is apparent from the fact that a Low tone can block the spreading of a High tone (as in Digo, Chapter Three). The spread of a feature is blocked only by the presence of the same feature, not by any other feature (as in vowel harmony systems, where the spread of [-back] is blocked by the presence of the feature [+back]). Such blockage is demonstrated in the next chapter.

The feature content of High and Low tones becomes more complicated in systems with three or more distinctive tones. Yoruba, for example, has a three way contrast between High, Mid, and Low tones (Pulleyblank 1986). Many proposals have been advanced for the decomposition of tones into binary features in such languages (Spreda 1986, Clements 1983, Pulleyblank 1986). Such considerations are outside of the scope of the present study, since the languages considered here show distinctive contrast only between High and Low tones.

2.2 Bantu morphology

2.2.1 Nominals and noun classes

Words in the Bantu languages are almost always polymorphemic. In the following sections the basic system for describing Bantu morphology is laid out.

Nouns and adjectives usually have the same structure in all branches of the Niger-Kordofanian family, including Bantu; both nouns and adjective therefore are considered together under the rubric "nominals." Bantu nominals almost always consist of a prefix and a stem. The prefix is commonly called a "noun class marker" or a "noun class prefix." The noun class prefix differs according to whether the nominal is singular or plural, as the examples from Swahili show (from Welmers 1973, 161).

(9)		<u>Singular</u>	<u>Plural</u>	
	m-, wa- :	m-tu	wa-tu	'person'
	m-, mi- :	m-zigo	mi-zigo	'load'
	∅-, ma :	tofali	ma-tofali	'brick'
	ki-, vi- :	ki-tasa	vi-tasa	'lock'
	N-, N- :	n-dizi	n-dizi	'banana'
	u-, N- :	u-bao	m-bao	'plank'

The symbol /N-/ designates a nasal consonant which always assimilates in place of articulation to the initial consonant of the following noun stem. Some languages have a zero prefix as one of the noun class markers, as for example the singular noun /tofali/ 'brick'. Most noun class markers are part of a system of singular-plural pairs, just as the markers in (9). Any given nominal stem appears with one member of its associated pair of class markers.

Noun class markers can be thought of as markers of grammatical "gender", although they do not really correlate with genders (masculine, feminine, neuter). Likewise, there is no distinguishable morpheme which encodes number: a noun class marker is simply and irreducibly singular or plural. At least nineteen, and perhaps as many as twenty-three noun classes have been reconstructed for Proto-Bantu (cf. Welmers 1973); most languages have collapsed a few of the classes, arriving at a system with about 15-20 classes.

There is no consistent semantic value for all of the noun classes in the various languages. Welmers 1973 indicates that classes 1 and 2 often constitute the singular-plural pair for noun stems of personal (human) nouns and some other animate nouns. Classes 3 and 4 are another singular-plural pair which includes plant names and some inanimate nouns. Classes 7 and 8 are a singular-plural pair which has a diminutive or augmentative meaning in some languages. Other classes tend to encode other semantic properties as well.

For the sake of concreteness, the entire noun class marker system of Shona (Zimbabwe) is given in (10) (reproduced from Myers 1987, 68).

(10)	mu-	Class 1	(sg., human)
	va-	Class 2	(pl. of Cl. 1)
	sa-, nya-	Class 1a	(variant of Cl. 1)
	va-	Class 2a	(pl. of Cl. 1a)
	mu-	Class 3	(sg.)
	mi-	Class 4	(pl. of Cl. 3)
	[+vcd]-, zi-	Class 5	(sg.)
	ma-	Class 6	(pl. of Cl. 5)
	chi-	Class 7	(sg.)
	zvi-	Class 8	(pl. of Cl. 7)
	[+nasal]-	Class 9, 10	(sg./pl.)
	dzi-	Class 10	(variant)

ru-	Class 11	
ka-	Class 12	(sg., diminutive)
tu-	Class 13	(pl. of Cl. 12)
hu-	Class 14	(sg.)
ku-	Class 15	(sg., infinitive)
pa-	Class 16	(sg., locative)
ku-	Class 17	(sg., locative)
mu-	Class 18	(sg., locative)

The [+voiced] marker of Class 5 and the [+nasal] marker of classes 9 and 10 are underspecified segments which produce the expected changes in the following consonant (i.e., voicing and nasalization).

A noun stem which takes a particular noun class marker also requires that a modifying adjective stem take the same noun class marker. This is seen in the Sukuma noun phrases in (11), where the adjective stem /-taale/ 'big' takes a different noun class prefix depending on the class of the preceding noun stem. These data (from Richardson 1971, 222) also show that Bantu modifiers typically follow the modified element. Tone markings are suppressed in these examples.

(11)	n-kolo	n-taale	'big sheep'	Class 9
	ba-temi	ba-taale	'big chiefs'	Class 2
	mi-ubu	mi-taale	'big kind of tree'	Class 4
	ginhi	n-taale	'big owl'	Class 9

Because the noun class prefixes mark concord in this way between noun and adjective, they are also called "concord elements." In the last example in (11) the class 9 noun stem, though it takes no overt prefix itself, still triggers a class 9 nasal prefix on the adjective stem.

In some Bantu languages nominals have an additional prefix before the noun class marker. This is called the "pre-prefix." Ci-Ruri has such pre-

prefixes (data from Massamba 1982, 188; tones markings are again suppressed).

(12)	o-mu-rume	'man/husband'
	e-ci-teBe	'chair'
	a-ma-ti	'trees'
	i-m-busi	'goat'
	e-li-iso	'eye'

In Ci-Ruri the pre-prefix is obligatorily present with most nouns, except for a few class 5 nouns such as li-Bui 'stone'. The pre-prefix has no true semantic value in Ci-Ruri. In other languages the pre-prefix has roughly the meaning of a definite article; this is the case, for example, in Zulu and Sukuma. In such languages the pre-prefix, then, is optionally present to signify definiteness of the noun. Compare the Sukuma nouns [ma-hagala] 'tree forks' and [a-ma-hagala] 'the tree forks'. Pre-prefixes often have special tonal or metrical significance, as in Sukuma (see Chapter Four).

In recent work in Bantu tonology the question has arisen as to whether the noun class marker and noun stem (or adjective stem) form a single word or two separate words. That is, is the nominal complex of Bantu analogous to the article-noun structure of English or to the affix-stem structure of Hebrew, Aramaic, and Swedish?

In the scholarly tradition of Bantu linguistics, the noun class marker and stem have been treated as a single word. However, in his 1987 dissertation, Tone and the Structure of Words in Shona, Scott Myers challenges this assumption. I recapitulate some of his arguments here.

The gravamen of Myers' argument is that the Bantu noun class marker appears not only in conjunction with noun and adjective stems (N^0 and A^0 in syntactic terms), but also with phrasal constituents. Myers demonstrates

from Shona that noun class markers appear along with verb phrases, noun phrases, and sentences. Of course, prefixes are elements of word-level morphology; any element which interacts with phrase-level morphology must be a word itself.⁶ Because noun class markers can "select" phrasal complements, Myers argues, they must be separate words in the syntax and not simply prefixes to nominal stems.

Typical of Bantu languages, Shona infinitives are formed by the collocation of a noun class marker (Class 15) and a verb stem.⁷ In other words, infinitives are nominalizations of verbal words. (Data are from Myers 1987, 27-30; tones are again suppressed.)

(13)	ku-tengwa	'to be bought'
	NCM-verb stem	
	ku-tengesa	'to be sold'
	ku-tengesa-tengesa	'to go all around selling'
	ku-tengeserana	'to sell to each other'
	ku-disa	'to want very much'
	ku-chatanura	'to divorce'

The third example in (13) is formed by reduplication, indicating iterative action. Note that the Class 15 noun class marker is not reduplicated with the rest of the verb stem. Other types of nominalization are possible; for example, addition of the Class 1 marker can yield an agentive human noun: [mu-tengesɪ] 'seller' (Myers, p. 36).

⁶Or a clitic, which is a word that "leans" on an adjacent word in some phonological sense.

⁷A fuller description of Bantu verbal morphology is given in the next section.

However, Myers notes (96, 99) that the complement to a noun class marker is not simply a verb stem, but also an entire verb phrase. His examples (repeated in 14) show this, where the verb phrase is underscored.

(14) ku-da vanhu
15-love people
'to love people'

ku-nzwa kuti u-no-gara pedyo ne-gomo riye
15-hear that you-hab-live near by-mountain that
'to hear that you live near that mountain'

ku-nzwa zyakanaka
15-listen which-is good
'to listen well'

mu-sika va-nhu
1 -create people
'creator of people' = 'God'

chi-tuta matuzvi
7- lift dung
'lifter of dung' = 'dung beetle'

ma-ramba ku-rima
6- refuse 15-cultivate
'those who refuse to cultivate' = 'baboons'

The syntactic sequence of a noun class marker and a verb phrase behaves like a noun phrase in its distribution. It can constitute the subject, direct object, indirect object, or prepositional object in a sentence. The noun phrase formed by adding a noun class marker to a verb phrase can also

take modifiers: these modifiers display Class 15 concord elements, as expected.⁸

(15) ku-kora kw-ake ku-kuru ku-no-shamisa
 15-be stout 15-his 15-great 15-astonish
 'his great stoutness is astonishing'

ku-da va-nhu kw-ake
 15-love 2-person 15-his
 'his love of people'

It appears, then, that a noun class marker can take a verb phrase as its complement. Noun class markers of Shona can also take entire noun phrases as their complements (Myers, p. 103).

(16) mu-mphatso iyi ya-sekuru mu-no umu
 18-hut(9) this(9) 9gen-uncle 18-this here this(18)
 'this inside here of this hut of my uncle'

pa-mu-she apo p-ose p-a-ka-chen-a
 16-3-home that(16) (16)-all (16)-white
 'at that whole white home'

sa- du-nhu iri
 1a-5-district this(5)
 'the head of this district'

Noun class markers take sentential complements also (Myers, 108).

(17) va-chi-tsva chi-ri mu-ru-tsoka
 2a- 7- new 7 - cop. 18-11-foot
 'Mister a-new-thing-lies-in-the-foot'
 (praise name for a well-traveled person)

⁸These examples show a widespread Bantu process of glide formation, turning a high vowel into the corresponding glide before another vowel: /ku-ake/ → [kw-ake].

The data in (14-17) show that noun class markers are sisters to phrasal constituents, and not only to nouns and adjectives. If one analyzes noun class markers as merely prefixes in the word-level phonology, then one is forced to posit the productive and compositional compounding of phrase-like elements in the word-level phonology. But, as Myers points out, such a move requires the complete recapitulation in the word-level phonology of all of the principles of the syntax (selectional restrictions, concord marking, word order, etc.). Such massive redundancy is unwarranted: it is simpler to posit that noun class markers of Shona are words themselves, words which take N' or phrasal complements to form noun phrases. To do otherwise is to pass up significant generalizations.

However, it is well established that syntactic words do not always match phonological words. An element that is a separate word of the syntax may in the phonology behave as though it is part of another word, and not an independent word.⁹ This type of behaviour is seen with the genitive morpheme in English. Syntactically this morpheme is a sister to an entire noun phrase, but phonologically it is a suffix to the last word of the phrase, as in the phrase the king of France's mother.

Syntax:	[[the king of France] _{NP} 's]	mother
Phonology	the king of [France's]	mother

Some sort of restructuring takes place in the phonology, making the genitive "word" a suffix to the final word of the noun phrase. In this environment the [s] undergoes all of the rules that any other suffixal morpheme would

⁹See Marantz 1988 for one theoretical approach to restructuring.

undergo: voicing assimilation (dog's, cat's) and epenthesis (France's, Hayes's). Likewise, the Bantu noun class markers – although they are independent words of the syntax – often undergo phonological restructuring and behave like affixes instead of words.

The "word-hood" of noun class markers, therefore, does not show up with equal perspicacity in the phonology of all of the Bantu languages. This is no doubt the reason why the noun class markers were traditionally parsed as prefixes to the following nominal. In Digo, on the one hand, the noun class markers behave rather strikingly as separate words; for the purposes of rightward tone shift, the class markers seem to group with the preceding word rather than with the following noun (Chapter Three). In Sukuma, on the other hand, the noun class markers behave as though they were a word-level prefix to the following noun; the class markers participate, for example, in the word-level rule of extrametricality marking.¹⁰ A comparative study of the phonological behavior of noun class markers in the Bantu family is an appropriate topic for future research.

¹⁰The noun class markers of Sukuma are referred to as "prefixes" in the following discussion, although it is perhaps more accurate to speak of them as function words which are phonological proclitics. As proclitics they participate in the word-level rules of metrical structure assignment.

2.2.2 Verbs, inflected and extended

The structure of Bantu verbs is even more complex than that of nominals. A traditional description of the Bantu verb would parse it in the following way.

(18) Subject -Tense - Object - Verb - Extensions - Final
Marker Marker Marker(s) Radical Vowel

The verb radical itself generally has the shape CVC:¹¹ /-bon-/, /-tem-/, /-vug/. The extensions are suffixes which most often change the argument structure of the verb: passive, reflexive, reciprocal, causative, etc. The extensions are generally of the shape VC. The Final Vowel is /-a/ in the unmarked case in most languages, although there are other final vowels indicating subjunctive (Ci-Ruri /-e/) or negative. The Final Vowel morpheme may contain more than one vowel, as for example the Ci-Ruri suffix /-ire/ which appears in place of the Final Vowel in the Distant Past.

Prefixes are typically of the shape CV or V. Negating prefixes appear on either side of the subject marker in the various Bantu languages. Languages differ in the number of Object Markers allowed in a single verb. Kinyarwanda allows as many as three, Ci-Ruri allows two, whereas Sukuma allows at most one. The verb which results from the concatenation of all these morphemes can be of an impressive length, as demonstrated by data from Ci-Ruri (from Massamba 1982)

¹¹I.e. Consonant-Vowel-Consonant.

- (19) ka-a-Ba-i-tem-er-a 'she is cutting it for them'
 SM-TM-OM-OM-Rad-Applic-FV
- ni-li-Ba-i-sorotor-er-a 'I will pull it out for them'
 SM-TM-OM-OM-Rad-Applic-FV

Recall from the previous section that the Bantu infinitive is a nominalization of the verb, formed by adding a noun class marker (and a pre-prefix, if required) to the stem. Object Markers may also appear in infinitives, along with any number of extensional suffixes and the final vowel. Subject Markers and Tense Markers do not appear in the infinitive. (Ci-Ruri data are from Massamba 1984.)

- (20) o-ku-tem-a 'to cut'
 prefx-NCM-Rad-FV
- o-ku-tem-er-a 'to cut for'
 prefx-NCM-Rad-Applic-FV
- o-ku-mu-tem-a 'to cut him/her'
 prefx-NCM-OM-Rad-FV
- o-ku-mu-tem-er-a 'to cut for him/her'
 prefx-NCM-OM-Rad-Applic-FV
- o-ku-Ba-li-tem-er-a 'to cut it for them'
 prefx-NCM-OM-OM-Rad-Applic-FV

Languages differ in various ways from the template given in (18), adding certain suffixes or prefixes in various places, or permuting certain elements of the verbal morphology. However, throughout the Bantu languages there is a pronounced tendency for the verb radical and all its following suffixes to cohere in a certain way. The constituent made up of [verb radical + extensions + final vowel] is traditionally labeled the "verbal

stem." The verbal stem acts as a unit to the exclusion of all morphemes preceding the radical, as for example in reduplication (cf. 13 above).¹² Often the Object Marker coheres with the verbal stem in some way as well.

However, the morphemes which bear inflectional information—the Subject Marker and the Tense Marker—behave as a separate constituent in some languages. Myers 1986 labels this constituent the "inflectional word," taking the position that the constituent break between the Tense Marker and the verbal stem is a word boundary, not simply some sort of "strong" morpheme boundary: [SM-TM]_{INFL} [(OM)-Verb-Ext-FV]_{Verb}. Barrett-Keach 1986 shows that Swahili phonology depends crucially on parsing the inflectional elements of the verb into a separate word.

In the first place, Barrett-Keach shows that the distribution of a certain set of pronominal clitics depends on the notion of an inflectional word. These are the O-forms (in Barrett-Keach's terminology), so-called because they all end in /o/: cho, zo, yo, and locative ko. These pronominal clitics show up on the right edge of a variety of constituents; examples of the constituent-final placement of O-forms is seen in (21). (Data from Barrett-Keach 1986, 560).

(21) kata nyama kwa-cho
 cut meat with-clitic
 'cut the meat with it'

ni-on-e kitabu ki-ngine-cho
 OM-see-imp book Pro-of the same kind-clitic
 'Show me a book of the same sort'

¹²See also Myers (1986, 31) for an argument from tone spreading in the Southern Karanga dialect of Shona which shows that the verbal stem is a constituent in a way that the entire string of verbal morphemes (including Object Markers) is not.

kisu amba-cho ki-ta-faa
 knife comp-clitic SM-TM-suffice
 'the knife which will be suitable'

The O-forms also appear to the right of one of four the Tense Markers in Swahili: li-past; taka-future; na-present; si-past, present, or future negative.

(22) kitabu ki-na-cho - somwa (Barrett-Keach 1986,561)
 book SM-TM-clitic be read
 'the book which is (being) read'

barua zi-taka-zo - faa
 letters SM-TM-clitic suffice
 'letters which will be suitable'

yai li-li-lo - anguka
 egg SM-TM-clitic fall
 'the egg which fell'

The encliticization of the O-forms to the inflectional constituent (Subject Marker and Tense Marker) indicates that this constituent is a free-standing word, parallel to the encliticization of the O-forms to the words in (21).

Barrett-Keach also finds evidence for the notion "inflectional word" in Swahili from stress patterns. Stress in Swahili is on the penultimate syllable, as shown by the imperatives in (23), in which there are no inflectional morphemes.¹³

¹³In the framework introduced in Chapter One, penultimate stress is derived (in the simplest case) by marking the final syllable extrametrical and then constructing a right-headed, unbounded constituent on the line or tier of asterisks. Swahili is the mirror image case of Dakota.

(23) zi-andík-e
OM-write-imp
'Write them!'

(Barrett-Keach 1986, 562)

vi-ondó-e vyombo
OM-clear away-imp dishes
'Clear away the dishes!'

When the inflectional morphemes are present, a secondary stress appears on the penultimate syllable of the inflectional constituent.

(24) a. ni-na - ku-pénda
SM-TM - OM-love
'I love you'

ni-li - zi-andíka
SM-TM - OM-write
'I wrote them'

b. [wa-táka kázi]_N
SM-want work
'those wanting work' or 'work wanters'

The stress patterns of the inflectional and verbal constituents in (24a) pattern after those of noun compounds (24b), suggesting that the structure of the inflected Swahili verb is that of a compound word. That is, an inflected verb is formed by compounding two words. The penultimate stress of the second word is augmented so that it has primary stress; the penultimate stress of the first word then surfaces as a secondary stress.

The stress patterns of Swahili, along with the encliticization of O-forms, suggests that there is a distinct inflectional word, made up of the Subject Marker and Tense Marker (and any intervening elements). The grammars of other Bantu languages distinguish the inflectional word. Myers

1986 argues that Shona is such a language; the inflectional word also finds place in the description of Digo (Chapter Three). In other Bantu languages the inflectional morphemes do not seem to form a separate constituent. Sukuma (Chapter Four) is such a language. As a category, inflectional words are available to every language; only certain languages, however, make use of this category.¹⁴

Returning to the discussion of the template in (18), most of the morphemes which make up a Bantu verbal or inflectional word can bear a High Tone in underlying form. The only morphemes which lack a distinction in tone are the extensional suffixes: these are toneless in almost all the languages.

The complex structure of Bantu verbs gives rise to a huge number of combinatorial possibilities for verb forms if one factors in all possible collocations of morphemes. David Odden (1981, 17) estimates that some 16,000,000,000,000 distinct forms can be built around a single verb radical, not counting the differences induced by distinctive tonal features of various morphemes. Even if this estimate is excessive by a couple of orders of magnitude, the vast array of possibilities which every speaker is able to produce strongly supports a generative approach to the Bantu languages.¹⁵

¹⁴In this sense the category INFL (erstwhile AUX) is like the category Adjective; some languages may use it less than others, or not at all.

¹⁵In contrast, say, to an approach to language which holds that all forms are produced by memory or analogy, as in a behaviourist-functionalist approach.

2.2.3 The structure of Bantu phrases

Sentences in the Bantu languages generally have the surface word order Subject-Verb-Object. Smaller phrases have the order of Modified-Modifier, as was shown in (11) above.

The syntactic structure of Bantu, nonetheless, is not always the same as the phonological structure of Bantu phrases. Rather, the phonological structure is derived by a set of rules, as in the theory of phonological phrase structure developed by Elizabeth Selkirk (1986). Selkirk has shown from a number of languages that phonological phrasal domains are end-based domains, derived from the syntactic structure by respecting the left or right brackets of syntactic phrases of a certain type (X^0 or XP). Such an end-based derivation is shown below.

In the analysis of Hyman 1985 the phonological phrase structure of Bamileke-Dschang (Grassfields Bantu, Cameroon) is distinct from the syntactic phrase structure in that function words (such as prepositions and determiners) behave as though they formed a phonological unit with a preceding word of a major category (Verb or Noun) rather than with words in their own maximal projection. That is, noun phrases with the syntactic bracketing shown in (25a) and (26a) have the phonological constituency shown in (25b) and (26b), where the "little" words are grouped with the preceding noun.¹⁶

¹⁶In (25) the abbreviation CM stands for '(noun) class marker' and AM for associative morpheme. Following Myers 1986, I construe the associative morpheme as a preposition, very much like the English preposition 'of'.

(25) a. [NP a [N sɑŋ] [PP a [NP mən] [N kɑ] [PP e [NP mə [N tsɑŋ]]]]]
 CM 'tail' AM CM 'monkey' AM CM 'thieves'
 'the tails of the monkeys of the thieves'

b. [a] [sɑŋ a mən] [kɑ e mə] [tsɑŋ]

(26) a. [NP a [N sɑŋ] [PP a [NP mən] [N dzwi]]]
 CM 'tail' AM CM 'leopards'
 'tail of leopards'

b. [a] [sɑŋ a mən] [dzwi]

Certain rules apply within phonological domains like those of (25b), but not across these derived domains. For example, a rule which spreads an underlying H tone to a vowel on the right applies within the derived word group of (26b), spreading the underlying High tone of the associative morpheme /á-/ to the following noun class marker: [àsɑŋ á mɔ́ndzwi].

[a]	[sɑŋ	+ a	+mən]	[dzwi]	-->	a	sɑŋ	a	mən	dzwi
								\ /	±	
L	H	H	L	H		L	H	H	L	H

This rule of High tone spreading does not apply, however, to the High tone of an associative morpheme when a low-toned noun stem follows. This is shown by data such as [àsɑŋ á nà] 'tail of animal' and [àsɑŋ á kɑŋ] 'tail of squirrel'. The phonological phrasing of these genitive constructions is as shown in (27), where again the function words are grouped with the preceding noun. In these examples the syntactic phrase-final nouns /-nà/ 'animal' and /-kɑŋ/ 'tail' bear an underlying Low tone, but spreading does not apply across the boundary of the derived phonological phrase.

(27) [a] [saŋ + a] [na]
 | | \ / |
 L H H L

[a] [saŋ + a] [kaŋ]
 | | \ / |
 L H H L H

Hyman 1985 shows that other tonal rules respect the boundaries of the phonological domains which are derived from the syntactic phrase structure by grouping certain smaller words with major categories words of a preceding constituent. Furthermore, Hyman shows that similar phonological phrase derivations hold for the Bantu languages Kikuyu (Hyman 1985) and Luganda (Hyman, Katamba, and Walusimbi 1987).

Selkirk 1986 proposes a system whereby such phonological phrases are derived from the syntactic structure. Briefly, the right (or left) boundary of each phonological domain is determined by matching it with the right (left) end of every syntactic category of a certain sort (χ^0 or χ^{max}). Thereafter, left (right) brackets are placed adjacent to the existing brackets to complete the construction of constituents.

For example, the rules for deriving phonological domains in Bamileke-Dschang are (i) insert a left phonological bracket in every place where a left N^0 bracket stands and at the beginning of the utterance; and (ii) insert a right phonological bracket at the end of the phrase and to the left of each left-bracket

	[_{NP} a [_N saŋ]	[_{PP} a [_{NP} məŋ [_N ka]	[_{PP} e [_{NP} mə [_N tsəŋ]]]]]
(i)	↓ ↓	↓	↓
	[a [saŋ	a məŋ [ka	e mə [tsəŋ
(ii)	↓	↓	↓ ↓
	[a] [saŋ	a məŋ] [ka	e mə] [tsəŋ]

Selkirk 1986 uses this theory of end-based phonological domains to explain certain facts of vowel length in Chi-Mwiini, another Bantu language. The fundamental idea of the theory is that the phonology picks one end of the major categories (such as V, N, VP, or NP) in an utterance and anchors the right or left boundary of the phonological domains to those points.¹⁷ The rest of the phonological boundaries are calculated from these points as well. In Bamileke-Dschang it is the left edge of a noun which counts as the left edge of a phonological domain; all material preceding the left edge of a noun—such as a class marker or associative morpheme—is automatically shunted into the domain of the preceding left phonological bracket.

This sort of phonological phrasing plays a role in the tonology of Digo, analyzed in Chapter Three. In Digo the noun class markers behave as though they were part of the phonological phrasal domain of the preceding word. There is, however, a twist for the theory of end-based domains in the Digo data: Digo builds its phonological domains cyclically. The complexity of Digo tonology requires that the discussion of these facts be postponed to the following chapter.

Again, not every Bantu language derives its phonological domains in the way outlined for Bamileke-Dschang. In many languages there is no reason to treat the noun class markers as a phonological constituent with the preceding word instead of with the following noun. And once again, there is need for more comparative research into these issues.

¹⁷Halle and Vergnaud (1987, 264) propose a similar scheme for the derivation of metrical constituents in the phrasal phonology of English: syntactic constituent boundaries are identified with metrical boundaries.

2.3 Case studies in metrical-tone interaction

In this section brief metrical analyses of tone assignment in Ci-Ruri and Kimatuumbi (both of Tanzania) are worked out, with some attention to previous metrical approaches. These languages provide examples of the kinds of metrical-tonal rules which are used in the following chapters to explain tone assignment in Digo and Sukuma. The analysis of Ci-Ruri and Kimatuumbi, then, is the first step in an effort to catalogue fully the kinds of rules which mediate metrical structure and tones. A more complete typology of metrical dependencies in tone assignment is given in Chapter Five.

2.3.1 Metrical spreading and delinking in Kimatuumbi nouns

2.3.1.1 The metrical theory of Pulleyblank 1983

Kimatuumbi tonology has been discussed by a number of researchers: Kisseberth and Odden 1980, Odden 1982, Pulleyblank 1983. Pulleyblank's (1983) analysis is a metrical one; his article forms the basis for the discussion below.

Many Kimatuumbi nouns in isolation form have a curious alternating pattern of tones: the first tone-bearing unit is low-toned, the second is high-toned. Thereafter the alternation of Low (L) and High (H) tones may be repeated many times (28a) or followed by a stretch of low-toned vowels (28b).¹⁸

¹⁸The page number of Pulleyblank's article from which the data are drawn is given on the right side of each numbered example, where 'P.' stands for 'Pulleyblank 1983'. Likewise, 'K&O.' stands for 'Kisseberth and Odden 1980' and 'O.' for 'Odden 1982'.

(28)	a.	n-chímbilíilí	'drip'	(P. 195)
		ka-lú-tebéelé	'little amaranthus plant'	
		ma-súmaáli	'large nails'	
		ma-sólokó	'black pulse plants'	
		njeénjemá	'mosquitoes'	
		asáabú	'punishment'	
		ma-kálaángalá	'chicken predators'	
		ndebéelé	'amaranthus'	
		n-tóopé	'handle'	
		ki-téleéko	'cooking pot'	
		m-múundáyi	'one who blunts'	(O. 350)
	b.	ki-wíkilyo	'cover'	(P. 199)
		*ki-wíkilyó		
		ngoóngowe	'marble'	
		lu-bágalo	'lath'	(K&O. 125)

A word-initial nasal consonant seems to count as a tone-bearing unit just in case it is followed by a voiceless obstruent or a sonorant:

n-chímbilíilí, n-tóopé, and m-múundáyi. In this case the vowel following the syllabic nasal has a H tone. If the word-initial nasal is followed by a voiced obstruent, however, it does not count as a tone-bearing unit.

Presumably such a nasal is really only a prenasalization component to the following consonant. In this case the first tone-bearing unit of the word is the first vowel, which is perforce low-toned. The second vowel of the word, then, has a H tone: njeénjemá and ngoóngowe.

In all of the nouns in (28), the H tones fall only on the even-numbered tone-bearing units. However, there are nouns in which the alternating H tones fall on odd-numbered tone-bearing units (i.e., the third and the fifth, but never the first).

(29)	changaláwe kalaángalá ngeengé balaása	'gravel' 'chicken predator' 'wires' 'veranda'	(P. 197)
------	--	--	----------

Pulleyblank 1983 takes the position that tone in Kimatuumbi nouns is a direct reflection of abstract metrical structure; that is, every vowel with a H tone has a metrical asterisk and every vowel with a L tone has no metrical asterisk.¹⁹

(30)	* * *	
	ma-ka la a nga la	--> ma-kálaángalá
	* ki-wi ki lyo	--> ki-wíkilyo

The metrical structures found in (30) are assigned in two different ways. The nouns in (28a) and (29) have a single line 1 asterisk on some vowel in their underlying representations. Binary, right-headed constituents are then built on line 0 from the underlying asterisk leftward, and the heads of these constituents are located on line 1.

(31)		*		*
	underlying:	ki-tele eko		bala asa
		*		*
	binary feet:	(ki-te)(le e) ko		(ba) (la a) sa
		* *		* *
	line 1 heads:	(ki-te)(le e) ko		(ba) (la a) sa

¹⁹I translate Pulleyblank's arboreal metrical representations into the notation introduced in Chapter One.

A unary foot, as in the second word balaása, loses its line 1 asterisk by a rule of deaccentuation.

non-branching	* * *
deaccentuation:	(ki-te)(le e) ko (ba) (la a) sa

H tone is then assigned to each stressed vowel and L tone to each unstressed vowel.

tone	* * *
assignment:	(ki-te)(le e) ko (ba) (la a) sa
	L H L H L L L H L
surface:	ki-téleéko balaása

Nouns may have the single lexical stress on any vowel, including the second vowel.

(32)	ma-tógolo	'bucks'	(P. 197)
	ki-túkutuku	'bird'	
	lu-kóngobe	'wood'	
	oté	'banana hands'	

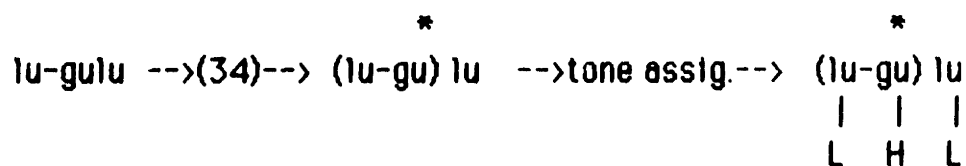
The nouns in (32) are derived like those in (31), except that only a single right-headed foot is constructed which contains the first and second vowels. These nouns in (32) with second-vowel H tone differ from those in (28b) above. The nouns in (28b) lose their second-vowel H tone when followed by an adjective (33a), whereas all other nouns (including those in 32) keep their isolation tone pattern (33b).

(33) a. ki-wíkílyo	'cover'	(P. 199)
ki-wíkílyo chaángu	'my cover'	
lu-gúlu	'leg'	
lu-gulu lwaángu	'my leg'	
ngoóngowe	'marble'	
ayí ngoongowe lí	'that isn't marble'	
b. ma-tógolo	'bucks'	
ma-tógolo gaángu	'my bucks'	
mi-butúka	'cars'	
mi-butúka yaángu	'my cars'	
ma-chángaláwe	'large gravel pieces'	
ma-chángaláwe gaángu	'my hunks of gravel'	

Pulleyblank posits a lexical difference between the nouns in (33a) (=28b) which lose their second-vowel H tone and those in (32) which keep their second-vowel H tone in phrase-medial environments. The nouns in (33a) have no underlying line 1 asterisk on any vowel. The metrical structure of these nouns is constructed by the following rule.

- (34) Construct a single, right-headed binary foot on the left edge of a domain (i.e. phrase) in which there are no other line 1 asterisks. Locate the head on line 1.

The unaccented nouns in (33a) receive a second-vowel accent in isolation by rule (34).



When an adjective with an underlying line 1 asterisk follows the noun, however, rule (34) does not apply.

*		*		
lu-gulu	lwa angu	-->tone assig.-->	lu-gulu	lwa angu
			L	L L
				L H L

Pulleyblank, then, uses three metrical structure rules to derive the tone patterns of Kimatuumbi nouns: (i) the construction of right-headed binary feet, right to left, starting from an underlying accent; (ii) in the absence of an underlying accent, the construction of a single right-headed foot on the left edge of the phrase; (iii) the deaccentuation of a constituent containing fewer than two vowels. The resulting line 1 asterisks are then interpreted phonetically as H tones on their vowels, with all other vowels receiving a default L tone.

2.3.1.2 Discussion of Pulleyblank 1983

There are two shortcomings to the above analysis, all having to do with the unconstrained nature of the metrical theory presumed.

In the first place, rule (34)—the rule which builds a single binary foot on the left edge of an unaccented noun—is an unusual rule. No other examples of such a metrical rule have ever been proposed. This rule is sensitive to the existence of metrical structure in another word: metrical structure is built over the noun only if there is no line 1 asterisk in the following adjective. Rule (34), then, must be rejected as an unlikely metrical rule.

Another problem with Pulleyblank's metrical analysis of Kimatuumbi is that the rules leave portions of words unmetrified. The operation of right to left constituent construction in accented nouns is most unusual: the construction starts from the accented vowel and goes leftward. All segmental material to the right of the accented vowel remains unmetrified.

*		*		
n-ki	li	si	tu	--> (n-)(ki li) <u>si tu</u>

'Christian' (O. 352)

*		*		
ki-wi	ki	lyo	--> (ki-wi) <u>ki lyo</u>	'cover'

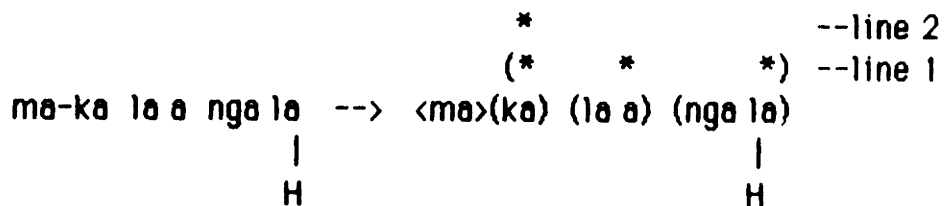
There are two objections to be made to this kind of rule. First, there are no other metrical systems which start metrifying a word at some arbitrary point in the middle. Metrical systems regularly start their operations at the peripheries of domains. Second, a metrical theory which requires the exhaustive metrical parsing of a string is more constrained

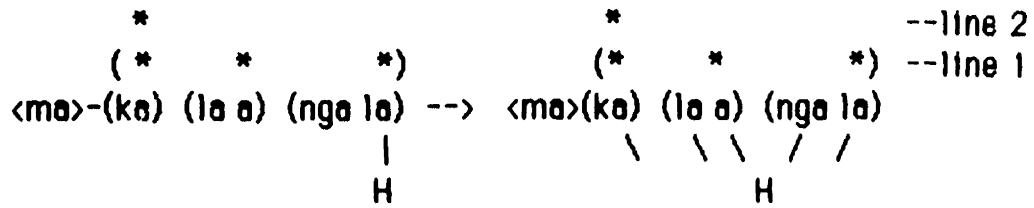
than a theory which allows parsings of any portion of a string. Halle and Vergnaud (1987, 15) argue for the more constrained metrical theory, introducing an "Exhaustivity Condition." This condition requires metrical rules to apply iteratively throughout an unmetrified domain; rules may not cease to apply at some arbitrary point in the string. The Exhaustivity Condition rules out in particular a rule such as (34) above, which applies non-iteratively even though there is more material to be metrified.

Granting these problems with Pulleyblank's metrical analysis of Kimatuumbi, can one devise an alternative analysis which employs a more constrained theory?

- (35) i. Assign line 0 asterisks to all moras.
 ii. Mark the first mora extrametrical.
 iii. Construct right-headed, binary constituents from right to left on line 0.
 iv. Locate heads of line 0 constituents on line 1.
 v. Construct a left-headed, unbounded constituent on line 1.
 vi. Locate the head of the line 1 constituent on line 2.

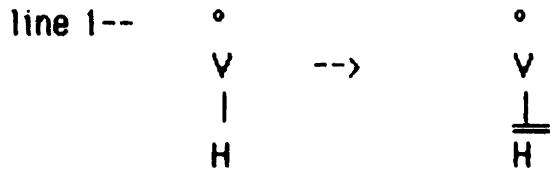
This produces the following intermediate representation for the word 'chicken predators'.²¹



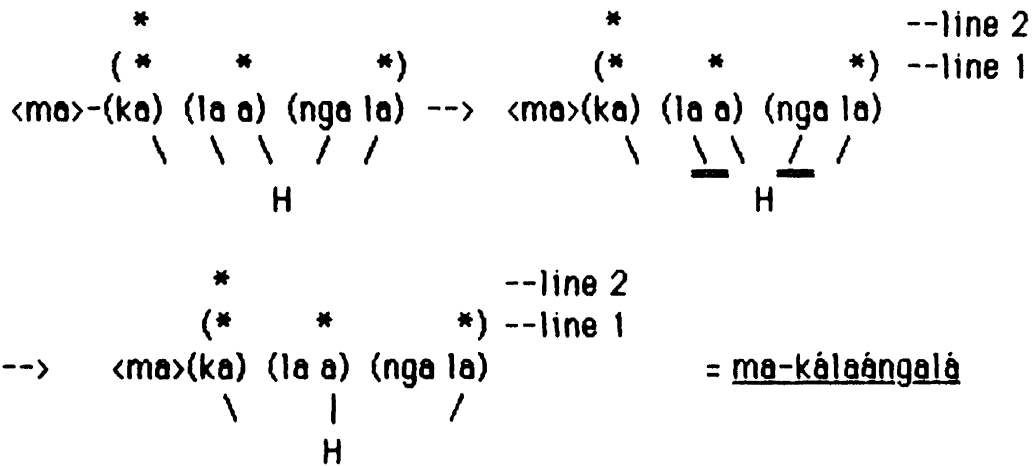


Tone Spread is followed by a rule which delinks the H tone from all unstressed vowels.

(37) Delinking: delink H from vowels without a line 1 asterisk.

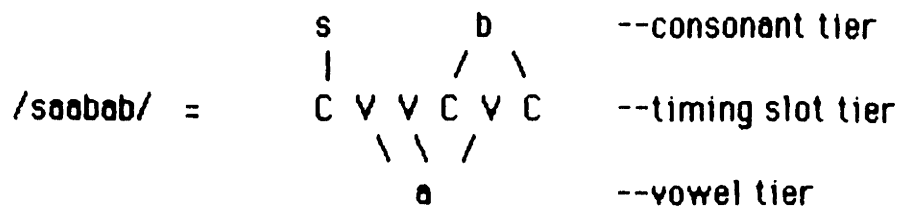


Delinking leaves the single H tone of a noun linked to every other vowel to the left.



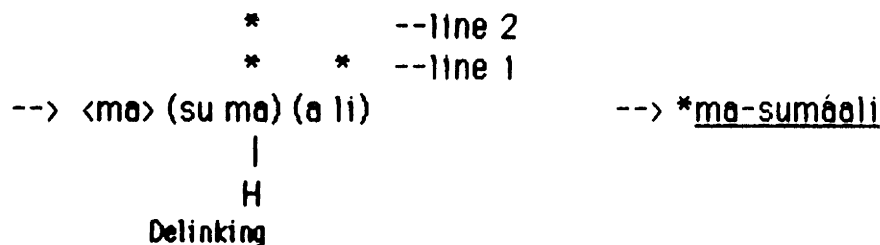
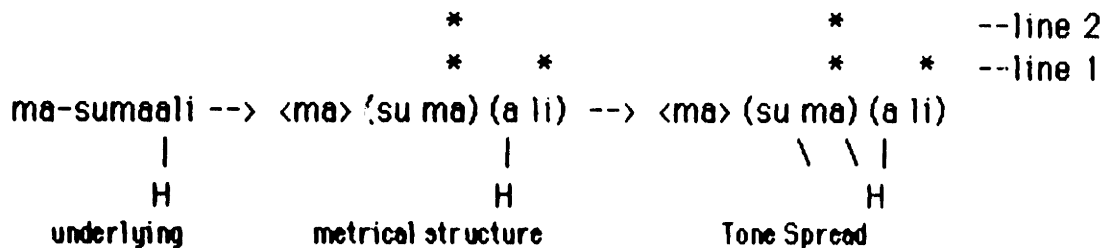
The representation above resembles the kinds of autosegmental representations posited for segment-to-template associations in Semitic

morphology. There also a single unit may be linked to non-adjacent vowel slots (cf. McCarthy 1979, McCarthy 1982a, McCarthy and Prince 1986).



There is no reason, a priori, for tones not to be linked to the timing slots of non-adjacent vowels, just as segmental units are sometimes linked to non-adjacent timing slots.

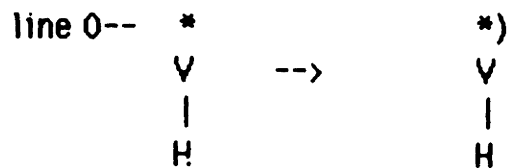
The noun ma-kólaóngaló 'chicken predators' has its lexical H tone on the final vowel. Because binary feet are right-headed and constructed right to left, the final vowel will always bear a line 1 stress. A noun such as ma-súmaáli 'large nails' has its lexical H on the penultimate vowel. Right to left construction of right-headed feet produces the wrong result in this case.



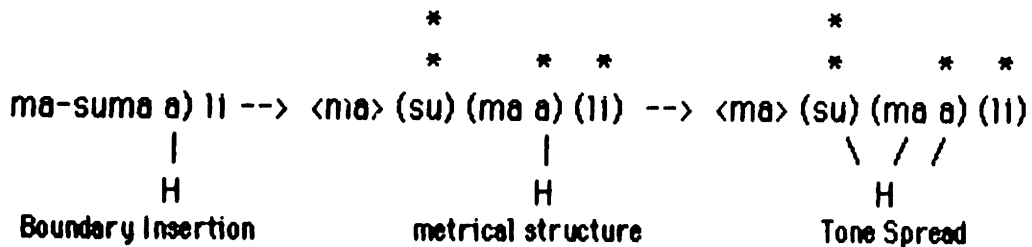
The problem with the above derivation is that the penultimate vowel with the lexical H tone is not stressed by the metrical rules. Instead, the vowel to its immediate left is stressed, and the H-L alternation is thrown off by one mora. One must ensure, then, that the high-toned vowel is always stressed, so that right to left constituent construction stresses every other vowel to the left of the high-toned vowel.

The stressing of the high-toned vowel is brought about by a rule which inserts a right metrical boundary to the right of the line 0 asterisk of a high-toned vowel. This sort of metrical rule was first proposed by Goldsmith, Peterson, and Drogo (in press) for Xhosa; variants of Metrical Boundary Insertion are found in the analyses of Digo and Sukuma. The effect of such a rule is to make high-toned vowels honorary metrical heads.

(38) Metrical Boundary Insertion: Insert a right bracket to the right of the line 0 asterisk of a vowel linked to H.



Metrical Boundary Insertion applies before the other rules of metrical structure assignment. The latter set of rules must "respect" the boundary placed by rule (38).



Delinking deletes the association of the H to the vowel of [-ma-]. The resultant surface form is the desired ma-súmaóli.

Metrical Boundary Insertion (38), Metrical structure assignment (35), Tone Spread (36), and Delinking (37)—along with the lexical linking of each noun's single H tone—suffice to derive the nominal tone patterns in (28a) and (32). These are the nouns which keep their H tone(s) in all phrasal environments.

Recall that the nouns in (33a) lose their second-vowel H tone when followed by another word.

(33) a. ki-wíkilyo	'cover'	(P. 199)
ki-wíkilyo chaángu	'my cover'	
lu-gúlu	'leg'	
lu-gulu lwaángu	'my leg'	
ngoóngowe	'marble'	
ayí ngoongowe lí	'that isn't marble'	

Pulleyblank analyzes these nouns as having no lexical accent mark on any vowel; his rule of metrical structure assignment (34) constructs a binary foot only when these nouns are final in the phrase.

In my analysis these nouns have no lexical H tone; binary constituents are constructed from right to left anyway.

<ki> (wi) (ki lyo) <lu> (gu lu) <ngo> (o) (ngo we)

As will be shown directly, the binary feet in toneless words must be left-headed, not right-headed. Rule (35iii) must be altered to accommodate this fact.²³

- (35) iii. In toneless words, construct left-headed, binary constituents from right to left; else, construct right-headed, binary constituents from right to left on line 0.

Left-headed constituents produce the following pattern of stresses in toneless words.

* *	*	* *
<ki> (wi) (ki lyo)	<lu> (gu lu)	<ngo> (o) (ngo we)

As before, the line 1 asterisks are grouped into a single left-headed constituent.

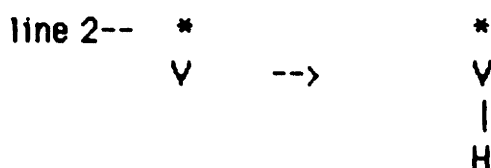
*	*	*
(* *)	(*)	(* *)
<ki> (wi) (ki lyo)	<lu> (gu lu)	<ngo> (o) (ngo we)

Another sort of metrical-tonal rule applies next. This is a rule which inserts a H tone in the tonal tier and links the tone to the timing slot of a vowel with a certain level of stress. In the toneless nouns of Kimatuumbi, the rule of High Tone Insertion links the inserted H to a toneless vowel which bears a line 2 stress.²⁴

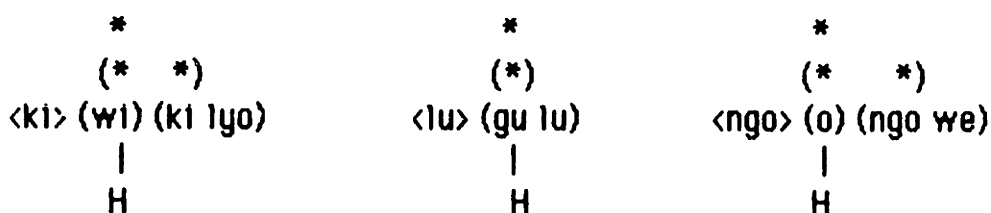
²³The added stipulation to rule (35iii) resembles the rule of foot construction which Halle and Vergnaud (1987, 24-25) posit for Yidin⁷. There, binary feet are right- or left-headed depending on the location of long vowels in the word.

²⁴A similar rule is found in Sukuma, linking an inserted H to a toneless vowel with a line 1 stress.

(39) High Tone Insertion: insert H on the tonal tier and link it to a vowel with line 2 stress.²⁵

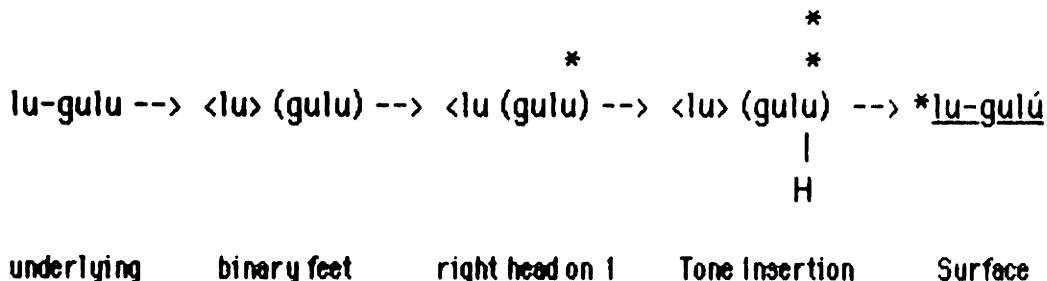


High Tone Insertion applies to the three nouns of (33a).



The H tone inserted by rule (39) does not interact with the rules of Tone Spread or Delinking (since it can spread nowhere to the left). These words surface with the desired second-mora H tone: ki-wíkilyo, lu-gúlu.

If the binary feet in the toneless words were right-headed as in words with lexical H tones, then an incorrect surface tone pattern would be derived for the second noun.

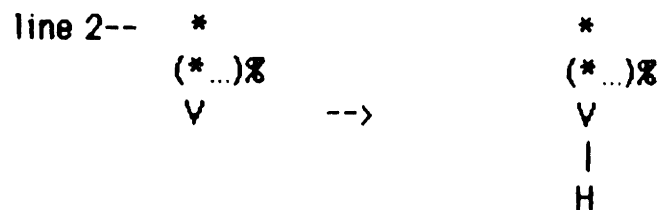


²⁵The fact that the line 2 stressed vowel is toneless need not be mentioned in the context of the rule: presumably, some universal convention prevents a H tone from being linked to a vowel (i.e. timing slot) which is already linked to a H tone. Therefore, a high-toned vowel with line 2 stress will fail to undergo the rule.

For this reason it is posited that toneless nouns have left-headed constituents.

Recall, though, that High Tone Insertion should apply only when the toneless word is final in the utterance: in phrase-medial contexts the noun must remain toneless. This fact necessitates an alteration of rule (39).

(39') High Tone Insertion: Insert H on the tonal tier and link it to a vowel with line 2 asterisk if this asterisk is head of a utterance-final constituent of line 1 asterisks.²⁶



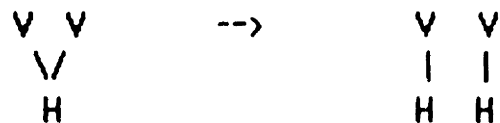
The line 1 constituent of a toneless noun is adjacent to the utterance boundary only if the noun is final in the utterance. The revised rule of High Tone Insertion puts a tone on the second mora only if the noun is last in the utterance.

After the rules of Tone Spread, Delinking, and High Tone Insertion apply, a rule of Linearization applies. This rule splits up a multiply linked H tone into a number of single linked H tones.²⁷

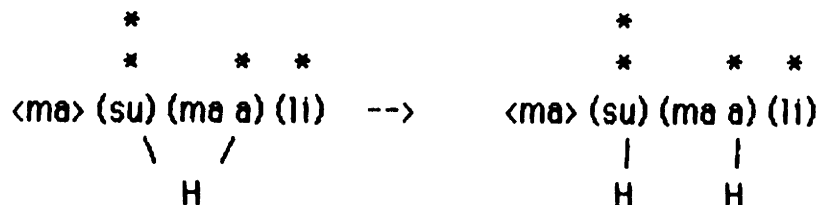
²⁶The percent sign '%' is used to mark a phrase or utterance boundary.

²⁷Such a rule is needed also for Semitic morphology. See also Odden 1980 for arguments for Linearization of multiply linked H tones in Shona.

(40) Linearization: copy H and link one-to-one to vowels.

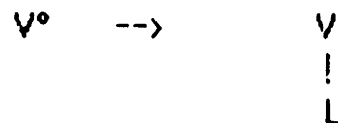


Linearization turns a doubly linked H tone into two singly linked tones..

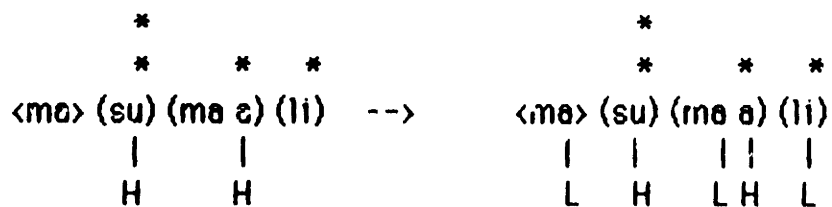


Thereafter, a rule of Default Low Tone Insertion fills in all toneless vowels with a L tone.

(41) Default L-insertion: insert and link L to every toneless vowel.²⁸



Default L-insertion applies to every noun.



--> ma-súmaóli

²⁸Here and elsewhere the degree sign '°' indicates a tone-bearing unit which is not linked to a tone, or a tone which is not linked to a tone-bearing unit (i.e. is floating): for example, V°, H°.

The Kimatuumbi noun tone patterns discussed so far are derived by the following set of ordered rules.

- (42) Kimatuumbi
 - Metrical Boundary Insertion (38)
 - Metrical Structure Assignment (35)
 - Tone Spread (36)
 - Delinking (37)
 - High Tone insertion (39)
 - Linearization (40)
 - Default L-Insertion (41)

Most of these rules appear again in the discussions of Digo and Sukuma tonology. Many other details of Kimatuumbi tone assignment must be put aside here.

2.3.2 Attraction and displacement in Ci-Ruri

In this section I give a metrical analysis of tone in the infinitive in Ci-Ruri, another Bantu language of Tanzania. The data are taken from David Massamba's article in Clements and Goldsmith 1984.²⁷ Massamba presents there an accentual analysis, much like Pulleyblank's 1983 analysis of Kimatuumbi.

Massamba's accent is a diacritic feature of certain morphemes; accents are moved and deleted by specific rules (viz., Penultimate Back-Hopping, Stem Accent Deletion, Prefix Post-Accenting, etc.). For every accent in a word, the tonal melody L-H-L is inserted and the initial L of the melody is linked to its respective accented syllable. Other rules apply to spread around the tones in the desired fashion (Tone Simplification, Final High Spread).

The analysis presented below differs from Massamba's in the following regards. First, "accent" is not a diacritic feature of certain stems.²⁸ Rather, accents are line 1 heads erected by the parametrized rules of metrical structure assignment. The relevant distinction, then, is not between accented and unaccented morphemes, but between high-toned and toneless morphemes. Second, the tonal melody of words is simply H or nothing, and this melody is present in the lexical representation of morphemes: it is not introduced into the derivation at any particular stage.

Morphological structure plays a role in the analysis. Making certain assumptions about the constituency of certain Bantu morphemes allows a

²⁷The number of the page in Massamba 1984 from which the data is taken will be found in parentheses on the right side of the page across from numbered examples.

²⁸Cf. Pulleyblank's 1986, 154-f. discussion of this notion of "accent".

simple analysis of various phenomena. Specifically, noun class markers are words separate from the following nominal. The separateness of class markers is not evident in Kimatuumbi, where they behave more or less like phonological proclitics. Ci-Ruri noun class markers do not count in the word-level rules of metrical structure assignment, unlike the noun class markers of Kimatuumbi, which count in the rule of extrametricality.

As in many Bantu languages, Ci-Ruri has a two-way lexical distinction between verb stems: some stems are toneless (43a) and some have a single lexical H tone (43b). This distinction is seen in the infinitives in (43). (ku- is the noun class prefix for infinitives and o- is a pre-prefix which is found on many nouns. Vowels are not marked for L tones in the data below, except where the L is part of a rising or falling contour tone.)

(43)	a.	o-ku-taβura	'to tear apart'	(M 235)
		o-ku-sorotoro	'to pull out'	
		o-ku-gura	'to buy'	(M 241)
		o-ku-gur-ira	'to buy for'	
	b.	o-ku-sumíka	'to tie'	(M 235)
		o-ku-saβúra	'to dish out'	
		o-ku-surúmura	'to untie'	
		o-ku-téma	'to cut'	(M 240)
		o-ku-tem-éra	'to cut for'	

The toneless stems have no lexical H to associate anywhere, and so a rule of default L tone insertion applies to assign each toneless vowel a L tone. The high-toned stems locate their H on the second, or peninitial, vowel of the verb (i.e., not counting the pre-prefix and the infinitive class marker): (o-ku)-surúmura. However, if the verb is only two syllables long,

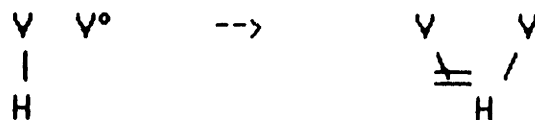
the lexical H is located on the first syllable, not the second: (o-ku)-téma, not *(o-ku)-temá.

The last two infinitives of (43a) and (43b) show stems which have been augmented by the applicative suffix -ir- 'to X for someone'.²⁹ This suffix is toneless of itself, seeing that it contributes no H to the toneless stem /gur/: o-ku-gur-ira. However, with the high-toned stem /tem/ the resulting verbal word is now longer than two syllables, so the lexical H of the verb stem shows up on the second vowel, that of /-er-/:

(o-ku)-tem-éra.

Let us leave aside for a moment the issue of initial H tone on disyllabic verbs like o-ku-téma. In all other cases of high-toned stems, the H clearly gravitates to the vowel of the second syllable. Let us suppose that H tones in Ci-Ruri are linked to the first vowel of a verb stem.³⁰ In this case one must also posit a rule of tone shift for Ci-Ruri. Such a rule shifts a H tone to the next vowel on the right if the vowel is toneless. In fact, tone shifting is very common in the languages of Tanzania: it is found in Digo, Sukuma (chapters Three and Four), Chizigula (Kenstowicz and Kisseberth 1989, and Jita (Downing 1988).

(44) Tone Shift: link H to a toneless vowel on the right, and delete the linkage to the left vowel.



²⁹This suffix ablauts to [-er-] in contexts which I will not define here.

³⁰Perhaps by left to right association of tones to vowels in the lexicon.

Tone shift moves the H tone which is lexically linked to the first vowel to the second vowel of the verb stem.

(45) su mi ka --> su mi ka su ru mu ra --> su ru mu ra
 | ≧ | | ≧ |
 H H H H

This leads to the surface forms oku-sumíka and oku-surúmura.

In high-toned bisyllabic verbs such as oku-téme, Tone Shift is blocked by the presence of a Low tone which is always linked to the final vowel of the utterance. A rule inserts this L tone at the right utterance boundary in the course of the derivation. Because Tone Shift applies only to a toneless vowel, the H on the stem-initial vowel cannot move away.³¹

oku te ma --> oku tema -->Shift d.n.a. --> oku-téme
 | | | | |
 H H L H L

The rule which inserts the Low tone at the right boundary of the utterance is given in (46).

(46) Boundary L-insertion: insert L and link it to the final vowel.

V% --> V%
 |
 L

³¹Downing (1988a, 29) shows that in Jita, a dialect closely related to Ci-Ruri, the stem-initial H tone of bisyllabic verbs does shift when the verb is not in phrase-final position: oku-Bóna 'to see' vs. oku-Bóná iifóni 'to see a bird'. The H of the verb stem can shift in phrase-medial position because there is no boundary L tone on the following vowel, since this L tone is linked only to the final vowel of the utterance. Massamba does not give any similar Ci-Ruri data.

Boundary L-insertion rules appear in the tonology of Digo and Sukuma as well.

Toneless verb stems such as /taBur/ and /gur/ do surface with H tones when a third person object marker is prefixed to the stem: /mu-/ 'him/her', /Ba-/ 'them', /li-/ 'it'. These third person object markers have their own lexical H tone which they contribute to the verbal word. Consider the paradigm in (47) with the toneless stem /gur/.

- (47) a. o-ku-gura 'to buy' (M 241)
 b. o-ku-gur-ira 'to buy for'
 c. o-ku-mu-gúra 'to buy him/her'
 d. o-ku-mu-gúr-ira 'to buy for him/her'

These tone patterns are also due to the operation of Tone Shift. The derivations of (47c) and (47d) can be seen in (48).

(48) underlying:	mu-gura	mu-gur-ira
	H	H
Tone Shift	mu-gu ra	mu-gu r-ira
	u	u
	H	H
Default L-insertion	mu-gu ra	mu-gu r-ira
	L H L	L H L L

When two high-toned object markers are prefixed to a toneless verb, one finds evidence of two surface H tones: one H shows up as a level tone on the second vowel of the verbal word, and the second H shows up as part of a

rising-falling pattern on the penultimate and final vowels. Consider the data in (49).³²

- (49) a. o-ku-Ba-li-gur-ĩrâ 'to buy it for them' (M 242)
 b. o-ku-Ba-li-taBur-ĩrâ 'to tear it apart for them'
 c. o-ku-Ba-li-sorotor-ěrâ 'to pull it out for them'

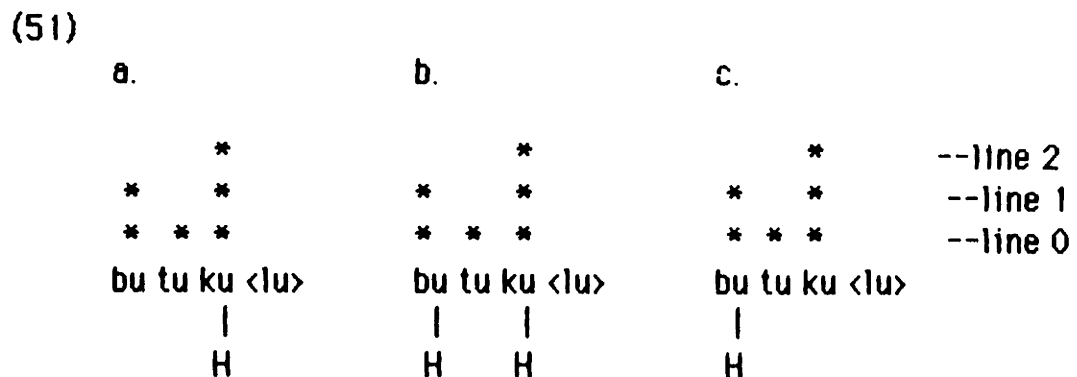
These words have two lexical H tones, both supplied by the third person object markers /Ba-/ and /li-/. These two H tones displace to nearly opposite poles of the verbal word. The first H starts out on the vowel of /Ba/ but shifts to the second vowel of the verb. The second H starts out on the vowel of /li/ and surfaces on both the penultimate and final vowel (which is demonstrated directly). The second H tone has traveled quite a distance – four to five syllables in (49b,c).

The movement of the second H tone – that of OM /li-/ – appears to be a non-local movement operation. That is, the H tone is moved to a vowel which is indeterminately distant from the vowel of origin. This sort of long-distance tone displacement resembles the effects of Goldsmith's (1987) Tone-Accent Attraction Condition. In his analysis of Kintandu, Goldsmith proposes that certain vowels in a word have metrical accents (or stresses), and that such metrically prominent syllables attract tones away from less prominent syllables. Goldsmith's formal statement of the "magnetic" power of accented vowels is given in (50).

³²Massamba 1984, 242 points out that it is possible to have two object markers with a verb when the verb has an applicative suffix. The indirect object marker always precedes the direct object marker, except when one is a 1st person object, in which case the order is DO-IO-Verb.

- (50) **The Tone-Accent Attraction Condition (Goldsmith 1987)**
 A tone-to-grid structure is well-formed if and only if there is no tone-bearing syllable which has a lower level of accent than a toneless syllable. [Thus, if a syllable S has a tone, all syllables with a greater level of accent than S must also bear a tone.]

The condition in (50) entails that of the following autosegmental structures, both (51a) and (51b) are well-formed, since the line 1 stressed syllable bu- only bears a H tone when the line 2 stressed syllable ku- also bears a H tone. (51c), however, is ill-formed: the highest stressed syllable is toneless, but a lower stressed syllable is high-toned.

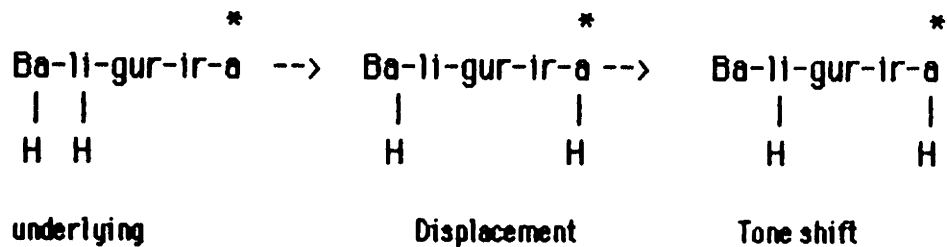


In Goldsmith's analysis of Kintandu, the single H tone in (51a) and (51c) is due to a H tone prefix to the noun. In (51a) this H tone has displaced along the tonal tier and is linked to the penultimate vowel, as desired. In (51c) the prefixal H tone has failed to displace as far as it should, and so the result is an ungrammatical form.

Goldsmith's Tone-Accent Attraction Condition removes the non-local nature of tone displacements, such as those found in Kintandu and Ci-Ruri. That is, the tone does not displace across some indeterminate distance, but rather it displaces to the next vowel which bears a stress of degree n

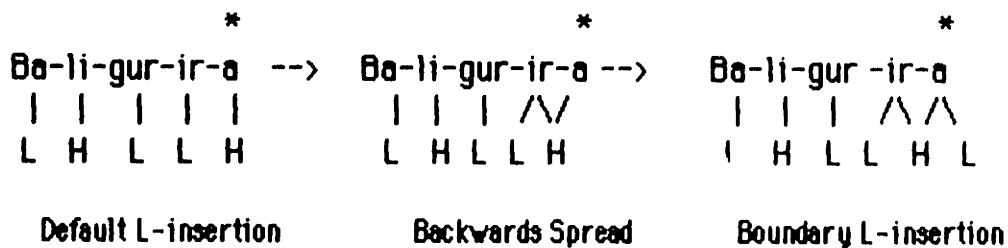
(where $n = 1, 2, 3, \dots$). Defined on the line 2 tier of metrical asterisks, then, Kintandu displacement is simply the movement of a tone from one line 2 unstressed vowel to the next line 2 stressed vowel. In this sense of "next-ness" displacement is a local operation on the line 2 tier.

Returning to Ci-Ruri and displacement to the final vowel, it appears in the forms in (49) that the final vowel is stressed and therefore tone-attracting. The vowel of the Object Marker /li-/ is unstressed; its H tone, therefore, is obliged to displace to the toneless final vowel, else the structure is ill-formed by the Tone-Accent Attraction Condition.



Default L-insertion (cf. 41) applies to the other toneless vowels.

Subsequent rules then spread the H of the final vowel back to the penult to create a rising LH contour on the penultimate vowel. Boundary L-insertion (46) adds a L tone to the final vowel to create a falling HL contour on it.



--> Surface: o-ku-Ba-li-gur-ir-a

Alternatively, one could suppose that the penultimate vowel, not the final vowel, is accented and attracts the second H; then a rule of rightward spread would apply to create the contour tones on the last two vowels. Ci-Ruri noun tone patterns help to decide between these two possible analyses, because here the difference between H tone on the penultimate vowel and on the final vowel is clear.

Ci-Ruri has three classes of nouns: toneless nouns (52a), nouns with penultimate H (52b), and nouns with rising-falling contours on the penultimate and final vowels, respectively (52c).

(52) Ci-Ruri Noun Patterns

(M 253)

a. toneless	b. penultimate	c. rising-falling
o-mu-sasi 'mad person'	o-mw-aána 'child'	a- <u>Ba</u> -yǎrâ 'girls'
e-mi-simu 'arrows'	a- <u>Ba</u> -gási 'women'	e-ci-Bũyâ 'gourd'
a- <u>Ba</u> -saani 'friends'	o-mu-rúme 'man/husband'	o-Bu-gǒrô 'snuff'
o-mu-wɔfu 'blind person'	o-mu-teéki 'cook'	amăt î 'trees'

The difference between a-Ba-gási 'women' and a-Ba-yǎrâ 'girls' is that a-Ba-gási has a H linked to the penultimate vowel, whereas a-Ba-yǎrâ has a H linked to the final vowel. The rule of Backwards Spread (53) links the H on a word-final vowel to the penultimate vowel as well. The boundary L tone is linked to the final vowel to make a falling tone: a-Ba-yǎrâ. These same rules of Backwards Spread and Final L-insertion have applied in like

manner to the verbs in (49). The rising-falling pattern, then, is a sign of final accentuation, not penultimate accentuation.

Backwards Spread is formulated in (53): the same rule is found in the Tanzanian language Digo (Chapter Three).

(53) Backwards Spread: spread a H linked to the phrase-final vowel back to the penultimate vowel.



The metrical structure rules of Ci-Ruri have yet to be discussed. From the preceding discussion, it might seem that Ci-Ruri metrical constituents are unbounded and right-headed, so that the final vowel is always accented. This cannot be correct, however, since one predicts in this case that a H tone is always attracted to the final vowel. Recall the data in (43b) and (47c,d) where the H tone of the stem or Object Marker always surfaces on the second vowel of the verbal word, not the final vowel.

- | | | | | |
|------|----|-----------------|----------------------|---------|
| (43) | b. | o-ku sumíka | 'to tie' | (M 235) |
| | | o-ku saBúra | 'to dish out' | |
| | | o-ku surúmura | 'to untie' | |
| | | o-ku téma | 'to cut' | (M 240) |
| | | o-ku tem-éra | 'to cut for' | |
| (47) | c. | o-ku mu-gúra | 'to buy him/her' | |
| | d. | o-ku mu-gúr-ira | 'to buy for him/her' | |

A H tone linked to the initial vowel of the word does not displace to the stressed final vowel, but rather shifts to the next vowel. The fact that a stressed final vowel cannot draw away the tone of an initial vowel

indicates that the initial vowel has an equal or greater degree of stress than the final vowel.

<p>(54) * *</p> <p> tem - er - a</p> <p> </p> <p> H</p>	<p> * *</p> <p> mu-gur-ir-a</p> <p> </p> <p> H</p>
---	--

Displacement does not apply to such structures, since they are not in violation of the Tone-Accent Attraction Condition.

The representations in (54) suggest that both the first and last vowels of verbal words are stressed.³³ Perhaps the simplest way to achieve this end is to posit that the Final Vowel morphemes of Ci-Ruri (/ -a/ and / -e/) have an inherent line 1 stress and that line 0 constituents are left-headed and unbounded. These stipulations result in stress on both the first and last vowels.

		*		*		*		*
mu-gur-ir-a	-->	(mu-gur-i)	(ra)	-->	(mu-gur-i)	(ra)		
H		H		H				

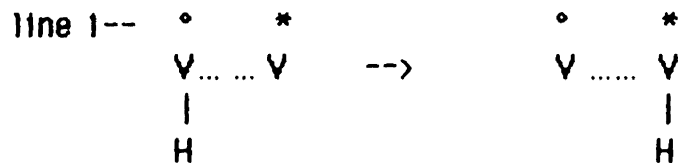
Two unbounded left-headed feet are formed. The second consists of the final syllable only; this stressed syllable is a foot by itself because the rules of constituent construction respect the inherent headedness of the lexical line 1 asterisk. The H tone is linked to a stressed vowel, and so the representation is well-formed without the benefit of Displacement (56).

³³This analysis echoes the analysis of Chizigula in Kenstowicz 1987, Kenstowicz and Kisseberth 1989.

(55) Ci-Ruri Metrical Structure Assignment:

- i. Assign a line 0 asterisk to all vowels.
- ii. Construct left-headed, unbounded constituents on line 0 [respecting the lexical stresses of Final Vowels].
- iii. Locate the heads of line 0 constituents on line 1.

(56) Displacement: move H from a stressless vowel to the following line 1 stressed vowel.



Tone Shift (44) applies to the initial H tones in (54) after Displacement (56) fails to apply, yielding second vowel H tones in these forms (along with Default L-insertion): (oku) tem-ér-a and (oku) mu-gúr-ir-a.



Consider now the paradigm of high-toned verbs with a third person object marker, comparing it with the same paradigm for a toneless verb stem (repeated from 47 above). One expects the object marker to contribute a H tone to the high-toned verbal word, as seen in (47) with the toneless stem /gur-/.

(57) high-toned stem

- | | | |
|--------------------|----------------------|---------|
| a. o-ku téma | 'to cut' | (M 240) |
| b. o-ku tem-éra | 'to cut for' | |
| c. o-ku mu-téma | 'to cut him/her' | |
| d. o-ku mu-tém-era | 'to cut for him/her' | |

(47) toneless stem

- | | | | |
|----|-----------------|----------------------|---------|
| a. | o-ku gura | 'to buy' | (M 241) |
| b. | o-ku gur-ira | 'to buy for' | |
| c. | o-ku mu-gúra | 'to buy him/her' | |
| d. | o-ku mu-gur-íra | 'to buy for him/her' | |

Both the toneless stem /gur-/ and the high-toned stem /tem-/ surface with a single high tone associated with the second vowel. It is interesting that (57c,d) do not parallel the forms in (49) which also have two underlying H tones (from two separate object markers). Why does one find o-ku-~~ba~~-lí-sorotor-~~ě~~râ but not *o-ku-mu-tém-~~ě~~râ? One expects the latter form, given that there are two underlying H tones in the infinitive 'to cut for him/her'. One H is associated with the stem, and the other with the third person object marker /mu-/. Nevertheless, this infinitive surfaces as if it had only one lexical H, parallel to o-ku-mu-gúr-ira.

Following Massamba 1984 and Kisseberth 1982, I posit a rule of stem tone deletion, familiar from many Bantu languages as "Meeussen's Rule" (cf. Goldsmith 1984b). This rule deletes the H of the verb stem when it is preceded by the H of an object marker.

- (58) Meeussen's Rule: delete the stem H tone when preceded by an object marker with H tone.

$$H \Rightarrow \emptyset / H [\text{stem} \text{ — }]$$

Meeussen's Rule must apply in the word-level phonology, while the bracketing distinction between stems and affixes is still available.³⁴

³⁴I assume that this sort of internal word structure is not available in later levels of the phonology.

Notice that the second of two H tones is deleted only when that H is a stem H: two H tones from two object markers remain intact (see the derivation of 49a above).

Meeussen's Rule (58) applies to the lexical representation of mu-tem-era, deleting the stem high.

(59)	mu-tem-era	⇒	mu-tem-era
	H H		H ∅

The single remaining H tone undergoes Tone Shift (44) : mu-tém-era. Default L-insertion rounds out the derivation.³⁵

The operation of Meeussen's Rule (58) can also be seen in the paradigm of high-toned verbs with two object markers. Such infinitives surface like those in (49), as if there were two lexical H tones (and not three, one from the stem and one from each of the two object markers).

(59)	a.	o-ku-Ba-lí-tem-ěrá	'to cut it for them'	(M. 242)
		b.	o-ku-Ba-lí-sumik-ĭrá	'to tie it for them'
		c.	o-ku-Ba-lí-surumur-ĭrá	'to untie it for them'

Here the lexical H of the object marker li- has triggered Meeussen's Rule with the lexical H of the verb stem. Thereafter, the derivation of these infinitives proceeds as with toneless stems (49).

³⁵If Meeussen's Rule deleted the prefixal H rather than the stem H, one would expect the form *mu-tem-éra after Tone shift moved the remaining stem H to the following vowel. The fact that the surface H shows up on the stem indicates that the prefixal H remains to be shifted, and it is the stem H which is deleted by Meeussen's Rule.

(60)

Ba-li-tem-era	⇒	ba-li-tem-era	Meeussen's
l l l		l l	Rule
H H H		H H Ø	

The rule of Tone Shift is a phrase-level rule in Ci-Ruri, as evidenced by the fact that it applies across word boundaries (as in Digo). When an Object Marker H tone displaces to the final (stressed) vowel of a verb, that H tone may undergo Tone Shift when followed by another word. This is seen in the forms in (61).

- (61) a. o-ku-Ḟa-lí-sumik-írâ 'to tie it for them' (M. 244)
b. o-ku-Ḟa-lí-sumik-ira lí-Bui 'to tie the stone for them'
c. o-ku-Ba-lí-sorotor-ěrá 'to pull it out for them'
d. o-ku-Ba-lí-sorotor-era lí-Bui 'to pull out the stone for them'

In these phrases the second H of the verbal word ends up on the prefix of the noun, not the final vowel of the verb. (Because the vowel of the noun class marker li- is not phrase-final, Backwards Spread (53) and Boundary L-insertion (46) do not apply to create rising-falling intonation.)

Ci-Ruri tonology, then, contains the following ordered rules.

(62) Ci-Ruri tone rules

Metrical Structure Assignment (55)
Displacement (56)
Tone Shift (44)
Default L-insertion (cf. 41)
Backwards Spread (53)
Boundary L-insertion (46)

2.3.3 Summary of metrical-tone interactions

The preceding case studies of Kimatuumbi and Ci-Ruri provide examples of some of the ways in which metrical structure interacts with the tonal tier. The primary modes of metrical-tone interaction are (i) spreading of a tone to a stressed vowel (with subsequent delinking), and (ii) displacement of a tone to a stressed vowel (as governed by the Tone-Accent Attraction Condition). Lexical tone linkings may also play a role in defining metrical structure, as demonstrated in Kimatuumbi. Here the position of an underlying H tone determined the position of metrical brackets. Similar rules show up in the analyses of Digo and Sukuma.

These types of metrical-tone interaction show up in Digo and Sukuma, along with most of the other tonal rules formulated above: Backwards Spread, Metrical Boundary Insertion, Boundary L-insertion, Default L-insertion, Tone Shift, and High Tone Insertion. These rules, along with some non-traditional notions concerning the make-up of Bantu words and phrases, form the basic armamentarium for the analysis of the more complex tone systems.

Chapter 3

TONE AND METRICAL STRUCTURE IN DIGO

In this chapter I present an analysis of Digo, a language spoken in the border region of Kenya and Tanzania (Guthrie's Zone E. 73). All of the data and many of the insights of my analysis are from Kisseberth's article in Clements and Goldsmith 1984.¹

The facts of Digo tonology are extremely complex. Only a highly modular and strongly constrained phonological theory can explain how these patterns of intonation may be learned. The analysis to follow builds upon the following hypotheses. First, I adopt the Lexical Phonology framework (cf. chapter 1.3.7) with its distinctions between rules of word-level phonology and rules of phrasal phonology, as well as the further subdivision of these two sets of rules into cyclic and non-cyclic blocks. Into this model I import the idea expressed by Clements and Goldsmith (1984, chapter 1) that all rules of metrical structure assignment precede all rules of tone manipulation (linking, spreading, copying, deletion, metathesis). More specifically, I adopt the working hypothesis for Digo and other accent languages that rules of tone manipulation are found only in the phrasal (post-lexical) component of the grammar. That is, the lexical phonology (cyclic and non-cyclic) manipulates the abstract² markers of metrical

¹The number of the page in Kisseberth 1984 from which the data is taken will be found in parentheses on the right side of the page across from numbered examples.

²Accent markers (asterisks on line 1, 2, constituent boundaries, etc.) are "abstract" in the sense that they do not have any inherent phonetic value of high intonation, vowel lengthening, or increased intensity; 'accent' is not equivalent to 'high tone' (cf. Inkelas and Zec 1988).

structure; tones may be present in lexical entries, but they play a minimal role in lexical phonology. The post-lexical phonology then uses the metrical structure to determine tone placement. These notions will be illustrated in the analysis of Digo below.

3.1 Difficulties for a tonal analysis of Digo

In this section I will introduce some of the simpler facts of Digo tonology and show that an analysis which employs only tones as the primitives of tonology runs into difficulties.

Digo, like all Bantu languages, has lexical distinctions between high-toned and low-toned verb stems and nouns. The following data illustrate this distinction: (1a) shows low-toned nouns; (1b) shows high-toned nouns. (2a) shows low-toned infinitives; (2b) shows high-toned infinitives.³

(1) a.	n-jira	'paths'	(K160)
	mu-hama	'millet'	
	tsongo	'bird(s)'	
	mu-hambo	'trap'	
	ma-ruwa	'flowers'	
	gari	'car'	
	tunda	'fruit'	
	banda	'shed'	
	goma	'drum'	
	chi-ronda	'sore'	

³Throughout this chapter, the following symbols will be used: [β] indicates a voiced bilabial sound which behaves as a sonorant; tone indications are high- [á], low- [à] or unmarked [a], rising- [ǎ], falling- [â].

b. chi-kǒpwê	'sweet potato leaves'	(K161)
chi-tábu	'book'	
kǔndê	'beans'	
kǎndê	'food'	
zódo	'cooked mangoes'	
bătâ	'duck'	
bǔndâ	'bunch'	
báda	'cassava meal'	
dǒnâ	'hard porridge'	
sahǎñi	'plate(s)'	
kofŷyâ	'hat(s)'	
pwéza	'octopus'	

(2) a. ku-ambir-a	'to tell'	(K106)
ku-changamuk-a	'to be cheerful'	
ku-dekez-a	'to spoil someone'	
ku-erek-a	'to carry on the back'	
ku-gandamiz-a	'to press, squeeze'	
ku-tsumbur-a	'to unearth'	

b. ku-arũkâ	'to begin, start'	(K107)
ku-bomǒrâ	'to demolish'	
ku-gongomě-â	'to hammer'	
ku-furukǔt-â	'to move restlessly'	
ku-sindĭk-â	'to shut the door'	
ku-yakinĭsh-â	'to confirm'	
ku-dunduríz-a	'to place in reserve'	
ku-fukíz-a	'to apply heat'	
ku-koróg-a	'to stir'	
ku-kurúg-a	'to smoothen by rubbing'	
ku-siríg-a	'to rub'	
ku-tanyiríz-a	'to drive off predators'	

There are two generalizations to be seen in these data. First, whether a stem is low-toned or high-toned is not predictable from its segmental make-up. Second, the position of the high tone in the word is

predictable for high-toned nouns and verbs: the high tone is realized either as a level tone on the penultimate vowel or as a rising tone on the penultimate vowel and a falling tone on the final vowel: cf. pwéza 'octopus', saháni 'plates'. Kisseberth notes (107) that these two intonation patterns – high/low on penult/final vs. rising/falling on penult/final – are in complementary distribution. Words with a level high on the penultimate vowel always have a voiced obstruent (/d, z, g, gw, dz, v, vy, b/)⁴ between the penultimate and final vowels. Following Kisseberth, therefore, I treat these two patterns as a single tonal type in underlying representation (viz., high-toned stems); a later rule which makes reference to voiced obstruents creates the distinction in surface intonation. This will be spelled out below.

A natural interpretation of these facts would be to posit a two-way distinction between stems: some stems have lexically supplied high tones (hereafter 'H') and other stems have no lexical tonal specification. The words in (1a) and (2a) would have no underlying tone; those in (1b) and (2b) would have an underlying H. In (1a) and (2a) a default rule assigns a low (L) tone to every vowel. In (1b) and (2b) the underlying H is lexically pre-attached to the final syllable and a rule spreads a phrase-final H backwards to the penult. A final (boundary)⁵ L is linked to the last vowel: this produces a falling tone on the final vowel. Any remaining vowels are assigned low tones by the default rule. Finally, a rule spreads the preceding L to the penult to produce rising intonation (except where a voiced obstruent

⁴Prenasalized obstruents such as /mb/, /nd/, /nj/, etc. do not count as voiced obstruents in Digo; at least, they never block spreading or displacement of H tones. Following a suggestion by Jim Harris, I view these prenasalized segments as being underspecified for voicing in underlying representations. A late rule fills in the feature [+voice] after all of the tonal perturbations have taken place.

⁵Following Pierrehumbert 1980 I mark boundary tones with a '%' sign.

changes this pattern into a level H on the penult – see below). The steps in this derivation are illustrated in (3).

(3)	chi-kopwe	tsongo
underlying:	 H	
Backwards Spread:	chi-kopwe \ H	tsongo
Boundary L- insertion:	chi-kopwe \ \ %L H L%	tsongo \ %L L%
Rising Tone Formation:	chi-kopwe / \ / \ %L H L%	tsongo \ %L L%
Surface:	chi-köpwê	tsongo

There is a problem with this analysis, however. As it stands, one has no explanation for why the H is always found at the right end of the word. If H tones were lexically pre-linked, then one might reasonably expect to find H tones on any syllable of the word, including the initial syllable. This is never the case, though: one never finds a word of the shape *chí-tabu.

A strictly tonal analysis can avoid this problem, however, by dropping the assumption that H tones are lexically pre-linked and by assuming rather that the H is "floating" in the underlying representation. An early rule of the grammar would then be responsible for linking the unattached H to the final vowel.

This move is also unsatisfactory, however. First of all, it is generally assumed in tonal analyses that tone-to-segment linkings are

governed by a Universal Association Convention (UAC). Pulleyblank's (1986, 11) statement of this convention is reproduced in (4).

(4) Association Conventions:

Map a sequence of tones onto a sequence of tone-bearing units, (a) from left to right

(b) in a one-to-one relation.

Well-formedness Condition:

Association lines do not cross.

These rules predict that tones are associated with the leftmost vowels in a word first, not the rightmost vowel as seems to be the case for Digo. That is, the UAC predicts that all high-toned Digo words should have the unattested pattern *chí-tabu.

There are two alternatives for the strictly tonal analysis of Digo. One alternative is to posit a rule for Digo which links H to the final syllable and which either precedes and bleeds the UAC or which follows and simply undoes the effects of the UAC. A second alternative is to deny the universality of the UAC altogether and to replace that convention with language-specific rules of left-to-right or right-to-left attachment of tones to tone-bearing units. In the case of Digo the grammar would have a rule stipulating that tones are linked to tone-bearing units one-to-one from right to left.

This analysis runs into problems, however, when one considers the behavior of H tones in phrases. Just as in single words there is a tendency in phrases for a H to attach as far to the right as possible. The data in (5) show that when a low-toned noun follows a high-toned verb as the direct object, the noun acquires the H of the verb.

- (5) a. n-jira 'path' (K163)
ku-onyěsâ 'to show'
ku-onyesa n-jĩrâ 'to show the way'
- b. ny-ama 'meat'
ku-afũnâ 'to chew'
ku-afuna ny-ãmâ 'to chew meat'
- c. n-guwo 'clothes'
ku-anĩkâ 'to dry'
ku-anika n-gũwô 'to dry clothes in sun'

These facts seem to fall out of the strictly tonal analysis, assuming that the rule of right-to-left linking takes place in the phrasal phonology, and not in the word-level phonology (or, perhaps not only in the word-level phonology). At the phrasal level the H of the verb is linked with the rightmost available vowel in the verb phrase: in (5a-c) this is the final vowel of the noun. Subsequent to this linking all the other rules apply as in the derivation in (3) above: Backwards Spread, Boundary L-insertion, Default L-insertion, and Rising Tone Formation.

Consider next verb phrases where both the verb and the noun have a lexical H, as seen in (6).

- (6) a. a-na-tsõr-â 'he's picking up something'
chi-dǎfũ 'young coconut'
a-na-tsor-a chí-dǎfũ 'he's picking up a young coconut'
- b. a-na-sũw-â 'he's washing something'
sahǎnî 'plates'
a-na-suw-a sáhánî 'he's washing something'

These facts do not fall out of the strictly tonal analysis. With right-to-left and one-to-one linking, one would expect the H of the noun to be linked to

the final vowel of the noun (intermediate chi-dafú, sahaní), and then the H of the verb would be linked to the next vowel to the left, the penultimate vowel of the noun (*a-na-tsor-a chi-dáfú, *a-na-suw-a sahaní). Subsequent rules will apply as in (3), but these rules will not bring about the correct surface forms. Simple right-to-left linking gives the wrong results.

Kisseberth (1984, 134, 171) modifies the strictly tonal analysis to include another rule which governs the attachment of the second H of two H in a phrase. This rule, called Displacement-to-Stem, moves a H from the leftmost vowel of the stem to its rightmost if possible, else to the vowel nearest the stem

This rule is used in the derivation of (6a), given in (7) below. There are two underlying H: one on the verb stem and one on the noun (7a). The first rule of the phrasal phonology links the rightmost H, the H of the noun, to the rightmost vowel (the rule of High Tone Displacement in Kisseberth 1984) as in (7b). Next, a rule inserts a low tone and links it to the initial voiced obstruent of the noun stem (the [d] of [dafu]): let us call this rule Obstruent L-insertion (7c). Next, Displacement-to-Stem applies to move the second H, the H of the verb, to the vowel of the noun class prefix (7d). It cannot move the H of the verb all the way to the noun stem [dafu] because of the intervening L of the voiced obstruent: the H is linked, therefore, to the vowel nearest the stem, the vowel of the noun class prefix. Next, the remaining tonal rules apply in order: Backwards spread (7e), Boundary L insertion (7f), Default L-insertion (7g), and Rising tone formation (7h).

(7)	a-na-tsor-a chi-dafu
a. underlying:	H H

- a-na-tsor-a chi-dafu
 | |
 H H
- b. rightward linking:
- a-na-tsor-a chi-dafu
 | | |
 H L H
- c. Obstruent L-insertion:
- a-na-tsor-a chi-dafu
 | | |
 H L H
- d. Displacement-to-Stem:
- a-na-tsor-a chi-dafu
 | | |
 H L H
- e. Backwards Spread:
- a-na-tsor-a chi-dafu
 | | |
 H L H
- f. Boundary L-insertion:
- a-na-tsor-a chi-dafu
 | | | |
 H L H L%
- g. Default L-insertion:
- a-na-tsor-a chi-dafu
 | | | | | | | |
 L L L L HL H L%
- h. Rising Tone Formation:
- a-na-tsor-a chi-dafu
 | | | | | | | |
 L L L L HL HL L%
- i. Surface: a-na-tsor-a chí-dǎfû

Mechanically, this solution, with its rule of Displacement-to-Stem, yields the correct intonation for this verb phrase. Nonetheless, this rule is objectionable on theoretical grounds. Consider Kisseberth's (1984, 134) statement of the rule of Displacement-to-Stem, reproduced in (8).

$$(8) \quad \begin{array}{c} V_i \\ | \\ H \end{array} \quad (Y) \quad V_j \quad \rightarrow \quad V_i \quad (Y) \quad \begin{array}{c} V_j \\ | \\ H \end{array}$$

Condition: Y is the maximal string of sounds which contains neither a voiced obstruent nor a vowel belonging to the verbal complex. V_i = a vowel that is not part of the verbal complex.

Kisseberth (134) explains this rule as follows: "[Rule (8)] says that a high tone (associated with a vowel other than the ultimate vowel) will associate with a vowel as far to the right as possible subject to the constraint that (a) it may not associate to the right of a voiced obstruent and (b) it may not associate to the right of a vowel in the verbal complex [or noun stem-BMS]." In other words, this rule tries to associate a H with the leftmost vowel of the verb stem or noun stem on the right. If this stem begins with a voiced obstruent, then Rule (8) associates the H with the vowel immediately preceding the voiced obstruent.

Such a rule is unsatisfactory on two counts. First, the rule includes a variable (Y) with two conditions. There has been a strong and successful tendency in phonological theory to do away with powerful theoretical devices such as conditioned variables, angle brackets, etc. Even if the theory should allow these devices, they must certainly have a high "cost" associated with them: that is, a theory without appeal to such devices which accounts for the data must be more highly valued than a theory employing conditioned variables and the like.

A second reason for dissatisfaction with Rule (8) is to be found in the expression "verbal complex" in the conditions of the rule. The "verbal complex" of Kisseberth 1984 includes not only the verb stem and its

derivational suffixes (extensions), it also includes the object markers which occur as prefixes on the verb stem. The motivation for this definition is seen in the inflected verbs in (9). The 3rd person subject marker /a-/ has a lexical H. The toneless verb stem /tsukur/ in (9a) shows that in the present tense (marked by /na/) the high tone of /a/ moves rightward all the way to the final vowel. In (9b), however, the stem /puput/ has its own lexical H, which is associated with the final vowel as in (7b). The H of the subject marker /a/ then shifts to the vowel of the object marker /mu/ and subsequently spreads rightward as far as possible.

- | | | | |
|--------|------------------|---------------------|--------|
| (9) a. | a-na-mu-tsukŭr-â | ‘he is taking him’ | (K127) |
| b. | a-na-mú-púpút-â | ‘he is beating him’ | (K126) |

The H of the subject marker /a/ moves to the vowel of /mu/, according to Kisseberth 1984, because /mu/ is part of the verbal complex or stem, and thus Displacement-to-Stem identifies the [u] of /mu/ as the first vowel of the verbal complex for the purposes of Rule (8). Although this notion of a “verbal complex” may have some utility in the description of Bantu languages (cf. Kisseberth, p. 129), it seems not to be a primitive of Universal Grammar. That is, it is not the norm for languages outside of the Bantu family to make appeal to this sort of constituent. As will be shown elsewhere, this notion “verbal complex” can be replaced by the better attested notion “phonological word.” Thus, Rule (8) (Displacement-to-Stem) is to be disfavored because of both its inherent complexity and idiosyncrasy.

The above arguments do not conclusively rule out an approach to Digo which admits only tones as primitives of tonology. Taken together, however, these considerations of the simpler facts of Digo tonology demonstrate that a strictly tonal analysis raises questions of learnability.

Is the human language acquisition device powerful enough to acquire a grammar which disregards the putative Universal Association Conventions or which relies on an idiosyncratic sort of constituent (viz., "verbal complex")? This question cannot be answered directly, of course. Instead, I offer below an analysis of Digo which employs simpler and better attested rules of grammar.

3.2 A Metrical Analysis of Digo

3.2.1 Tone and metrical structure in simple nouns and verbs

In this section I introduce the basic notions of an accentual analysis of Digo. The heart of this analysis is the notion that high tone may occur on vowels which are "heads" in the sense of metrical theory. That is, the rules which build metrical structure parse strings of speech sounds into constituents using a small set of well-defined, parametrized rules, as defined for example in Halle and Vergnaud 1987. The rule constructing metrical structure for Digo is given in (10).

- (10) Assign line 0 asterisks to all vowels; construct a right-headed, unbounded foot on line 0 and locate its head on line 1.

The output of this rule for simple words is a single constituent which contains the entire word and which is headed by the final vowel of the word. Rule (10) applies whether or not the word has a lexical H. The structure assigned by (10) is illustrated with examples from (1) and (2) above with both a high-toned and a low-toned noun and verb.

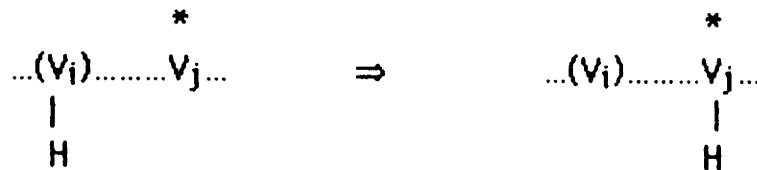
- (11)
- | | | | |
|--|----------------|--|----------------|
| | * | | * |
| | [ku-gongome-a] | | [ku-tsumbur-a] |
| | | | |
| | H | | |
| | | | |
| | * | | * |
| | [sahani] | | [chi-ronda] |
| | | | |
| | H | | |

Rule (10) is part of the word-level phonology (see also the section on neutralizing words).

This accent "attracts" some marked element of the intonational melody of a word. This rule of attraction is exemplified by the Ci-Ruri data in Chapter Two, where the H of an object prefix moves to the right edge of the verbal word. A similar rule of tone attraction is posited by Kenstowicz and Kisseberth (1989) for Chi-zigula, a close neighbor of Digo.

For Digo, the lexical melody of a word is either a single H tone or no tone at all. At some level of the grammar the single H becomes linked to an accented vowel at the right edge of the word. The rule which accomplishes this linking is formulated in (12).

(12) High Tone Displacement



This rule says that a singly linked H tone⁶ will reassociate with an accented vowel to the right which has no H tone. Presumably this last condition – that the target vowel have no H tone already – need not be stipulated. Universal Grammar would seem to rule out the possibility of a tone-bearing unit being linked to two tones of the same type. The label "High Tone Displacement" is from Kisseberth 1984. If a word has an accented vowel but no available H (cf. 11 above, ku-tsumbur-a, chi-ronda), then the

⁶The argument for assuming that Digo H tones are underlyingly linked and not floating is found in the discussion of Meeussen's Rule below.

accented vowel receives a L tone by default, just as do the unaccented vowels.

After High Tone Displacement the other tonal rules apply. These rules have already been seen in the derivations in (7) above, or in (9b) in the case of High Tone Spread. The formal statements of (7c, e-h) and High Tone Spread are given in order in (13).

- (13) a. Obstruent L-insertion: assign a linked L tone to voiced obstruents.⁷

$$\begin{array}{ccc} C & \Rightarrow & C \\ [+voice] & & | \\ & & L \end{array}$$

- b. High Tone Spread: spread a tone as far as possible to the right.

$$\begin{array}{ccc} [.....V...V...V...] & \Rightarrow & [.....V...V...V...] \\ | & & | / / \\ H & & H \end{array}$$

- c. Boundary L-insertion: link a L tone to the final vowel of the utterance.

$$\begin{array}{ccc} V & \Rightarrow & V \quad / \quad \text{---} \quad | \text{utterance} \\ & & | \\ & & L\% \end{array}$$

⁷The fact that the segment in question is not a sonorant need not be specified for the sake of the rule of Obstruent L-insertion, since one can posit that sonorants are underspecified for voicing in underlying representations, just like prenasalized obstruents (cf. fn. 4). A late rule, applying after Obstruent L-insertion, fills in the default feature [+voice] for sonorants.

d. Default L-insertion: assign a L tone to all toneless vowels.

$$V \Rightarrow \begin{array}{c} V \\ | \\ L \end{array}$$

e. Backwards Spread: spread a phrase-final H back to the preceding vowel

$$\begin{array}{c} VC \underline{V}] \text{ phrase} \\ | \\ H \end{array} \Rightarrow \begin{array}{c} VC \underline{V} \\ \backslash | \\ H \end{array}$$

I show a derivation of the intonation pattern of a high-toned verb in (14).⁸

(14) underlying: ku-gongome-a
|
H

Accent assignment (10): ku-gongome-a *
|
H

High Tone Displacement (12): ku-gongome-a *
|
H

Obstruent L-insertion (13a): ku-gongome-a
| |
L H

High Tone Spread (13b): does not apply

⁸For typographical convenience, I denote an accented vowel with underscoring throughout most of the derivation.

	ku-gongome-a
Boundary	\
L-insertion (13c):	L H L%
	ku-gongome-a
Default	\
L-insertion (13d):	L L L L L H L%
	ku-gongome-a
Backwards	\ \
Spread (13e):	L L L L L H L%
Surface:	<u>ku-gongomě-â</u>

This set of rules, then, can generate the correct intonation pattern for simple high-toned words in Digo, those in which the lexical H is realized as a rising tone on the penultimate vowel and a falling tone on the final vowel.

It may strike the reader as odd that voiced obstruents should be assigned a L tone by an ordered rule (13a) in the course of the derivation. It has been argued that the feature of voicing in obstruents, [+slack vocal cords], is the same thing as low tone (cf. Halle and Stevens, 1971). Therefore, the lexical specification of these consonants as [+voice] is equivalent to specifying them as low-toned from the start of the derivation, it would seem. An argument for the rule of Obstruent L-insertion and its ordering as in (13) will emerge from the data of phrasal tonology (cf. also 21 below).⁹

⁹The notion that L tone is the same as the feature [slack v.c.] is also refuted by the observation that voiced obstruents are not depressor consonants (low-toned) in every Bantu language (e.g., Shona). That is, they do not always block spreading of H tones as in Digo, which is contrary to expectation if a lexical [+voice] marking is equivalent to the feature [+slack vocal cords] (i.e., low tone). Given the fact that voiced obstruents are not universally low-toned in Bantu, it should not be so surprising that Obstruent L-insertion is an ordered rule of the phonology. It is often the case that the synchronic order of rules follows diachronic order. My analysis suggests that the rule of Backwards Spread entered Digo grammar before voiced obstruents came to be treated as

Now consider the other class of high-toned Digo words, those which surface with a level high tone on the penultimate vowel and a level low on the final vowel. As mentioned above, these words all have a voiced obstruent before the final vowel. Examples from (1) and (2) are repeated below).

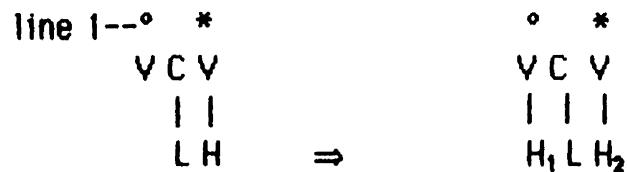
(15)	pwéza	'octopus'
	chi-tábu	'book'
	ku-dunduríz-a	'to place in reserve'
	ku-kurúg-a	'to smoothen by rubbing'

Obstruent L-insertion (13a) precedes and blocks Backwards Spread (13e), since it links a L tone to the consonant between the final high-toned vowel and the penultimate vowel to which the H tries to spread. Nonetheless, the penultimate vowel surfaces with a H tone as if the final H was able to link to it. That is, the penultimate vowel preceding a voiced obstruent receives a H of its own.¹⁰ I accomplish this with the rule shown in (16), which creates a second H precisely in those environments where Backwards Spread would apply, were it not for the intervening L of the consonant. This rule of the High Tone Doubling is borrowed from Kisseberth (1984, 165). I order High Tone Doubling before Default L-insertion.

low-toned segments, not an implausible suggestion (although I have no independent evidence for this). For more evidence that Obstruent L-insertion is an ordered rule of the phonology, see the section on phrasal tonology below, where it is clear that voiced obstruents do not hinder High Tone Displacement, but do stop High Tone Spreading.

¹⁰Such a sound change is no doubt due to diachronic rule ordering. Backwards Spread entered the grammar of Digo first. Later, Obstruent L-insertion entered the grammar and split up the rising/falling contour. For some reason, speakers chose to leave the H on the penultimate vowel rather than the final vowel. Perhaps the related language Chi-zigula went through a similar historical sound change; here, however, the penultimate H tone was levelled through the grammar (cf. Kenstowicz and Kisseberth, 1989). See the appendix to this chapter for more discussion of this rule.

- (16) High Tone Doubling: insert a H on an unstressed¹¹ vowel in a word if it is followed by a low-toned segment and a H tone.



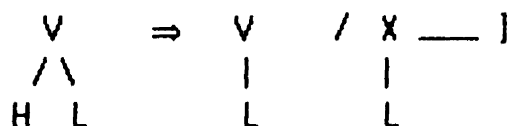
The result of High Tone Doubling is two H tones from one. The felicitousness of this result appears in the discussion of phrasal tonology.

First we must address the question of the fate of the second (original) H tone. This tone does not appear in the surface form of such words: cf. ku-*du*nduriza, but not *ku-*du*ndurizá.



The absence of a high tone on the final vowel in surface form is due to a rule of LHL Levelling. This rule applies after Obstruent L-insertion and Boundary L-insertion but before Default L-insertion; it turns final HL contours into level L tones when the preceding tone-bearing unit bears a L tone.

- (17) LHL Levelling: delink H from a HL contour when the preceding tone-bearing unit is low.



¹¹The reason for stipulating that the vowel of the copied H is unstressed will be clarified in the section on neutralizing verbs.

Rule (17) applies to the final vowel of ku-*dunduriz-a* after Boundary L-insertion creates a falling tone on the final vowel. Default L-insertion finishes the derivation.

	ku- <i>dunduriz-a</i>
Boundary	\
L-insertion:	L HLH L%

	ku- <i>dunduriz-a</i>
LHL	
Levelling:	L HL L%

	ku- <i>dunduriz-a</i>
Default	
L-insertion:	L L L L H L L%

It has not yet been shown why High Tone Doubling should create two separate H tones out of a single H. Why not simply metathesize the final vowel's H around the voiced obstruent's L?

V C V		V C V
	⇒	
L H		H L

Such a move eliminates the need for a rule of LHL Levelling.¹²

Despite the attractiveness of this solution, there is good reason nonetheless for supposing that the level H on the penultimate vowel in a word like pwéza arises from the creation of a second H tone. The evidence for this is found in phrases where a low-toned noun follows a verb such as ku-*dunduriz-a*, i.e., one whose stem ends in a voiced obstruent. Consider the

¹²Further evidence for the rule of LHL Levelling is found in the section on Neutralization, where it is shown that the L tone assigned by Neutralization also triggers LHL Levelling of a final falling contour.

phrases in (18), where the inflected verb and noun are also listed in their isolation forms.¹³

- (18) a. a-na pí-g-a gǒmâ 'he's beating a drum' (K 163)
(cf. a-na pí-g-a, goma)
- b. a-na ragíz-a kalámû 'he's ordering a pen'
(cf. a-na ragíz-a, kalamu)
- c. ni-na ádz-a mǔtû 'I'm mentioning someone'
(cf. ni-na ádz-a, mutu)

There is a single underlying H in each of the phrases in (18), and in each case it is associated underlyingly with the inflected verb. On the surface, however, there are two H tones: one still associated with the penultimate vowel of the inflected verb and one associated with the final vowel of the noun (which is subject to Backwards Spread, etc.). This two-from-one behavior is not found in other phrases (composed of high-toned verbs and low-toned nouns) when the verbs do not contain pre-final voiced obstruents: compare the phrases in (5), repeated in (19).

- (19) a. ku-onyesa n-jírâ 'to show the way'
(cf. ku-onyěsâ, n-jira)
- b. ku-afuna ny-ǎmâ 'to chew meat'
(cf. ku-afŭnâ, ny-ama)
- c. ku-anika n-gǔwô 'to dry clothes in sun'
(cf. ku-aníkâ, n-guwo)

¹³Not enough of the rule system has been introduced to derive the tone patterns of these phrases fully; the reader is asked to suspend disbelief until the section on phrasal tonology.

It appears, then, that Obstruent L-insertion and High Tone Doubling do bring about two H tones from one: the first H remains on the penultimate vowel of the verb, and the second H is free to move to the final vowel of a following word. However, if no other word follows the verb the second H is delinked by LHL Levelling after Boundary L-insertion. The details of phrasal phonology are worked out below.

I recapitulate in (20) the partially ordered list of rules which has been posited so far.

- (20) a. Metrical Structure Assignment (10)
- b. High Tone Displacement (12)
- c. Obstruent L-insertion (13a)
- d. High Tone Doubling (16)
- e. High Tone Spread (13b)
- f. Boundary L-insertion (13c)
- g. LHL Leveling (17)
- h. Default L-insertion (13d)
- i. Backwards Spread (13e)

3.2.2 Tone and metrical structure in neutralizing verb stems

Kisseberth 1984 discusses a class of verb stems in Digo which have lexical H tones, but which surface as if they were low-toned (toneless) stems unless they have suffixes. The applicative verbal suffix /-ir-~ -er-/ has no H of its own; when it is suffixed to toneless verb stems, the complex word surfaces with all L tones (21). Nevertheless, there is another set of verbs which appear toneless in citation (infinitive) form, but which surface with a final H when /-ir-~ -er-/ is suffixed, as in (22).

(21)	ku-rir-a	'to cry'	ku-rir-ir-a	'to cry for' (K 118)
	ku-guz-a	'to sell'	ku-guz-ir-a	'to sell to'
	ku-riß-a	'to pay'	ku-riß-ir-a	'to pay with'
	ku-dzeng-a	'to build'	ku-dzeng-er-a	'to build for/with'
	ku-vut-a	'to pull'	ku-vut-ir-a	'to pull for/with'
(22)	ku-tsun-a	'to skin'	ku-tsun-ĩr-â	'to skin for/with'
	ku-wad-a	'to roast'	ku-wad-ĩr-â	'to roast for/with'
	ku-vwin-a	'to sing'	ku-vwin-ĩr-â	'to sing to'
	ku-som-a	'to read'	ku-som-ěr-â	'to read to/for/with'
	ku-vug-a	'to cook'	ku-vug-ĩr-â	'to cook for/with'

Kisseberth (p. 119) points out that the verb stems in (21) come from historically low-toned verb stems of Proto-Bantu, whereas the verb stems in (22) come from high-toned Proto-Bantu verb stems. Therefore, there is diachronic support for supposing that the verbs in (22) have an underlying H which they hide in unsuffixed forms for some reason. Following Kisseberth, I shall refer to this class of monosyllabic verb stems as "neutralizing" stems.

Not all monosyllabic verb stems which are high-toned display neutralizing behavior. Non-neutralizing verbs are listed in (23), along with their corresponding Proto-Bantu reconstructions (according to Guthrie).

(23)	<u>Proto-Bantu</u>		<u>Digo</u>	(K 120)
	*-tóód-	marry	ku-rǒr-â	'to marry'
	*-néén-	speak	ku-něń-â	'to speak, say'
	*-kúér-	go up	ku-kwěŕ-â	'to climb'
	*-déét-	bring	ku-rěh-â	'to bring'
	*-dúík-	clothe	ku-vwĩk-â	'to clothe'
	*-bǐád-	bear (child)	ku-vyǎŕ-â	'to give birth'

Note that these non-neutralizing monosyllabic stems all derive from Proto-Bantu stems with long nuclei. This contrasts with the high-toned neutralizing stems of (22), repeated with their historical antecedents in (24).

(24)	<u>Proto-Bantu</u>		<u>Digo</u>	(K 119)
	*-dúg-	cook	ku-vug-a	'to cook'
	*-tég-	set (trap)	ku-heg-a	'to trap'
	*-bǐn-	dance; sing	ku-vwin-a	'to sing'
	*-dúm-	bite	ku-rum-a	'to bite'
	*-kúd-	grow up	ku-kur-a	'to grow'
	*-bón-	see	ku-on-a	'to see'

Neutralizing verb stems all derive from Proto-Bantu monosyllabic stems with short vowels.

I offer now a conjecture on how Neutralization – the loss of a high tone on monosyllabic verb stems – came about. There is pronounced tendency in Digo (and in Tanzanian languages generally) for high tones to move rightward, as evidenced by High Tone Displacement (12) and High Tone Shift (see below). Suppose that this tendency for rightwards shift of tone

historically preceded the shortening of long vowels. For the high-toned stems with short vowels (24), the H of the stem would surface to the right of the stem, while the stem itself would be low-toned: **-tég-* >> **-teg'-*. For high-toned stems with long vowels (23), however, the H could shift rightward one vowel, and yet there would still be a H tone on the (second vowel of) the stem: **-tóóó-* >> **-toóó-*. That is, the monosyllabic stems with long vowels would still be "high-toned" after the shift, whereas the monosyllabic stems with short vowels would be "low-toned" stems with a high-toned suffix. After the historical process of vowel shortening, this difference in stem types became lexicalized as a difference between high-toned non-neutralizing and high-toned neutralizing stems.

The question arises now of how to represent this difference in the synchronic grammar of modern Digo. Kisseberth relates the distinctive characteristic of neutralizing verbs (and neutralizing nouns – see below) to the penultimate vowel: words which display neutralizing behavior are words where one has reason to expect the lexical H to be linked to the penultimate vowel rather than the final vowel. Kisseberth's reasons for diagnosing the situation this way are theory-internal and will not be rehearsed here. Instead, I will extract the central insight of his analysis – the penultimate vs. final vowel distinction – and translate it into a metrical analysis.

It has been well attested that canonical "stress" languages such as English and Russian have morphemes which are inherently stressed (cf. Halle and Vergnaud 1987). I import this notion into the analysis of Digo. I suppose that neutralizing words differ from non-neutralizing ones by virtue of having a stressed penult. This can be accomplished for verbs by positing that the monosyllabic neutralizing verb stems are marked in the lexicon

with an inherent line 1 accent on their single vowel. Examples of such a representation are shown in (25).



The metrical structure building rules will subsequently build right-headed, unbounded feet on these representations, adding a second accent on the final vowel.



High Tone Displacement applies to these representations, shifting the lexical H to the final vowel.



The next rule is Obstruent L-insertion, assigning L tones to the [v] and the [g] of /vug/.

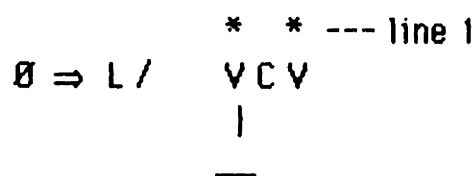


This L tone insertion would generally create the context for High Tone Doubling to apply. It does not, however, because the penultimate vowel is stressed: the rule was stated in (16) so as to apply to unstressed vowels only. High Tone Spread is inapplicable in both representations. Boundary L-insertion links the phrase-final L tone to the last vowel.



In ku-vug-a the inserted L tones together create the context for LHL Levelling to delete the H tone, yielding the desired low-toned surface form. In ku-tsun-a, however, there is no preceding L tone to be the left context for LHL Levelling (17). I posit, therefore, a rule which assigns a L tone to a stressed vowel before another stress vowel.

(26) Neutralization: assign a low tone to an stressed vowel before another stressed vowel.



Neutralization will link a L to the penultimate vowels of both verbs, and so LHL Levelling will delete both H tones.

Neutralization

* *

(ku - vug) - (a)

| | | | \

L L L H L%

* *

(ku - tsun) - (a)

| | \

L H L%

LHL Levelling

* *

(ku - vug) - (a)

| | | \

L L L L%

* *

(ku - tsun) - (a)

| \

L L%

Thus are the desired low-toned surface forms derived.

Consider now the cases where a neutralizing verb bears a suffix. Neutralizing verb stems have an inherent accent on the stem vowel. When a derivational suffix is added, the final vowel ends up with the verb's H tone. Backwards Spread and the other rules apply as with non-neutralizing verbs. In other words, when a suffix is added, it is as if the verb becomes de facto non-neutralizing. This behavior may be modeled by assuming that derivational suffixes cause the lexical stress of the verb stem to be deleted, leaving only one stressed vowel, the final vowel. I posit that the derivational verbal suffixes of Digo are cyclic affixes¹⁴ which effect the erasure of previous metrical structure (i.e., stresses). The addition of one of these suffixes wipes out the stress on the stem; the later non-cyclic application of Metrical Structure Assignment (10) will build a single foot, headed by the final vowel. High Tone Displacement links the lexical H of the neutralizing stem to the final vowel. The other rules apply predictably.

¹⁴Compare the analysis of Sukuma verbs in this thesis.

3.2.3 Verbs with Object Markers

Along with the derivational suffixes, or "extensions", which operate on the argument structure of Bantu verbs, verbs may also have a prefix which marks the presence of a syntactic object. These prefixes, traditionally called "object markers" in Bantu studies, sometimes affect the intonation of the verb to which they are affixed.

The verb stem /vugur/ is a toneless stem in Digo. This is evident from the form of the simple infinitive (28a) and the infinitive with the applicative extension /-ir-/ (28b).

- (28) a. ku-vugur-a 'to untie' (K 109)
b. ku-vugurir-a 'to untie for'

Consider next the paradigm of /vugur/ with object markers.

- (29) ku-vugurir-a 'to untie for' (K 110)
ku-ni-vugurir-a 'to untie for me'
ku-ku-vugurir-a 'to untie for you(sg.)'
ku-mu-vugurir-a 'to untie for him/her'
- ku-u-vugurĩr-â 'to untie for us'
ku-a-vugurĩr-â 'to untie for you(pl.)/them'

The last two forms in (29) show the presence of a H tone which has undergone High Tone Displacement to the final, accented vowel, Boundary L-insertion on the final vowel, Backwards Spread, Default L-insertion, and L-spread. The plural human object markers /-u-/ and /-a-/ seem to make the word become a high-toned word. This is seen also in the paradigm of /raβiz/.

(30)	ku-raβiz-a	'to insult'	(K 110)
	ku-ni-raβiz-a	'to insult me'	
	ku-ku-raβiz-a	'to insult you(sg.)'	
	ku-mu-raβiz-a	'to insult him/her'	
	ku-u-raβiz-a	'to insult us'	
	ku-a-raβiz-a	'to insult you(pl.)/them'	

The paradigm of /raβiz/ differs from that of /vugurir/ predictably: because /raβiz/ ends in a voiced obstruent, the intonation is high/low on the penult/final vowels rather than rising/falling.

Following Kisseberth, I account for these paradigms by positing that the 1st person plural object marker /-u-/ and the 2nd plural/3rd plural object marker /-a-/ have a lexical H tone which they contribute to the word. The derivation of these words is straightforward, following the previously posited rule system.

If the object markers /-u-/ and /-a-/ add a H to a low-toned verb, what is their effect on a high-toned verb? The representative paradigm of a high-toned verb with object markers is seen in (31) with the stem /pupūt/.

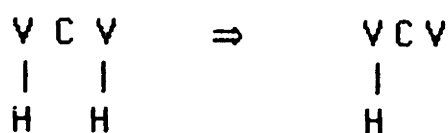
(31)	ku-pupūt-â	'to beat'	(K 122)
	ku-ni-pupūt-â	'to beat me'	
	ku-ku-pupūt-â	'to beat you(sg.)'	
	ku-mu-pupūt-â	'to beat him/her'	
	ku-u-pupūt-â	'to beat us'	
	ku-a-pupūt-â	'to beat you(pl.)/them'	

The presence of two lexical H tones—one from the stem and one from the object marker—is not apparent from the surface paradigm, which exactly resembles the paradigms of the toneless stems. The intonation pattern is

that of a word with one H. Other Eastern Bantu languages have a similar paradigm for high-toned verbs with objects markers (cf. Goldsmith 1984b).

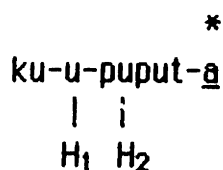
I will follow other researchers of Bantu by positing a word-level rule which deletes the second of two H tones in adjacent syllables in order to account for this paradigm.¹⁵ This is the familiar "Meeussen's Rule", shown in (32) below.

(32) Meeussen's Rule: delete the second of two high tones on adjacent syllables in a word.



In order for this rule to give the correct results I must assume, following Kenstowicz and Kisseberth's (1989) analysis of Chizigula, that lexical H tones are not floating, but are linked to the first available vowel of their morpheme.¹⁶

The representation of ku-u-puput-a 'to beat us' after Rule 10 (accent assignment) will show two linked H tones and an accented final vowel.



Meeussen's Rule (32) deletes the second (stem) H.

¹⁵There is, in fact, no real evidence in Digo for saying that the second H and not the first is the H which is deleted. The derivations work out either way; my choice of deleting the second is purely arbitrary. Cf. Goldsmith 1984a on Meeussen's Rule and Anti-Meeussen's Rule.

¹⁶Kenstowicz and Kisseberth (1989, 10-f.) suggest that this linking to the leftmost vowel is due to an Association Convention applying lexically. This assumption is necessary in order to ensure that the stem H and the object marker H are in adjacent syllables; otherwise there is no reasonable formulation of Meeussen's Rule.

*
ku-u-puput-a
|
H₁

Next the rule of High Tone Displacement links H₁ to the final vowel. The rest of the rules apply in order. The entire word surfaces with the intonation pattern of a word with a single H tone.

Consider now the paradigm of a high-toned neutralizing verb stem (i.e., one with a lexical accent on the stem vowel).

(33)	ku-on-a	'to see'	(K 123)
	ku-ni-on-a	'to see me'	
	ku-ku-on-a	'to see you(sg.)'	
	ku-mu-on-a	'to see him/her'	
	ku-tu-ǒn-â ¹⁷	'to see us'	
	ku-a-ǒn-â	'to see you(pl.)/them'	

One expects that the stressed stem vowel [o] of /on-/ will receive an inserted L tone via Neutralization, since it precedes another stressed vowel. The stem H will shift to the last vowel, Neutralization will put a L on the penult, Boundary L-insertion will create a final HL contour and LHL Leveling will delete the H tone. This analysis holds for the verb with toneless object markers. However, with the high-toned object markers /-u-/ and /-a-/ the verb has the tone pattern of a non-neutralizing verb, just like (29-31) above.

¹⁷This form alone of all of Kisseberth's data has /-tu-/ instead of /-u-/ for the 1st plural object marker. I copy it here, but assume it is a typo. In any case, it is of no consequence for the analysis.

It seems that these high-toned object markers have an effect on the metrical structure of the verb stem: they remove the Neutralization-triggering accent of the stem vowel and leave an accent on the final vowel. That is, the derived metrical structure of ku-u-on-a must be as shown below.

° ° * --line 1
 (ku- u-on-a)
 | |
 H H

The tonal derivation of this form will then proceed as with ku-u-pupŭt-â above: Meeussen's Rule will delete the stem H and the H of the object marker /-u-/ will be linked to the final vowel by High Tone Displacement.

In order to accomplish the desired change in the metrical structure, I assume that the high-toned object markers /-u-/ and /-a-/, like the derivational verbal suffixes, are cyclic and hence stress-erasing (cf. Halle and Vergnaud 1987, 83-f.). These two prefixes eliminate the lexical line 1 asterisk of neutralizing verbs. Thereafter rule 10 applies to stress only the final vowel. (34) shows the representation of a neutralizing verb with object marker after the application of rule 10.

(34)

	*				°
	u - on - a	⇒ Stress Erasure ⇒	u - on - a	⇒ Rule 10 ⇒	
	H H		H H		
	° ° *		° ° *		
	(u - on - a)	⇒ Meeussen's Rule ⇒	(u - on - a)	⇒	
	H H		H		

>> other tonal rules>> ku-ǒn-â

I assume, then, that the singular human object markers are non-cyclic and non-stress erasing, whereas the plural object markers are cyclic, stress-erasing, and high-toned. These assumptions suffice to derive the paradigm of (33) along with the previously posited theoretical machinery. It will also be shown below that Stress Erasure plays a role in the cyclic phrasal phonology as well as the cyclic word-level phonology of derived verbs.

3.2.4 Noun tone patterns and locative phrases

In this section the three types of Digo nouns are discussed, both in isolation and in locative phrases. The locative phrase offers a good starting point for the investigation of phrasal tonology and the rule of High Tone Shift.

If one considers only citation forms, Digo nouns seem to group into two classes, high-toned and toneless. The high-toned nouns display the familiar distinction between rising/falling on the penultimate and final vowels and level high/level low when there is a voiced obstruent.

(35) a. n-jira	'path(s)'	(K 160)
mu-hama	'millet'	
tsongo	'bird(s)'	
vi-yogwe	'sweet potatoes'	
gunguhi	'bed leg'	
b. kũndê	'beans'	(K 161)
kãndê	'food'	
sahãñî	'plate(s)'	
chi-tábu	'book'	
pwéza	'octopus'	

The nouns in (35a) are toneless and those in (35b) have a lexical H which displaces to the final stressed vowel and spreads backwards. The other tonal rules apply predictably.

Digo has a locative postposition /-ni/ which has no lexical H tone. The tonelessness of /-ni/ can be inferred from the tone patterns of certain toneless nouns which remain toneless in phrases with this postposition.¹⁸

¹⁸One might be inclined to attempt an analysis in which /-ni/ has a lexical H tone which is somehow deleted (perhaps by Neutralization?) in the PPs in (36) but preserved

(36)	n-jira	'path(s)'	n-jira-ni	(K 160)
	mu-hama	'millet'	mu-hama-ni	
	tsongo	'bird(s)'	tsongo-ni	
	mu-hambo	'trap'	mu-hambo-ni	
	ma-ruwa	'flowers'	ma-ruwa-ni	
	chi-ronda	'sore'	chi-ronda-ni	

With other nouns which are low-toned in citation form, however, the suffix /-ni/ shows up with a final H tone which spreads backwards.

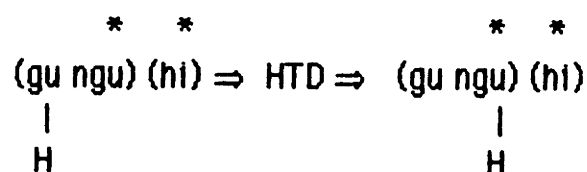
(37)	biga	'water pot'	bigǎ-nî	(K 160)
	renje	'pumpkin'	renjě-nî	
	fumo	'spear'	fumǒ-nî	
	tsui	'leopard(s)'	tsuĩ-nî	
	vi-yogwe	'sweet potatoes'	vi-yogwě-nî	
	ny-umba	'house(s)'	ny-umbǎ-nî	
	gunguhi	'bed leg'	gunguhĩ-nî	
	m̩-fumbati	'side-bar of bed'	m̩-fumbatĩ-nî	

Since the postposition /-ni/ does not have a H of its own, the H in these derived words must come from the noun. Such behavior is reminiscent of neutralizing verbs, those which show their lexical H only in suffixed forms (22). I shall therefore propose a somewhat parallel analysis of the nouns in (37).

In order for Neutralization to apply in nouns such as those in (37), two conditions must be met. First, both the final and penultimate vowels of these nouns must be stressed. Second, the lexical H of the noun must be linked to the final vowel in underlying representation (and not to the first

in those of (37). Such an analysis, however, runs into the problem of PPs with high-toned nouns (cf. 38): these phrases for the most part appear to contain a single H tone, not two. Besides this, I know of no evidence from other Bantu languages for considering this morpheme /-ni/ to be high-toned.

vowel as in normal noun and verb stems). If the underlying H of neutralizing nouns were linked to the first syllable, then in trisyllabic (or longer) nouns High Tone Displacement would move the H to the stressed penultimate syllable, not the final syllable, since the penultimate vowel is the nearest stressed vowel to the right.



This representation is undesirable for two reasons. First, it is not obvious that Neutralization will be able to "neutralize" this penultimate H tone in conjunction with LHL Leveling as in neutralizing verbs. Rather, another rule will have to be posited to get rid of the H tone. Second, there is evidence from verb-noun phrases (see 61 below) that a H tone from a preceding verb must be able to displace to the penultimate vowel of a neutralizing noun prior to Neutralization.¹⁹ The penultimate vowel of the noun, then, must be unassociated with any other H; this entails that the lexical H of the noun must be linked to the final or penultimate vowel in underlying representation.

There are then two problems with neutralizing nouns: getting the penultimate syllable stressed and getting the underlying H on one of the last two syllables. However, if one supposes that the underlying H is linked to the final vowel, then one has a means of deriving penultimate stress as well. Following Halle (in press), I posit a rule of metrical boundary

¹⁹This is seen in a phrase such as 'to chew a coconut' ku-afuna nâzi. The penultimate vowel has a falling HL tone: the H comes from the preceding verb stem /afun/ and the L comes from Neutralization applying to a stressed penultimate vowel before a stressed final vowel.

* *
 (vi-yo) (gwe)
 |
 H

* *
 (gungu) (hi)
 |
 H

In this way the penultimate vowel is stressed in these nouns, with the result that the final H will never surface. Neutralization (26) will assign a L to the penultimate vowel. After Boundary L-insertion makes a final HL contour, LHL Levelling will delete the H. Thus, like neutralizing verbs, neutralizing nouns do not show their H in non-derived forms.

When the suffix /-ni/ is cliticized, however, the nouns do show their H tones. The lexical H of the neutralizing noun shifts from the noun to the following postposition, and from there it spreads backwards as in simple nouns and verbs.

* * °
 [vi-yo gwe]_N - ni
 |
 H

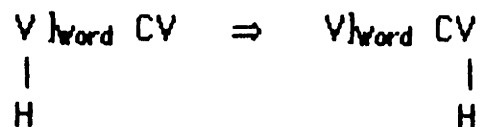
* * °
 [gungu hi]_N - ni
 |
 H

This shift is not due to High Tone Displacement, since the postposition /-ni/, a function word, does not receive a metrical stress. If it did, then Neutralization would assign a L to the final vowel of the noun (because it is a stressed vowel preceding a stressed vowel), and this would result in the deletion of the H linked to /-ni/.

Instead, the reassociation of the H to /-ni/ is due to a more general rule of the phrasal tonology of Digo. This rule, High Tone Shift, moves a word-final H to the vowel of a following word if that vowel is not already

linked to a H, or if no obtruent L intervenes. Evidence for High Tone Shift will be seen repeatedly in the tone patterns of Digo phrases.²¹

(39) High Tone Shift: shift H to the first vowel of the next word.



After High Tone Shift moves the neutralizing noun's H to the postposition, the other rules of Boundary L-insertion, Default L-insertion, and Backwards Spread complete the derivation of the phrases: vi-yogwě-nî and gunguhĩ-nî.



High-toned non-neutralizing nouns with this postposition /-ni/ display unusual tone patterns. The nouns in (40a), for example, do not have the normal rising/falling contours on the penultimate/final vowels. Rather, one finds a level high/falling pattern: sahanĩ-nî. The nouns in (40b), on the other hand, show the usual rising/falling pattern, but also have a level H tone on the vowel before the pre-final voiced obstruent: chi-tábũ-nî.

(40) a. kũndê	'beans'	kundé-nî	(K 161)
kãndê	'food'	kandé-nî	
sahãñî	'plate(s)'	sahanĩ-nî	
chi-kõpwê	'sweet potato leaves'	chi-kopwé-nî	
bãtã	'duck'	batá-nî	

²¹Ci-Ruri (Chapter Two) has a similar rule of tone shift.

bũndâ	'bunch'	bundá-nî
kofĩyâ	'hat(s)'	kofiyá-nî
dõnâ	'hard porridge'	doná-nî

b. báda	'cassava meal'	bádǎ-nî
chi-tábu	'book'	chi-tábũ-nî
pwéza	'octopus'	pwézǎ-nî
zódo	'cooked mangos'	zódǒ-nî

The existence of a level H on the antepenultimate vowels which precede voiced obstruents is due to the rule of High Tone Doubling (16). This rule has evidently applied in the noun after High Tone Displacement moved the underlying H to the final vowel the noun (cf. 18 above, where High Tone Doubling applies in a verb after a lexical H is displaced to the final vowel of the inflected verbal word). After Displacement and Doubling take place, High Tone Shift (39) moves the H to the enclitic postposition /-ni/, from which the H spreads backwards.

The phrasal phonology of Digo has both a cyclic and a non-cyclic component, as schematized below. This organization of rules will be defended and illustrated throughout the rest of the chapter.

(41) (Word-level metrical structure rules)

Cyclic phrasal tonology
 High Tone Displacement
 Obstruent L-insertion
 High Tone Doubling
 High Tone Shift

Non-cyclic phrasal tonology
 Neutralization
 Boundary L-insertion
 LHL Levelling
 High Tone Spread
 Default L-insertion
 Backwards Spread

The derivations of the phrases sahani-ni and chi-tabu-ni are given below.

The underlying representations are the following.²²



Metrical feet are built over the nouns in the word-level phonology. The postposition remains unstressed (like function words in many languages).



The first rule of the phrasal phonology is High Tone Displacement, moving the underlying H to the final vowel of the noun. Obstruent L-insertion links a L tone to the [b] of chi-tabu. This insertion of a L tone triggers High Tone Doubling. The results will be the following representations.



High Tone Shift then moves the noun-final H to the postposition.



²²The noun prefixes /chi-, mu-, ny-, vi-, ma-, n-, m-, u-/ are noun class markers, such as are found throughout Bantu. I will argue below in the section on phrasal phonology that these are separate words from the noun itself, not prefixes. In fact, these morphemes will be shown to be phonological enclitics, just like the postposition /-ni/.

The non-cyclic block of rules comes next. The penultimate vowel is stressed, but Neutralization does not occur, since the final vowel is unstressed. If Neutralization were to apply, the H on the final vowel would eventually be eliminated by LHL Levelling.

Boundary L-insertion links a L tone to the final vowel of both utterances. Default L-insertion adds L tones to the other vowels as well.

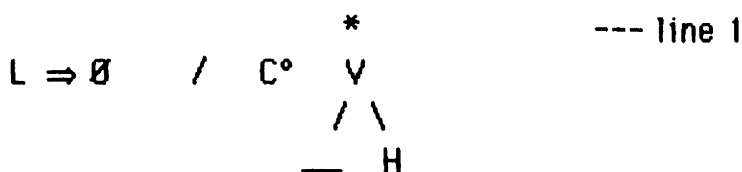
*	°		*	°
(sahani)	ni		(chi-ta bu)	ni
	\			\
L L L	H ₁ L ₂		L H ₁ LL	H ₂ L ₂

Backwards Spread links the H of [ni] to the penultimate vowel. In the case of chi-tábŭ-nî this spreading produces the correct surface form, with rising/falling contours. In the case of sahani-nî, however, one is left with a rising tone on the penult where a level high tone belongs: *sahani-nî.

*	°		*	°
(saha ni) ni)			(chi- ta bu) ni)	
\ / \			\ / \	
L L L H ₁ L ₂			L H ₁ LL H ₂ L ₂	

How is sahani-nî different from chi-tábŭ-nî (or ku-gongomě-â in (14) above), such that the rising tone on the penultimate vowel is simplified to a level H? The words like sahani-nî in (40a) are different in two respects. On the one hand, the phrases in (40a) have a line 1 stress on their penultimate vowels, unlike final-stressed ku-gongomě-â. On the other hand, words like chi-tábŭ-nî also have a stressed penultimate, but in these words the consonant preceding the penultimate vowel is a voiced obstruent. With these two differences in mind, I propose a rule of Stress Decontouring which simplifies rising tones to level high tones.

- (42) Stress Decontouring: delete the L tone of a LH contour on a stressed vowel when it follows a toneless consonant.



Stress Decontouring applies after Backwards Spread to produce a level high/falling pattern on the other words in (38a): sahani-nî --> sahani-nî.²³

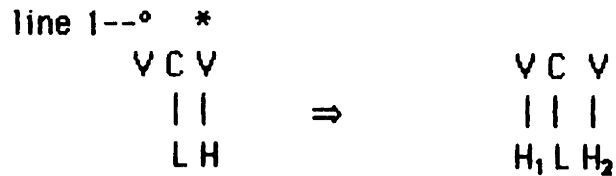
The derivation of chi-tábŭ-nî above raises a question about the derivation of the neutralizing nouns in (37). Why does the final H tone in these nouns not trigger High Tone Doubling when preceded by a voiced obstruent? For example, consider the phrase vi-yogwě-nî derived above. The segment [gw] is a voiced obstruent in Digo, and yet no doubled H appears on the vowel preceding [gw] (i.e. *vi-yógwě-nî), parallel to the H preceding the [b] in chi-tábŭ-nî. How is one to account for the difference?

As with Stress Decontouring, the difference is one of abstract metrical structure. The vowel preceding [gw] in vi-yogwě-nî is stressed (since it is the penultimate vowel of a neutralizing noun), whereas the vowel preceding [b] in chi-tábŭ-nî is unstressed. The rule of High Tone

²³It is true that Stress Decontouring is an ad hoc rule, introduced only to account for the penultimate level high tones in these high-toned nouns. Nonetheless, it is noteworthy, I claim, that a metrical analysis of Digo can even define such an ad hoc rule. In a theory without stressed and unstressed vowels, there is no way to distinguish between the penultimate vowels in ku-gongomě-â and chi-tábŭ-nî on the one hand and kandé-nî on the other hand. In the metrical theory, these vowels differ with respect to independently motivated structure. In a sense, then, this ad hoc rule is evidence for a metrical approach to Digo. Stress Decontouring is probably one of those things which Samuel Johnson would have grouped with dogs walking on their hind legs: it may not be done well, but we should rather be surprised that it is done at all.

Doubling (16) must be adjusted to be sensitive to this difference. In (43) I reformulate the rule.²⁴

(43) High Tone Doubling: link a H to an unstressed penultimate vowel in word if it is followed by a voiced obstruent and a H tone.



Since the vowel of [yo] in the neutralizing noun vi-yogwě-nî is stressed, Doubling cannot apply as in the non-neutralizing noun chi-tábŭ-nî.

This discussion of the tone patterns of nouns has been an introduction to the analysis of Digo phrasal tonology. I turn now to the tone patterns in phrases formed by the combination of verbs and inflectional words.

²⁴This reformulation of High Tone Doubling is not so ad hoc. It also will be shown to account for the fact that Doubling does not occur on the stressed penultimate vowels of neutralizing verbs in phrasal contexts, but does occur on the unstressed vowels of noun class markers and the destressed vowels of verb before nouns.

3.2.5 Tone patterns in inflected verbs

The rule system outlined above accounts for the tone patterns of Digo inflected verbs, if one admits some assumptions about the structure of Digo. First, following Myers (1987) analysis of Shona, I shall parse the tense and subject morphemes as an "inflectional" word, distinct from the verb and its object markers.²⁵ Second, I assume that the phonological phrase structure of Digo phrases is left-branching: [[[INFL] V] ...]. These assumptions are explained and demonstrated directly.

An important consideration for phrasal tonology is the cyclic/non-cyclic distinction in the application of rules.²⁶ Arguments for assigning the rules formulated above to either the cyclic or the non-cyclic stratum of the post-lexical phonology have not yet been seen; these arguments are found in the data to follow.

(44) Word-level phonology

cyclic

Stress Erasure

Meeussen's Rule (32)

Metrical Boundary Insertion (38)

non-cyclic

Metrical Structure Assignment (10)

Phrasal phonology

cyclic

High Tone Displacement (12)

Obstruent L-insertion (13a)

High Tone Doubling (43)

High Tone Shift (39)

²⁵This notion is explained and defended in Chapter Two.

²⁶The crucial insight that some of the phrasal tone rules apply cyclically is due to Kisseberth 1984.

non-cyclic

- Neutralization (26)
- Boundary L-insertion (13c)
- LHL Levelling (17)
- High Tone Spread (13b)
- Default L-insertion (13d)
- Backwards Spread (13e)
- Stress Decontouring (42)

3.2.5.1 Inflected verbs with one H tone

Kisseberth 1984 gives evidence for assigning lexical H tones to the the 3rd person subject markers of the present tense, /a-/ 'he/she' and /ma-/ 'they'. The present tense morpheme is /-na/. Consider the conjugation of the toneless verb stem /togor/ 'praise' in the present tense.

(45)	[ku-togor-a]	'to praise'	(K 111)
	[ni-na] [togor-a]	'I am praising'	
	[u-na] [togor-a]	'you(sg.) are praising'	
	[a-na] [togõr-â]	'he/she is praising'	
	[tu-na] [togor-a]	'we are praising'	
	[mu-na] [togor-a]	'you(pl.) are praising'	
	[ma-na] [togõr-â]	'they are praising'	

The underlying representation of 'he/she is praising' has a single H tone associated with the 3rd singular subject marker /a-/. The subject marker /a-/ and the present tense marker /-na/ group together as a constituent, the inflectional word (INFL). The INFL word and the verbal word together form the phrasal constituent of an inflectional phrase (IP). Since Digo

phrasal phonology is left-branching, the INFL word is the head of the phrase, and therefore the innermost cycle for the purposes of rule application.

(46) [IP [a-na] INFL [togor-a] V]IP
 |
 H

The rule of metrical structure assignment will apply to both the verbal word and the inflectional word in the lexical phonology, building right-headed feet. Stress Erasure and Meeussen's Rule are both inapplicable.

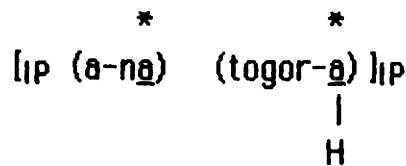
* *
 (a-na) (togor-a)
 |
 H

The rule of High Tone Displacement is the first to apply. The innermost cycle is the word /a-na/. High Tone Displacement links the underlying H of the subject marker /a-/ to the stressed final vowel of /-na/.

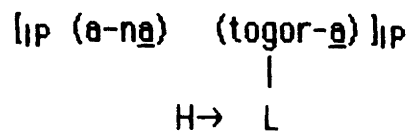
* *
 [IP [(a-na)] (togor-a)]IP
 |
 H

There are no voiced obstruents in the inflectional word, so Obstruent L-insertion and Doubling cannot apply. Since the verbal word is not visible on the first cycle, High Tone Shift will not apply either.

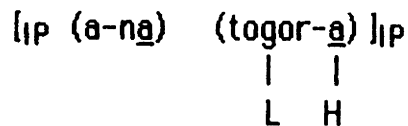
On the second cycle, the constituent IP, the rule of High Tone Displacement applies again, moving the H to a stressed vowel to its right, the final vowel of the verb.



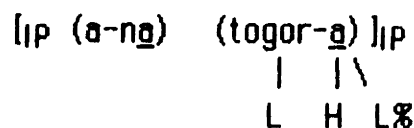
Note that High Tone Displacement has moved the H of the INFL word over a voiced obstruent, the medial /g/ of /togor/. If voiced obstruents were underlyingly marked as low-toned (as a consequence of voicing), then High Tone Displacement should be blocked from moving the H across another tone.²⁷



The fact the High Tone Displacement can move the H all the way to the end of the verb is evidence that Obstruent L-insertion applies after High Tone Displacement (and cyclically, as will be seen). Obstruent L-insertion applies to [g]; High Tone Doubling and High Tone Shift are not applicable.



We commence now with the non-cyclic block of rules. Neutralization finds no stressed penultimate vowel, so no L tone is assigned. Boundary L-insertion applies to the final vowel of [togor-a] because it is the final vowel of the phrase.



²⁷The arrow here denotes attempted movement, not structural change.

LHL Levelling will not come into the derivation, since the tone-bearing unit preceding the vowel with the HL contour is toneless, not low-toned. Default L-insertion then fills in the other toneless vowels.

[ɪp (a-na) (togor-a) ɪp
 | | | | | \
 L L LLL H Lʒ

Backwards Spread links the H back to the penultimate vowel. Stress Decontouring will not simplify the resulting rising tone, because the LH contour is on an unstressed vowel.

[ɪp (a-ɪa) (togo r-a) ɪp
 | | | | | \ /
 L L LLL H Lʒ

The surface form is ana-togŕ-â: the toneless verbal word /togor-a/ acquires a H in the phrasal phonology from the inflectional word.

A similar derivation takes place when the inflectional word contains the present perfect marker /-ka/. Compare the paradigm of (45) above with (47).

(47)	ni-ka	tsukŕr-â	'I have carried'	(K 127)
	u-ka	tsukŕr-â	'you (sg.) have carried'	
	a-ka	tsukŕr-â	'he/she have carried'	
	tu-ka	tsukŕr-â	'we have carried'	
	mu-ka	tsukŕr-â	'you (pl.) have carried'	
	ma-ka	tsukŕr-â	'they have carried'	

In this paradigm it is the tense marker /-ka/ and not the person markers which bears the single lexical H tone. In all other respects these phrases are derived just like ana togŕ-â above.

Unexceptional also are inflected verbs where the single H comes from an object marker of the verb, not from the inflectional word.

(48)	ni-na gurir-a	'I am buying for'	(K 131)
	ni-na a-gurŕr-â	'I am buying for them'	
	ni-na demurir-a	'I am scolding'	
	ni-na a-demurŕr-â	'I am scolding them'	

In these phrases the lexical H of the object marker H is moved on the second cycle from the initial vowel of the verbal word to the final vowel. The rest of the derivation is straightforward.

3.2.5.2 Inflected verbs with two H tones

There are two situations in which an inflected verb may have two underlying H tones. In the first case one H is contributed by the inflectional word (person or tense marker) and the second H is contributed by the verbal word (object marker or stem, but not both due to Meeussen's Rule, 32). In the second case both H tones are contributed by the inflectional word, as is the case in the /-a-/ past tense of Digo. Inflected verbs with two H tones provide evidence for ordering Obstruent L-insertion after High Tone Displacement but before High Tone Shift and High Tone Spread, since the inserted L tones block the latter rules, but not the former one.

3.2.5.2.1 High-toned verbs with high-toned inflections

Compare the paradigm in (45) above of a toneless verb in the present tense with the forms in (49).

(49)	ni-na	pupŭt-â	'I am beating'	(K 125)
	u-na	pupŭt-â	'you (sg.) are beating'	
	a-na	púpút-â	'he/she is beating'	
	tu-na	pupŭt-â	'we are beating'	
	mu-na	pupŭt-â	'you (pl) are beating'	
	ma-na	púpút-â	'they are beating'	
	a-na	mú-púpút-â	'he/she is beating him/her'	(K 126)
	a-na	á-púpút-â	'he/she is beating them'	
	ni-na	tanyiríz-a	'I am driving off predators'	(K 125)
	a-na	tányíríz-a	'he/she is driving off predators'	

ni-na furukūt-â	'I am moving about restlessly'
a-na fúrúkút-â	'he/she is moving about restlessly'
ni-na chimbír-â	'I am running away'
a-na chímбір-â	'he/she is running away'
ni-na sindík-â	'I am shutting the door'
a-na síndík-â	'he/she is shutting the door'
ni-na ßaßás-â	'I am groping in the dark'
a-na ßáßás-â	'he/she is groping in the dark'

These forms all have the same pattern. Without the high-toned subject markers /a-/ or /ma-/ the inflected verbs surface with the verb's H tone on the final vowel in a typical rising/falling contour except when a voiced obstruent triggers High Tone Doubling. When the high-toned subject markers are part of the inflectional word, however, the tone pattern consists of level high tones throughout the verbal word except for a falling tone on the final vowel: a-na mú-púpút-â. The same pattern is found with high-toned verbs in the present perfect tense, whether the verb's H is contributed by the verb stem itself or by the object marker /u-/.

(50) ku-kumbukír-â	'to remember'	(K 128)
ni-ka kúmbúkír-â	'I have remembered'	
u-ka kúmbúkír-â	'you (sg.) have remembered'	
a-ka kúmbúkír-â	'he/she has remembered'	
tu-ka kúmbúkír-â	'we have remembered'	
mu-ka kúmbúkír-â	'you (pl.) have remembered'	
ma-ka kúmbúkír-â	'they have remembered'	
ku-rimir-a	'to cultivate for'	
a-ka rimír-â	'he/she has cultivated for'	
a-ka ni-rimír-â	'he/she has cultivated for me'	
a-ka ú-rimír-â	'he/she has cultivated for us'	

ku-pupūt-â	'to beat'
a-ka púpút-â	'he/she has beaten'
a-ka ní-púpút-â	'he/she has beaten me'
a-ka ú-púpút-â	'he/she has beaten us'

The derivation of the last phrase above will suffice to represent the derivations of all phrases of this type. The underlying representation has three H tones: one for the tense marker, one for the object marker, and one for the verb stem.

a - ka	u - puput - a
H	H H

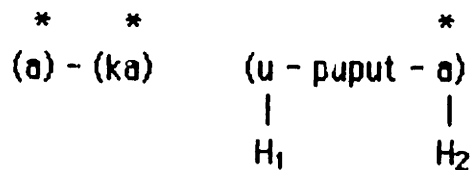
Meeussen's Rule, however, will delete the H of the verb stem. Boundary Insertion (38) applies to the vowel of the tense marker /-ka/. Metrical Structure Assignment then builds three right-headed feet.

*	*		*
(a) - (ka)	(u - puput - a)		
H ₁	H ₂		

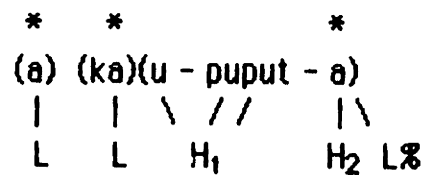
The first cycle of the phrasal phonology is the inflectional word /a-ka/. Nothing happens on this cycle. The second cycle is the entire phrase. Displacement moves H₂ to the final vowel of the phrase; H₁ is not displaced, as there is no other stressed vowel on the right to which to move it.

*	*		*
(a) - (ka)	(u - puput - a)		
H ₁			H ₂

Obstruent L-insertion and High Tone Doubling fail to apply in the absence of voiced obstruents. High Tone Shift links H₁ to the toneless vowel to its right.



Of the non-cyclic phrasal rules, only Boundary L-insertion, High Tone Spread, and Default L-insertion apply.



This gives the correct surface form aka-ú-púpút-â.

Consider now the paradigms of inflected high-toned verbs which contain voiced obstruents.

- | | |
|--|---|
| <p>(51) ni-na babadŭr-â
a-ná babadŭr-â</p> | <p>'I am forcing s.t. apart' (K 130)
'he/she is forcing s.t. apart'</p> |
| <p>ni-na garagăr-â
a-ná garagăr-â</p> | <p>'I am tossing around'
'he/she is tossing around'</p> |
| <p>ni-na dundurĭk-â
a-ná dundurĭk-â</p> | <p>'I am walking stealthily'
'he/she is walking stealthily'</p> |
| <p>ni-na zungumúz-a
a-ná zungumúz-a</p> | <p>'I am conversing'
'he/she is conversing'</p> |
| <p>ni-na vurúg-a
a-ná vurúg-a</p> | <p>'I am stirring'
'he/she is stirring'</p> |

	ni-ká bomǒr-â	'I have demolished'	(K 131)
	ni-ká vwinĩr-â	'I have sung for'	
	ni-ká doněr-â	'I have kissed'	
	ni-ká gongomě-â	'I have hammered'	
(52)	a-ka ézěk-â	'he/she has thatched'	(K 132)
	a-ka wézěsh-â	'he/she has enabled'	
	a-ka tábĭk-â	'he/she has become distressed'	
	a-ka tábǎng-â	'he has spoiled by mixing with s.t.'	
	a-ka súrúbĭk-â	'he/she is strong/firm'	
	a-ka ézekěr-â	'he/she has thatched for/with'	
	a-ka ú-tógǒr-â	'he/she has praised us'	
	a-ka ú-ságĭr-â	'he/she has ground s.t. for us'	
	a-ka ú-rágĭr-â	'he/she has treated us (medically)'	

The inflected verbs in (51) have stem-initial voiced obstruents; those in (52) have stem-medial voiced obstruents. In both cases the derivation proceeds straightforwardly with the previously hypothesized rule system.

The crucial assumption is that Obstruent L-insertion precedes and blocks High Tone Shift or Spread. In a phrase such as ni-ká bomǒr-â, then, the H linked to the tense marker /-ka/ will be unable to shift to the first vowel of the verb stem, since the linked L of the voiced obstruent [b] intervenes. The H of /-ka/ will therefore remain in place, and Default L-insertion and Backwards Spread will fill out the derivation.

In a form such as a-ka súrúbĭk-â in (52), the H which is associated in underlying form to the tense marker /-ka/ may be shifted to the right (to the first vowel of the verb) and spread from there, but spreading stops at the L tone of the voiced obstruent [b]: súrúb..... Again, Default L-insertion and Backwards Spread apply predictably.

We see then that phrases with two underlying H tones can be modeled by the rule system in (44) above.

3.2.5.2.2 Monosyllabic verbs with high-toned inflections

The discussion of neutralizing verbs above made a three-way distinction in monosyllabic verb stems: toneless, high-toned, and lexically stressed high-toned stems. Toneless (53) and high-toned (54) verb stems have unremarkable tone patterns when inflected in the present tense.

(53)	a-na tsǒng-â	'he/she is carving'	(K 142)
	a-na rĩr-â	'he/she is crying'	
	a-na ßǒnd-â	'he/she is pounding'	
	a-na sũk-â	'he/she is plaiting'	
	a-na fĩk-â	'he/she is arriving'	
	a-na vwĩk-â	'he/she is dipping s.t. in'	
	a-na gũr-â	'he/she is buying'	
	a-na dzǝng-â	'he/she is building'	
	a-na zãm-â	'he/she is stooping/bending'	
(54)	a-na nén-â	'he/she is speaking'	(K 141)
	a-na nyór-â	'he/she is shaving'	
	a-na tány-â	'he/she is stopping a fight'	
	a-na ßéh-â	'he/she is sifting grain'	
	a-ná dũng-â	'he/she is piercing'	
	a-ná vyãr-â	'she is giving birth'	
	a-ná bãnd-â	'he/she is hitting so as to break in two'	

The inflected verbs in (53) are derived in parallel fashion to the polysyllabic inflected toneless verbs in (45) above. The inflected high-toned verbs in (54) are derived parallel to the verbs in (49) and (51) above.

Neutralizing verb stems show a different pattern when inflected in the 3rd person singular present tense.

(55)	a-na hêg-a	'he/she is trapping'	(K 141)
	a-na sôm-a	'he/she is reading'	
	a-na chêm-a	'he/she is shouting'	
	a-na îm-a	'he/she is standing'	
	a-na mêng-a	'he/she is breaking off a piece'	
	a-ná ban-a	'he/she is pressing'	
	a-ná vug-a	'he/she is cooking'	
	a-ná zim-a	'he/she is extinguishing'	
	a-ná dony-a	'he/she is choking'	
	a-ná jib-a	'he/she is answering'	

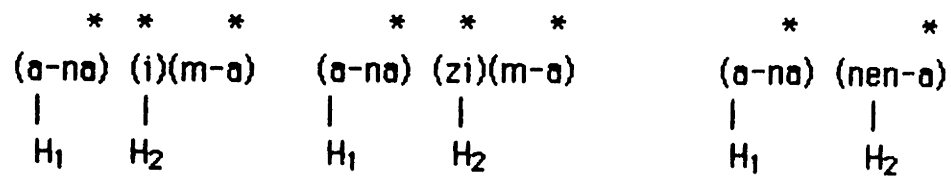
The penultimate vowel of the inflected verb has a falling tone unless it is preceded by a voiced obstruent, in which case the antepenultimate vowel of the phrase has a level H tone.

The tonal patterns of all these inflected verbs are generated by the rule system prescribed above. I show below the derivations of a-na îm-a and a-ná zim-a from (55) and a-na nèn-â from (54). The underlying representations of these phrases will show that the neutralizing verbs have a lexical line 1 stress along with a H tone. The third person subject marker /a-/, it will be remembered, contributes a lexical H to the phrase.

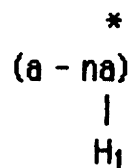
	*		*		
a-na	im-a	a-na	zim-a	a-na	nèn-a
H ₁	H ₂	H ₁	H ₂	H ₁	H ₂

Each word of the phrase passes through the word-level phonology first. The cyclic rule of Stress Erasure will not apply, as there are no object markers present. Likewise, Meeussen's Rule will not apply, as no word has two

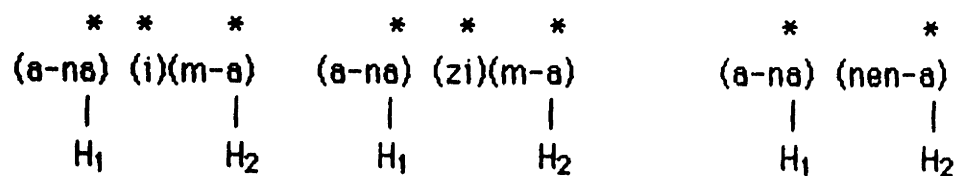
adjacent H tones. Only the word-level rule of metrical structure assignment (10) applies, stressing the final vowel (along with the penult in neutralizing words).



Now the phrasal phonology comes into play. The first cycle is the inflectional word a-na. High Tone Displacement moves H₁ to the second vowel. Obstruent L-insertion, High Tone Doubling, and High Tone Shift do not apply.

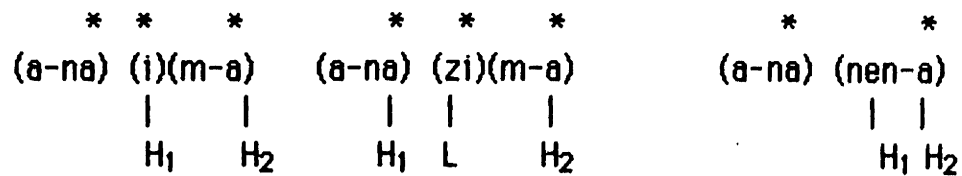


On the second cycle High Tone Displacement applies to the high tones from left to right, displacing H₂ only. H₁ cannot move because H₂ is still linked to the following vowel, and so H₁ simply remains linked to the accented vowel of the inflectional word. H₂ is shifted to the final vowel of each verbal word.

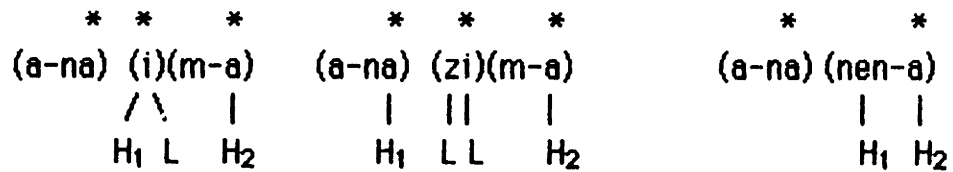


Obstruent L-insertion assigns a L to the [z] of /zim/. High Tone Doubling is inapplicable. High Tone Shift moves H₁ to the verb's first vowel in the first

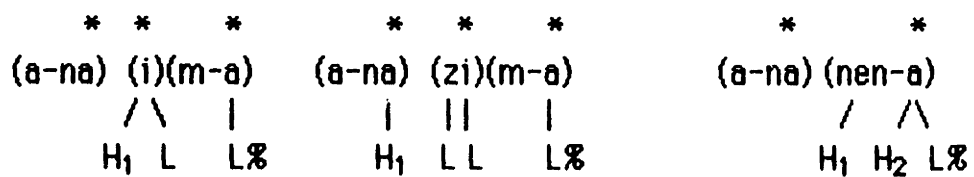
and third phrases; shifting is blocked by the voiced obstruent in the second phrase.



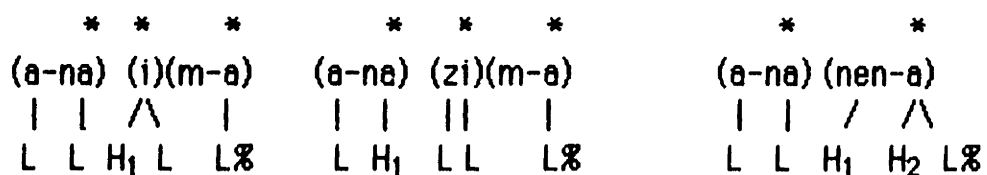
The non-cyclic block of rules begins with Neutralization. This rule applies in first two phrases, linking a L tone to the stressed penultimate vowels.



Boundary L-insertion and LHL Levelling conspire with the L of Neutralization to delete H₂ in the first two phrases.



Default L-insertion completes the derivations of ana-îm-a, aná-zim-a, and ana-nénâ.



There is one other class of verb stems which behaves in a curiously parallel fashion to the neutralizing verbs just considered. This is the set of verbs without stem vowels. Kisseberth (p. 144) offers ku-ty-a as an example, in which the stem vowel [i] has become a glide before another vowel. The stem /ti/, according to Kisseberth, has a lexical H, but like a neutralizing verb its H does not appear in unsuffixed forms.²⁸ If the preceding inflectional word has a H, this H shows up as a falling tone on the vowel preceding the verb stem.

(56)	ni-na ty-a	'I am obeying'	(K 144)
	u-na ty-a	'you (sg.) are obeying'	
	a-nâ ty-a	'he/she is obeying'	
	tu-na ty-a	'we are obeying'	
	mu-na ty-a	'you (pl.) are obeying'	
	ma-nâ ty-a	'they are obeying'	

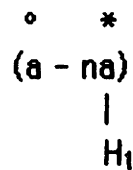
Recall that the third person subject markers /a-/ and /ma-/ are high-toned in the present tense.

It is interesting confirmation for the present analysis that these forms fall out of the rule system with one modification, a modification which is justified below. Consider the representation which the word-level phonology produces (where I assume that /ti/ has a stressed stem vowel in the lexicon like a neutralizing verb).

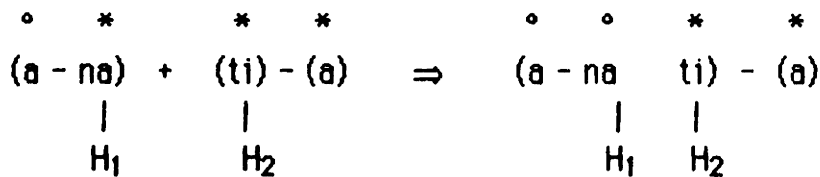
²⁸For this verb ku-ty-a it seems reasonable to suppose that the surface [y] is an underlying high vowel [i] which undergoes Glide Formation before another vowel. Since this is the only paradigm of a "vowelless" available to me, I cannot ascertain whether this analysis could hold for all of the such verb stems of Digo.



Rule 10 stresses the second vowel of the inflectional word and the final vowel of the verbal word. On the first phrasal cycle the H of /a-/ displaces to the vowel of /-na/ in the inflectional word.



The second cycle adds the verbal word to the phrase. Above in connection with neutralizing verbs and the extensional and object marking affixes a rule of Stress Erasure was posited for the cyclic word-level phonology. I propose now that this rule applies also in the cyclic phrasal phonology.²⁹ That is, on cycle n+1, all metrical structure present on cycle n is erased. Since Digo metrical feet are right-headed and unbounded, the prosodic elements of cycle n are incorporated into the leftmost foot of cycle n+1.



On the second cycle the H of the stem /ti/ displaces to the final vowel.

²⁹Halle and Vergnaud (1987, ch. 3) take the stand that such Stress Erasure is simply a consequence of cyclic concatenation. That is, Stress Erasure need not be stipulated; it is a fact of Universal Grammar that the metrical structure of previous cycles will be erased. Although there is a growing body of evidence for the pervasiveness of cyclic stress erasure, Harris 1988 argues convincingly that Spanish is a counterexample to claims for the universality of this phenomenon.

° ° * *
 (a - na ti) - (a)
 | |
 H₁ H₂

° ° * *
 (ni - na ti) - (a)
 |
 H

No other cyclic phrasal rules apply.

In the non-cyclic phrasal phonology Neutralization will assign a L tone to a stressed vowel before another stressed vowel. However, if Glide Formation applies before Neutralization, the vowel of the verb stem /ti/ will no longer be stress-bearing; that is, it may not bear the line 1 asterisk which heads its metrical foot. This line 1 asterisk, however, does not disappear. Rather, it shifts over to the next stress-bearing element within the foot, the final vowel of the inflectional word /a-na/.³⁰

° * *
 (a - na ty) - (a)
 | |
 H₁ H₂

° * *
 (ni - na ty) - (a)
 |
 H

Now Neutralization adds a L tone to the penultimate vowel in both phrases. This insertion will occasion LHL Leveling of the final H in both cases, but in the first phrase the H of the subject marker persists as part of a falling tone on the penultimate vowel.

° * *
 (a - na ty) - (a)
 / \
 H₁ L

° * *
 (ni - na ty) - (a)
 |
 L

³⁰Cf. Halle and Vergnaud (1987, 28-34) and Al-Mozainy, Bley-Vroman, and McCarthy (1985) for similar cases of stress shift.

Extending cyclic Stress Erasure to the phrasal domain of rules thus allows for a simple explanation of the paradigm in (56). Further evidence for phrasal Stress Erasure will be seen below in connection with High Tone Doubling and High Tone Displacement.

3.2.5.2.3 Verbs in the -A- past tense³¹

The /-a-/ past tense of Digo is unusual in that the inflectional word in this tense contributes two H tones to the inflected verb, not just one as with the present and present perfect. This is so because (following Kisseberth's analysis) both the tense morpheme /-a-/ and the subject markers have lexical H tones in this tense. Kisseberth 1984 gives only paradigms with the 1st singular subject marker /-ni/ 'I'. Before the past tense morpheme /-a-/ the vowel of /-ni/ elides, and so the resulting inflectional word is simply [n'á], where the H linked to the elided [i] is floating.³²

The surface forms of both toneless (57) and high-toned (58) verb stems in the /-a-/ past tense have the same pattern as high-toned verbs inflected with /-ka/ and /a-na/ in (49-52) above.

(57)	n-a tsúkúr-â	'I carried'	(K 146)
	n-a wóchér-â	'I received'	
	n-a róngóz-a	'I led'	
	n-a tsór-â	'I picked up'	
	n-a pí-g-a	'I hit'	
	n-á gŭr-â	'I bought'	
	n-á vugŭr-â	'I untied'	
	n-á vumkíz-a	'I agreed'	
	n-a tógŭr-â	'I praised'	
	n-a rá-gŭr-â	'I treated (medically)'	
	n-á dzěng-â	'I built'	

³¹Kisseberth 1984 does not explain the precise value of this tense. In Ci-Ruri the /-a-/ morpheme signifies the Toóay Past tense (Massamba 1982).

³²The reader may wonder why one of these two adjacent H tones is not deleted by Meeussen's Rule. In my analysis Meeussen's Rule is a cyclic word-level rule; the various parts of the inflectional word, however, are posited to be non-cyclic morphemes, and therefore do not undergo the cyclic Meeussen's Rule.

(58)	n-a kúmbúkír-â	'I remembered'
	n-a túrúk-â	'I went out'
	n-a púpút-â	'I beat'
	n-a nén-â	'I spoke'
	n-á vwinír-â	'I sang for'
	n-á dunduríz-a	'I put something aside'
	n-á garagár-â	'I rolled about in pain'
	n-á dűng-â	'I pierced'
	n-a ézék-â	'I thatched'

The representation of a toneless verb and a high-toned verb in the past tense are shown in (59), where subscripts are used to distinguish the underlying H tones.

(59)	toneless		high-toned
	* *		* *
	n(i)-a ragur-a		n(i)-a kumbukir-a
	H _{ni} H _a		H _{ni} H _a H _v

In both phrases the rightmost H will displace to final vowel of the verb at the start of the second phrasal cycle; the penultimate H will displace to the past tense marker /-a/.

	* *		* *
	n(i)-a ragur-a		n(i)-a kumbukir-a
	H _{ni} H _a		H _{ni} H _a H _v

The H linked to /-a/ will then shift over to the verb and spread rightward as far as possible (i.e., up to the next H or up to the L of a voiced obstruent).

Boundary L-insertion, Default L-insertion, and Backwards Spread complete the derivation.



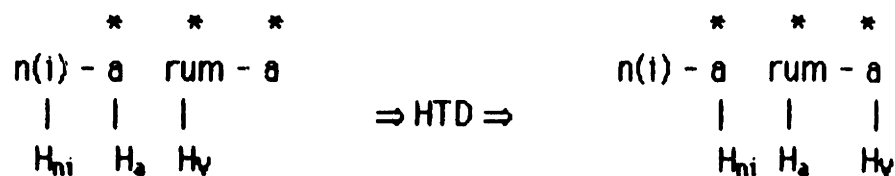
The vowel of /ni-/ will elide at some point in the derivation, leaving its H tone floating in the case of n-a kumbukir-a. The H does not automatically (i.e., by convention) re-associate to the segmental tier. Rather, this floating H tone remains unrealized phonetically since there are no other stressed vowels available to which it may be linked.



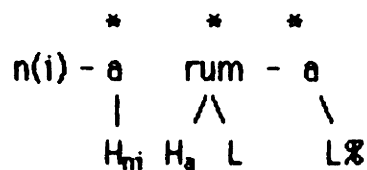
Neutralizing verb stems in the past tense do not have this "housing shortage" of stressed vowels for H tones, since both the penultimate and final vowels of a neutralizing stem are stressed. These inflected verbs have the tone pattern shown in (60).

- | | | | |
|------|------------|-----------------------|---------|
| (60) | n-á meg-a | 'I broke off a piece' | (K 146) |
| | n-á san-a | 'I went out' | |
| | n-á rum-a | 'I bit' | |
| | n-á ßah-a | 'I got' | |
| | n-á hem-a | 'I cleared forest' | |
| | n-á vwin-a | 'I sang' | |

When High Tone Displacement occurs on the second phrasal cycle, all three H tones will be shifted one vowel to the right.

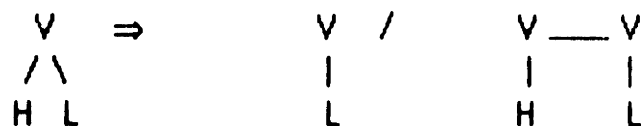


Neutralization and Boundary L-insertion set up the deletion of the final H via LHL Levelling. The output is a falling tone on the penultimate vowel and a level L on the final vowel.



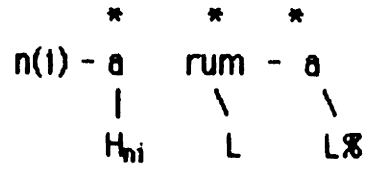
To derive the surface form, however, the penultimate falling tone must be levelled to a L tone. Following Kisseberth (1984, 149) I propose a rule of Fall Simplification to accomplish this levelling.³³

(61) Fall Simplification: delete the H of a HL contour when preceded by a H and followed by a L.



³³My rule differs from Kisseberth's in prescribing a right-hand (low-toned) context for the rule. Kisseberth calls Fall Simplification "an extremely plausible rule." This is no doubt due to the fact that it lines up the break between high tone and low tone with a segmental break (different vowels).

Fall Simplification takes place after LHL Levelling to reduce the penultimate falling tone to level L, yielding n-á rum-a after elision of the [i].



Fall Simplification will also show up in the tonology of phrases in which neutralizing nouns follow high-toned inflected verbs.

3.2.5.3 Imperatives

The derivation of Digo imperatives is somewhat problematic. In the first place, the available data are rather scanty. In the second place, the structure of the Digo imperative is unusual. The plural subject marker /-ni/ – part of the inflectional word – follows rather than precedes the verb. High Tone Displacement is not blocked by the L tones of voiced obstruents in other words, but displacement does seem to be blocked by them in imperatives. These complexities are demonstrated directly.

The analysis to follow contains many unmotivated assumptions. My reasons for including a section on the Digo imperative are two: (i) I feel an obligation with such an unresearched language to include as much data as I have available, even if it does not support my analysis; and (ii), I hope to demonstrate that an analysis is at least possible within the solution space delineated by the leading ideas of this thesis.

The tonal patterns of verbs in the imperative mood are curious in that the lexical distinction between high-toned and toneless stems is eliminated. Compare the paradigm of the toneless stem in (62a) with that of the high-toned stem in (63a). The morpheme /-ni/ marks plurality of the implicit second person subject; /-a/ is the final vowel when there is no object marker or when the object marker is 1st sg. /-ni/, else the final vowel is /-e/.

(62) Toneless stems

a.	tsukur-a	'carry!'	(K 153)
	ni-tsukur-a	'carry me!'	
	a-tsukûr-e	'carry them!'	

tsukur-ǎ-nî	'pl. carry!'
ni-tsukur-ǎ-nî	'pl. carry me!'
a-tsúkúr-é-nî	'pl. carry them!'

b. vumikiz-a	'say yes!'	(K 157)
ni-vumikiz-a	'say yes to me!'	
á-vumikiz-e	'say yes to them!'	
vumikiz-ǎ-nî	'pl. say yes!'	
ni-vumikiz-ǎ-nî	'pl. say yes to me!'	
á-vumikiz-é-nî	'pl. say yes to them!'	

c. rejezer-a	'soak for!'
ni-rejezer-a	'soak for me!'
a-réjezer-e	'soak for them!'
rejezer-ǎ-nî	'pl. soak for!'
ni-rejezer-ǎ-nî	'pl. soak for me!'
a-réjezer-é-nî	'pl. soak for them!'

(63) High-toned stems

a. ßirik-a	'send it!'	(K 158)
ni-ßirik-a	'send for me!'	
a-ßírík-e	'send for them!'	
ßirik-ǎ-nî	'pl. send for!'	
ni-ßirik-ǎ-nî	'pl. send for me!'	
a-ßírík-é-nî	'pl. send for them!'	

b. vwinir-a	'sing to!'
ni-vwinir-a	'sing to me!'
a-vwinir-e	'sing to them!'
vwinir-ǎ-nî	'pl. sing to!'
ni-vwinir-ǎ-nî	'pl. sing to me!'
a-vwinir-é-nî	'pl. sing to them!'

Compare, for example, the paradigms of /tsukur/ 'to carry/ and /Birik/ 'to send'. The former is a toneless verb stem and the latter has a lexical H, yet the paradigms have precisely the same pattern. The other verbs have different patterns due to the presence of voiced obstruents in the verbs.

Some further observations are in order. First, comparison of the toneless stem tsukur-a and tsukur-ǎ-ní shows that the plural morpheme /-ni/ contributes a H to the imperative. Second, the level penultimate H in á-vwɪnɪr-é-ní and á-vumikiz-é-ní suggests that there are three H tones in the surface form of this word: one on the object marker /a-/, one on the plural marker /-ni/, and one on the vowel /-e-/. Compare this level penultimate H with that of ana-nénâ in (54) above. I therefore posit that the morphemes /-ni/ and /-e-/ both have lexical H tones. The implications of this will be worked out directly.

Note thirdly the shape of the third line in (62a) and (63a): both a-tsukûr-e and a-βirík-e look like neutralizing verbs with high-toned inflections. Compare these forms to (55) above, where the verbs also have a falling tone on the penultimate vowel. This is an indication of a stressed penult in these forms. The H of these HL contours cannot, however, be due to the high-toned object marker /a-/. The H of high-toned object markers is not generally prevented by voiced obstruents from displacing rightward in a word, since Obstruent L-insertion applies after High Tone Displacement. This is obvious from the data in (64), where the H of the object markers /u-/ and /a-/ displace over two voiced obstruents, [v] and [g].

(64)	ku-vugurir-a	'to untie for'	(K 110)
	ku-u-vugurĩr-â	'to untie for us'	
	ku-a-vugurĩr-â	'to untie for them'	

The same H which contributes to the HL contour in a-tsukũr-e, however, is blocked from displacing to the penult in â-yumikiz-e (62b) by the initial voiced obstruent. It shows up rather on the first vowel, shifts rightward, and spreads as far to the right as possible unless it runs into the L of a voiced obstruent, as in a-réjezer-e (63c). I construe this prefixal H to be an inflectional H of the imperative mood which shows up with forms ending in the final vowel [e]. This imperative H tone is added to the verb on the second phrasal cycle, after the cyclic phrasal rule of Obstruent L-insertion applies in the verbal word on the first cycle (see below).

Certain rules must apply to verbs in the imperative mood such that (i) the difference between toneless and high-toned verbs is neutralized, and (ii) the singular imperatives have the metrical structure of neutralizing verbs, viz., a stressed penult, and (iii) voiced obstruents block the movement of a prefixal H. In the present analysis, a rule of the word-level cyclic phonology deletes the first H tone (of a stem or object marker) in the verb.

(65) Imperative Deletion:

delete first H in verb

$$H \Rightarrow \emptyset / [\text{---} \dots]_V$$

The underlying representation of Birik-e and a-Birik-e are as follows.

Birik-a	a-Birik-e
H	H H H

Imperative Deletion deletes the first (or only) H of the verb after Meeussen's Rule deletes the stem H when the object marker is high-toned.

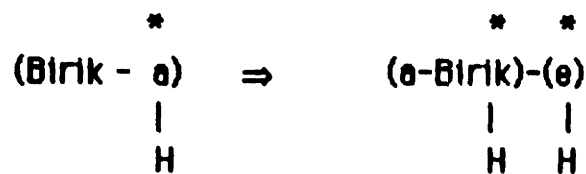
Birik-a	a-Birik-e
Ø	Ø Ø
	H

Because of the rule of Metrical Boundary Insertion (38), the lexical H of the suffix /-e/ ensures that the penultimate vowel of the verbal word is a stressed vowel. This is so because Metrical Boundary Insertion places a left bracket before the high-toned final vowel, just as in neutralizing nouns. After Metrical Boundary Insertion and Metrical Structure Assignment the representations are these:

*	*	*
(Birik - a)	(a-Birik)-(e)	
	H	

High Tone Displacement does not apply in the first cycle of either phrase. On the second cycle the prefixal imperative H is concatenated to the second form (because its final vowel is [e]) by linking it to the initial vowel.³⁴ High Tone Displacement then applies on the second cycle to relink this H to the penultimate vowel.

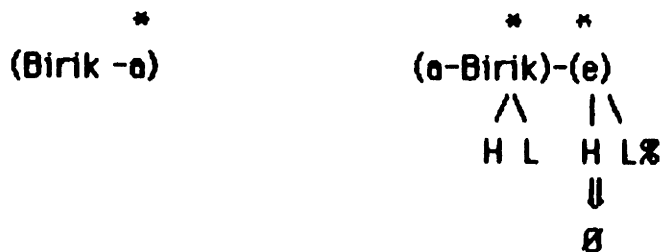
³⁴Whether this linkage to the initial vowel is by special rule or general principle, I cannot say for lack of empirical evidence. The fact that this H undergoes High Tone Shift (39) is puzzling under the present formulation of that rule, which requires an intervening word boundary. Perhaps the boundary symbol should be left out of the rule and instead one could suppose that H tones shift in a phrasal cycle subject to some sort of strict cyclicity. I choose not to alter the rule here, since there are so many uncertainties in the analysis of the imperative.



The first rule of the phrasal phonology to apply is Neutralization, inserting a L on the stressed penultimate vowel.

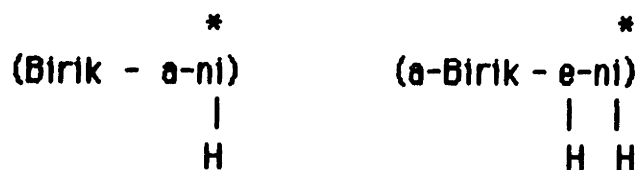


Boundary L-insertion and LHL Levelling conspire to delete the final H, but leave a HL contour on the penultimate vowel if there is a second H.



⇒⇒ Birík-a a-Birík-e

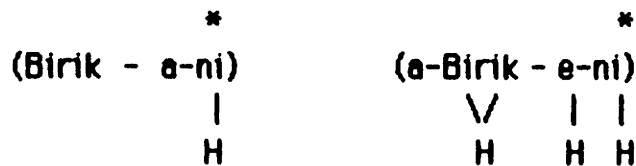
The morpheme /-ni/ is added to imperatives with plural subjects. Curiously, this inflectional morpheme follows the verbal word, unlike other subject markers (cf. 3.2.5). When the monomorphemic inflectional word /-ni/ is added to the above imperatives, cyclic phrasal Stress Erasure removes all previous metrical structure, leaving only the stress on the inflectional word /-ni/.



On this second cycle the prefixal H of the imperative with /-e/ is linked to the first vowel. This may not be displaced to the right since there is no stressed vowel for it to go to.



The prefixal H then shifts and spreads.



Backwards Spread and Boundary L-insertion create the expected rising/falling contours. The further derivation of βirik-ǎ-nî and βirik-ǎ-nî proceeds just like ku-gon-gomé-â in (14) above.

The presence of voiced obstruents in the stem inhibits the shift or spread of the prefixal H, as is seen in the words á-vumikiz-a, a-réjezer-a, a-réjezer-é-nî and á-vumikiz-é-nî. This suggests, as mentioned above, that the verbal word is the innermost cycle of the imperative phrase; the floating H prefix is linked only on the second cycle, after the obstruents receive their L tones.³⁵

³⁵Note, though, that this second cycle H does not induce phrasal Stress Erasure in a form like a-tsukûr-e, since the penultimate vowel of the verbal word – the inner constituent – must still be stressed to attract the prefixal H. Perhaps Stress Erasure is caused only by concatenation of something prosodic, and a floating H tone does not count as a prosodic entity.

There is one further twist in the tale of the Digo imperative. This shows up in high-toned verb stems which are three syllables long or longer. Kisseberth (1984, 158) offers the following paradigm.

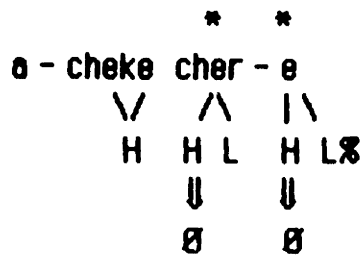
(66)	chekecher-a	'sift for!'	(K 158)
	ni-chekecher-a	'sift for me!'	
	a-chékéchér-e	'sift for them!'	
	chekecher-ǎ-nî	'pl. sift for!'	
	ni-chekecher-ǎ-nî	'pl. sift for me!'	
	a-chékéchér-é-nî	'pl. sift for them!' ³⁶	

The surprise is found in the third form, the singular imperative with the third person object marker, a-chékéchér-e, not, as expected, *a-chekechêr-e. The correct form can be derived only if there is a third H in the word which does not get removed by Imperative Deletion or Meeussen's Rule.

	*	*
a - chekecher - e		
H	H	H

This form would be derived like n-á rum-a in (57) above. There, Neutralization conspired to delete the final H, and Fall Simplification removed the medial H from the penultimate vowel because the preceding vowel was high-toned. The prefixal H shifts and spreads to the antepenult.

³⁶I assume that the published gloss of this form, "pl. sift for me", is a typographical error.



Fall S. Neut.

Perhaps this third H is the original stem H, untouched by Imperative Deletion in three-syllable stems with 3rd person object markers. But why does this extra H not show up in chekecher-a or ni-chekecher-a? I have no explanation for this problem.

In conclusion, Digo imperatives present a number of puzzles, and the metrical analysis of tone offers no unique insights into their solutions.

This is an appropriate point to recapitulate the complete rule system for Digo.

(67) Word-level phonology

cyclic

- Meeussen's Rule (32)
- Imperative Deletion (65)
- Metrical Boundary Insertion (39)
- Stress Erasure

non-cyclic

- Metrical Structure Assignment (10)

Phrasal phonology

cyclic

- Stress Erasure
- High Tone Displacement (12)
- Obstruent L-insertion (13a)
- High Tone Doubling (16)
- High Tone Shift (39)

non-cyclic

Glide Formation

Neutralization (26)

Boundary L-insertion (13c)

LHL Levelling (17)

High Tone Spread (13b)

Default L-insertion (13d)

Backwards Spread (13e)

Stress Decontouring (39)

Fall Simplification (61)

3.2.6 Verb phrases containing noun phrases

The rule system outlined in (67) suffices to derive Digo phrases consisting of noun phrases and inflected or uninflected verbs. As will be seen, one needs only to maintain the assumption that Digo phonological phrases are left-branching. To this I add the assumption that the various noun class markers (NCM) – /mu, ma, ny, m, n, w, vi, chi, ku/ – are not prefixes to the following noun, but rather are separate determiner words. These words behave as phonological enclitics; in the post-lexical (phrasal) phonology they behave as part of the verbal word ($[V-NCM]_{Verb}$). This is due to the sort of phonological restructuring discussed in Chapter Two, found elsewhere in Bantu. The noun class markers are present on the cycle of the verb and participate in the tonology on that cycle, parallel to the locative /-ni/ suffix on nouns. The structure of a phrase consisting an inflected verb and a noun with a class marker is as in (68).³⁷

(68) [[[INFL] Verb-NCM] Noun]

Cycle 1	[INFL]
Cycle 2	[INFL Verb-NCM]
Cycle 3	[INFL Verb-NCM Noun]

The phonological phrase structure of Digo is different from the syntactic deep structure. In the syntax the verb and direct object NP form a phrasal constituent, but in the phonology the INFL and the verb form a constituent.

³⁷It is conceivable that the structure $[[INFL] Verb]$ is due to Verb-to-INFL (head-to-head) movement, creating a two word phrase in the syntax. One expects rather that the verb and its direct object would form a constituent; it will be seen in the behavior of High Tone Displacement that this cannot be the phonological structure of Digo phrases.

Syntax: [INFL [V NCM-Noun]]

Phonology: [[INFL V-NCM] Noun]

The phonological phrase structure must somehow be derived from the syntactic phrase structure. Unfortunately, not enough data on phrasal tonology is available to allow a formal proposal for how Digo syntactic structure is mapped into the cyclic layers of Digo phonological structure. Explicit arguments are given below for the cyclic structure shown in (68), but it is difficult to see how one might apply the ideas of Hyman 1985 or Selkirk 1986 (cf. Chapter Two) to arrive at cyclically nested phrasal domains. Michael Kenstowicz (personal communication) suggests that the phrasal tonology of the closely related language Chizigula also operates in a cyclic fashion. My arguments for cyclicity in Digo phrasal phonology are due to Kisseberth (1984, 167-f.)

3.2.6.1 Phrases with no surface H tones

There are two sorts of phrases which are completely low-toned. This first type has no underlying H tones at all. Examples are in (69)

- | | | | |
|------|--------------------|------------------------|---------|
| (69) | ku-gur-a ŋombe | 'to buy a cow' | (K 162) |
| | ku-henz-a mu-ganga | 'to look for a doctor' | |
| | ni-na pi-g-a goma | 'I am beating a drum' | |
| | ni-na guw-a tunda | 'I am peeling a fruit' | |

The second type of low-toned phrase has a single underlying H tone associated with a phrase-final neutralizing noun. In this case the underlying H is deleted by LHL Levelling in cooperation with Neutralization and Boundary L-insertion.

(70)	ku-takas-a ny-ungu	'to clean a pot'	(K 162)
	ku-rand-a chi-tanda	'to spread a bed'	
	ni-na jit-a vi-yogwe	'I am cooking sweet potatoes'	
	ni-na gur-a shoka	'I am buying an axe'	

3.2.6.2 Phrases with one surface H tone

There are two types of phrases with a single surface H. The first type is the phrase which ends the familiar rising/falling contours. In such phrases the underlying H may come from the noun (71), the verb stem (72), a subject marker (73), a tense marker (74), or a neutralizing verb stem (75).³⁸

(71)	ku-sag-a ma-pěmbâ	'to grind maize'	(K 163)
		(cf. ma-pěmbâ, ku-sag-a)	
	ku-vugur-a fűndô	'to untie a knot'	
	ku-andik-a chi-tábu	'to write a book'	
	ni-na tsor-a chi-dăfű	'I am picking a young coconut'	
	ni-na vugur-a fűndô	'I am untying a knot'	

³⁸I have no doubt that an object marker's H behaves the same way, although Kisseberth 1984 gives no examples of phrases with noun following a verb with an object marker.

(72) ku-onyes-a n-ǰrâ	'to show the way' (cf. ku-onyěs-â, n-ǰira)
ku-afun-a ny-ãmâ	'to chew meat'
ku-anik-a n-gũwô	'to dry clothes in sun'
ni-na ezek-a bãndâ	'i'm thatching a shed'
ni-na reh-a chi-gwázo	'i'm bringing a peg'
ni-na ádz-a mũ-tû	'i'm mentioning someone'
(73) a-na henz-a mu-gǎngâ	'he's looking for a doctor' (cf. ku-henza muganga, K 162)
a-na ǰit-a mǎngâ	'he's cooking cassava'
a-na plg-a gómâ	'he's beating a drum' (cf. ni-na pig-a goma, K 162)
a-na ragíz-a kalǎmû	'he's ordering a pen'
(74) a-ka gur-a n-gũwô	'he has bought clothes' (cf. a-ka gũr-â, n-guwo)
a-ka ǰit-a má-zu	'he has cooked bananas'
a-ka ragíz-a kalǎmû	'he has ordered a pen'
(75) ku-heg-a n-gurũwê	'to trap a pig' (K 167) (cf. ku-heg-a, n-guruwe)
ku-heg-a n-ǰyâ	'to trap a pigeon'
ku-ih-a mu-gǎngâ	'to call a doctor'

ni-na βah-a ma-tũndâ	'I'm getting fruit' (cf. ni-na βah-a, ma-tunda)
ni-na vug-a w-ãrĩ	'I'm cooking rice'
ni-na tsun-a ɲombê	'I'm skinning a cow'

Wherever the underlying H starts out, it moves in successive cycles of the phrasal phonology to the end of the next word. Finally in the non-cyclic component this H spreads backwards.

Evidence for the cyclic phrasal application of certain rules comes from phrases such as the last two in (73). The phrases in (73) are sentences where the vrb has an overt direct object: these sentences consist of an inflectional word with a lexical H, a toneless verbal word, and a toneless noun. (Note the low-toned phrases with 1st person subject markers.) In a-na piŋ-a gõmâ and a-na raŋiz-a kalãmũ we find the strange Digo phenomenon discussed above in connection with (18) and (19), where a single underlying H surfaces as two H tones. The reason for this can be seen in the derivation of a-na-piŋ-a gõmâ, the underlying representation of which is shown in (76).

(76)

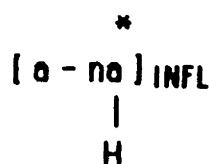
[a - na] INFL	[piŋ - a] v	[goma] NP
H		

First the word-level rules apply, stressing the final vowel of all three words. (Stress Erasure and Meeussen's Rule are inapplicable.)

* [a - na] INFL	* [piŋ - a] v	* [goma] NP
H		

The phonological structure of Digo is left-branching. The first cycle of the phrasal phonology, then, is simply the INFL word; [INFL-V] is the second cycle and [INFL-V-NP] is the third and final cycle.

On the first cycle High Tone Displacement moves the H of /a-/ to the final vowel of the INFL word; Obstruent L-Insertion, High Tone Doubling, and High Tone Shift cannot apply.



On the second cycle High Tone Displacement reapplies, moving the singly linked H to the final vowel of the verb pig-a. Phrasal application of cyclic Stress Erasure deletes the asterisk of the INFL word.



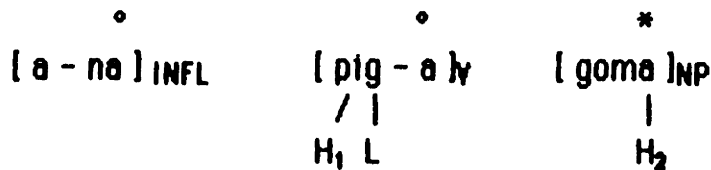
The final consonant of the verb stem /pig-/ is a voiced obstruent, and so Obstruent L-insertion assigns a L tone.



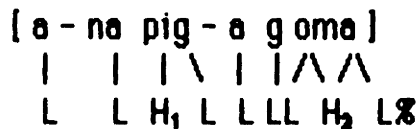
This application of Obstruent L-Insertion sets up the context for High Tone Doubling, since the preceding vowel is unstressed. Two separate H tones are created: one H linked to the vowel before the voiced obstruent, and one unlinked H following the obstruent.



On the third cycle the toneless noun is concatenated, and the stress on pig-a is erased. High Tone Displacement scans the string in order to link H tones to accented vowels to the right. H₁ cannot be displaced because of the following linked L tone. It therefore remains in place. High Tone Displacement also examines H₂. In this case, there is "clear sailing" for H₂ to move to the stressed vowel to its right, the final vowel of the noun goma.



Obstruent L-insertion assigns a L to the initial consonant of the noun. Doubling and Spreading are blocked from applying. Of the non-cyclic rules, only Boundary and Default L-insertion apply, along with Backwards Spread.



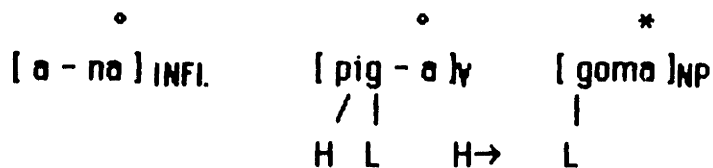
This completes the derivation of the phrase, yielding the surface form a-na pig-a gómâ.

Two observations should be made about the derivation of a-na pig-a gómâ. First, this phrase shows that the lexical H of the subject marker /a-/ first undergoes High Tone Displacement, Obstruent L-insertion, and High Tone Doubling in connection with the final vowel of the verb pig-a before these rules re-apply to the H in connection with the final vowel of

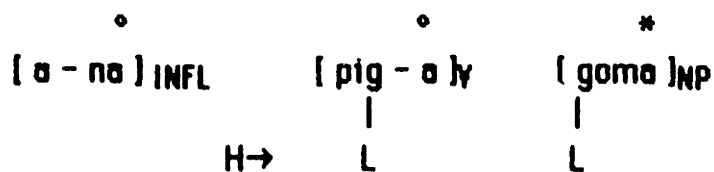
the noun goma. That is, this phrase shows that these rules apply cyclically to an inner constituent before applying to the entire domain. This also shows that the noun is part of the outermost constituent and the last cycle, whereas the verb and inflectional word together form the inner constituent.

This is evident from the H tone on the penultimate vowel of piŋ-a: this H is a vestige left by Obstruent L-insertion and High Tone Doubling. If these rules applied in non-cyclic fashion, however, one would have no way of deriving the H on the [i] of piŋ-a. The incorrect form *a-na piŋ-a gōmâ should surface, since High Tone Displacement would move the H of the initial vowel all the way to the final vowel of goma in one step. This phrase is evidence, then, for the cyclic application of certain rules of phrasal tonology.

A second observation to be made with respect the derivation of a-na piŋ-a gōmâ is that the set of cyclic phrasal rules (High Tone Displacement, Obstruent L-insertion, High Tone Doubling, and High Tone Shift) are necessarily rules of the phrasal phonology only, and not also of the word-level phonology. If Obstruent L-insertion had applied at the word level to the noun goma, the initial consonant would be linked to a L tone. This inserted L would prevent the re-application of High Tone Displacement which crucially moves the H of verbal word (and originally the subject marker) to the final vowel of the noun.



In fact, the H of the subject marker could not even make it as far as the final vowel of the verb, seeing that there is a voiced obstruent in the stem.



Obstruent L-insertion, therefore, must apply in the phrasal phonology, not the word phonology, else High Tone Displacement would be severely impeded.

It is also evident that High Tone Displacement applies on a cycle following the application of Obstruent L-insertion and Doubling. This shows that High Tone Displacement is a rule of phrasal phonology as well, since it follows the phrasal rule of Obstruent L-insertion. As there is no evidence for supposing that High Tone Displacement applies earlier as well in the word-level phonology, it is most reasonable to assign it and the rules which follow it to the cyclic phrasal phonology. This fact comports well with the hypothesis that rules of metrical structure precede rules of tone manipulation. The metrical structure rules of Digo seem to be word-level rules, whereas the tonal rules seem to operate on phrasal constituents.

Consider now the data in (75) above, where a neutralizing verb is followed by a toneless noun: e.g. ku-heg-a n-gurŭwê, ni-na vug-a w-ǎrî. Here the verb stem /heg/ also ends in a voiced obstruent before the final vowel /-a/, but there is no H on the penultimate vowel as in a-na píg-a gŏmâ. The neutralizing verbs /heg/ and /vug/ have lexical H tones which displace to their final vowels on their cycles: what distinguishes them from /pig/ such that High Tone Doubling does not apply? The answer, of course, is metrical structure. As discussed in connection with the reformulation of High Tone Doubling in (43) above, a stressed vowel which precedes a voiced obstruent (as in a neutralizing noun or verb) does not receive a doubled H.

The stem vowels of /heg/ and /vug/, being lexically marked with line 1 asterisks, are not sites where Doubling may apply. Once again, independently motivated metrical structure³⁹ provides a crucial distinction in abstract representations, allowing us to account for surface distinctions in tone patterns (cf. footnotes 22 and 23).

Another type of phrase with a single surface H tone is the phrase which ends in a neutralizing noun and has a high-toned inflected verb. Examples are given in (77).

(77) ku-afun-a nâzi	'to chew a coconut'	(K 169)
	(cf. ku-afŭn-â, nazi)	
ku-azim-a shôka	'to borrow an axe'	
	(cf. ku-azĭm-â, shoka)	
ku-ar-á demu	'to take a rag'	
	(cf. ku-âr-â, demu)	
ku-ar-a chí-demu	'to take a small rag'	
	(cf. chi-demu)	
ku-ádz-á dzina	'to call by name'	
	(cf. ku-ádza, dzina)	
a-na-jit-a ma-rênje	'he's cooking pumpkins'	
	(cf. a-na-j ĭtâ, ma renje)	

³⁹The "independent motivation" for assuming that the penultimate vowels of neutralizing words are stressed comes from the way they "attract" displaced H tones from previous words, as in (52) and (77). That is, these penultimate vowels behave like final vowels in that they attract preceding H tones, and so it is reasonable to assign them a like metrical prominence.

This formulation of High Tone Doubling also explains why there is no H on the first vowel of a neutralizing noun such as bigǎ-nĭ in (37) above. Cf. bádǎ-nĭ in (38b). In the latter noun High Tone Doubling applies to the initial vowel on the first cycle (i.e., [bádǎ]) since the first vowel is unstressed and the second vowel is stressed. However, on the first cycle of the neutralizing noun [bigǎ] the first syllable is stressed (due to Boundary Insertion before the final high-toned vowel), blocking Doubling.

a-na-andik-a chi-tânda	'he's making a bed' (cf. a-na-andík-â, chi-tanda)
a-na-andik-a barûwa	'he's writing a letter' (cf. baruwa)
a-na-tsong-a gungûhi	'he's cutting a bed leg' (cf. a-na-tsǒng-â, gunguhi)
a-na-angamíz-a pêsá	'he's losing money' (cf. a-na-angamíz-a, pesa)
a-na-vuw-a má-zobe	'he's fishing for crabs' (cf. a-na-vǔw-â, ma-zobe)

The derivation of these phrases is quite straightforward under the rule system discussed previously. I illustrate with the phrases ku-azim-a shôka and ku-ar-á demu.

At the end of the first cycle the underlying H of the infinitive has been moved to the final vowel. Obstruent L-insertion assigns a L to the [z] of /azim/.

	*		*
ku-azim-a		ku-ar-a	
L	H _v	H _v	

The underlying H of the neutralizing noun is linked in the lexicon to its final vowel (vid. the discussion of nouns above); the H of the verb displaces on the second cycle to the stressed penult of the noun. On the second cycle the [d] of /demu/ is also assigned a L. Cyclic phrasal Stress Erasure removes the asterisk on the final vowel of the verb.



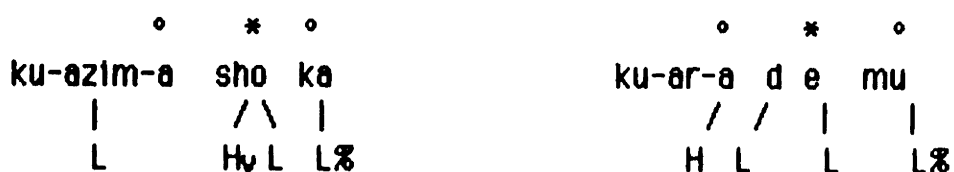
Because the final vowel of the verb ku-ar-a is unstressed High Tone Doubling may apply across the voiced obstruent [d] of demu.



In the non-cyclic phrasal phonology Neutralization assigns a L to the phrase-penultimate vowels because they are stressed. Boundary L-insertion adds a phrase-final L.



This sets the stage for LHL Levelling (17) of the falling tones on the final vowel of shoka and on both vowels of demu, since both [e] and [u] are linked to HL contours which are preceded by a L tone.



After Default L-insertion the forms ku-azim-a shôka and ku-ar-á demu are derived. The H on the final vowel of the verb ku-ar-a is further evidence for

cyclic phrasal Stress Erasure, as discussed above in connection with ky-ty-a in (56) above.

3.2.6.3 Phrases with multiple surface H tones

In this section I show how the rule of High Tone Shift (39) fits into the phrasal phonology. It will also be shown how Spreading bleeds the later cyclic application of Displacement.

Consider first phrases such as those in (78) where a high-toned inflectional word and a high-toned verb are followed by a toneless noun.

(78)	a-na chékéch-á ú-ngâ	'he's sifting flour'	(K 172)
	a-na ézek-a bǎndâ	'he's thatching a shed'	
	a-na ádz-a mũ-tû	'he's mentioning s.o. by name'	
	a-na tsíndz-á má-dzogǒrô	'he's slaughtering roosters'	
	a-ka tsúkúts-á chí-róndâ	'he has cleaned a wound'	
	a-ka tsúkúts-á chí-dǒndâ	'he has cleaned a wound'	
	n-á gwír-a dzogǒrô	'I caught a rooster'	
	n-a hénz-á mú-gǎngâ	'I looked for a doctor'	

The derivation of a-na ézek-a bǎndâ is as follows. On the first cycle the H of the subject marker /a-/ displaces to the following vowel.

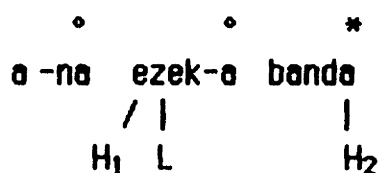
*
a - na
|
H

On the second cycle the H of the verb displaces to its final vowel, and the H of the INFL word shifts to the first vowel of the verb.

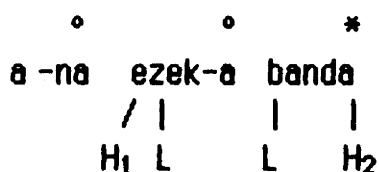
° *
a - na ézek - a
/ | |
H₁ L H₂

Obstruent L-insertion has also applied on the second cycle to the [z] of the verb stem. If the verb had an initial voiced obstruent, the H of the INFL would have been unable to shift, as in n-á gwir-a dzogǒrô in (7B).

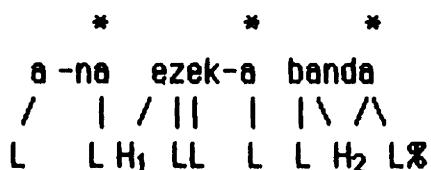
On the third cycle the toneless noun banda is concatenated. Once again High Tone Displacement applies to H₂, linking it to the final, stressed vowel of the noun.



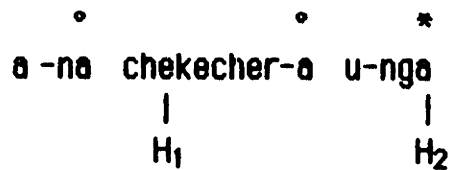
Note that the voiced obstruent [b], the initial consonant of the noun, does not block the displacement of H to the last vowel. This entails that at the stage of the derivation where High Tone Displacement has applied, the obstruent has not yet been assigned a L. This is evidence for ordering the rule of Obstruent L-insertion after Displacement. The output of the cyclic phrasal phonology is below.



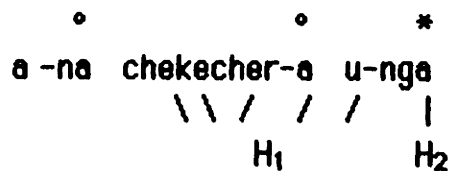
The non-cyclic rules fill out the derivation unremarkably.



Consider now the derivation of a-na chekecher-a u-nga. In this phrase there are no voiced obstruents to block Spreading. What is noteworthy here is that on the third cycle when the toneless noun is added, only the second H displaces; the inflectional H does not displace again to the final vowel of the verb, the vowel recently vacated by the second H.



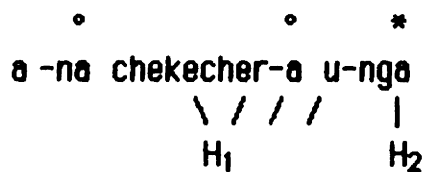
In my analysis this follows from cyclic phrasal Stress Erasure. On the third cycle the final vowel of the verb loses its stress; there is therefore no stressed vowel to which the inflectional H₁ may displace. In the non-cyclic phrasal phonology H₁ spreads rightward all the way to the vowel of H₂.



The latter representation is of some theoretical interest. It has been claimed in the literature that the Obligatory Contour Principle (OCP) should control the spreading of H tones so that a H is never spread onto a vowel which immediately precedes another high-toned vowel unless a linked or floating L intervenes (cf. Myers 1986: 183-f. for Shona; Kenstowicz and Kisseberth 1989 for Chizigula). Note, though, that in the above representations, H₁ and H₂ are linked to adjacent tone-bearing units. The OCP, therefore, does not block this configuration in Digo. This entails that

the cases in Shona and Chizigula where the OCP putatively blocks spreading are due rather to language-specific rules.⁴⁰

This phrase shows also that High Tone Shift applies only on the second cycle to H₁. If High Tone Shift applied on the third cycle the output of the cyclic phrasal phonology would be as below, where H₁ has been shifted from both the final vowel of the inflectional word and the initial vowel of the verbal word.



This representation will produce the incorrect surface form

*a-na chekéché-r-á ú-ngá. As it is, H₁ must be shifted only once; this follows from the formulation of High Tone Shift (39), which depends crucially on an intervening word boundary.⁴¹

Now consider the phrase a-na ádz-a mũ-tũ. The phrase shows that, contrary to the ordering given in (64), the rule of High Tone Shift precedes and bleeds High Tone Doubling. On the second cycle the verb's H is displaced to the final vowel and Obstruent L-insertion assigns a L to the voiced affricate [dz].

⁴⁰See especially Odden 1986 for arguments against the OCP as a principle of grammar.

⁴¹As discussed in the section on imperatives, the condition requiring an intervening word boundary should perhaps be dropped in favor of an analysis where a second shifting of H₁ is blocked by the Strict Cycle Condition in the phrasal phonology, inasmuch as on the third cycle (when the noun is added) there is no derived environment for the purposes of the shift of H₁.

◦		*
a -na	adz - a	
H ₁	L	H ₂

Now if Doubling takes place the output will be as follows.

◦		*
a -na	adz - a	
H ₁	H L	H ₂

H₁ will not be shifted because the following vowel already has a H tone. The above representation will thus yield the incorrect surface form *a-ná ádz-a mú-tú, where the final vowel of the inflectional word wrongly has a H tone. The phrase na-hénz-á mú-gǎngá in (78) is derived in similar fashion.

The correct result is achieved by ordering Shift before Doubling. In this case the output of the second cycle is as follows.

◦		*
a -na	adz - a	
	/	
H ₁	L	H ₂

High Tone Doubling will not apply since the relevant vowel is already attached to a H tone. The final representation of the surface form is the following.

◦		◦		*
a -na	adz - a		mutu	
			/\	/\
L	L H ₁ L	L	L H ₂	L%

Let us now consider phrases with two H tones where one H belongs to the noun.

- | | |
|---|---|
| <p>(79) a. ku-banang-a kándê
 ku-anik-a ma-pémbâ
 ni-na azim-a chi-kárángô</p> | <p>'to spoil food' (K 171)
 'to put maize in the sun to dry'
 'I'm borrowing a frying pan'</p> |
| <p>b. a-na vugur-a fúndõ
 a-na jit-á zódo
 a-na ragíz-a chi-tábu
 a-na tsor-a chí-dǎfû
 a-na suw-a sáhání</p> | <p>'he's untying a knot'
 'he's cooking mangos'
 'he's ordering a book'
 'he's picking up a young coconut'
 'he's washing plates'</p> |

In (79a) the first H of the phrase comes from the verb stem; in (79b) the first H comes from the subject marker /a-/. The second H comes from the noun in both sets.

These phrases are derivable from the rule system outlined already, given an assumption about the morphological status of noun class markers in Digo. As introduction, let us walk through the derivation of phrases where the noun has no overt noun class marker: a-na jit-á zódo and a-na suw-a sáhání.

Both phrases have three words: a high-toned INFL, a toneless verb, and a high-toned noun. In the word-level phonology only metrical structure assignment will apply, stressing the final vowels of each word.



Next come the cyclic phrasal rules. The output of the first two cycles will show H₁ shifted to the final vowels of the verbs. Obstruent L-insertion applies to the [j] of /jit/.



The third cycle sees the noun added to the phrase. High Tone Displacement shifts H₂ to the final vowel. High Tone Shift moves H₁ to the first vowel of sahani, but is blocked by the [z] in zodo. Doubling of the noun-final H puts another H on the first vowel of zodo.



Boundary L-insertion triggers LHL Levelling in the first phrase; High Tone Spread links H₁ in the second phrase to the second vowel of the noun. Default L-insertion also applies to give the surface forms a-na jit-á zódo and a-na suw-a sáháni.



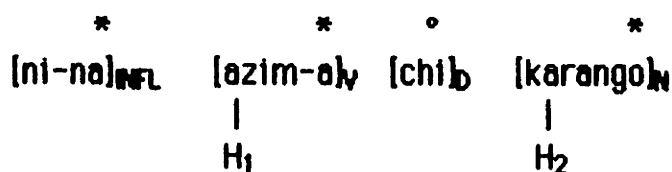
The question to be addressed now is why the noun class markers /chi-/ and /ma-/ in (79) are uniformly low-toned in phonetic form: e.g., ni-na azim-a chi-kárángô, not *ni-na azim-a chí-kárángô. One would expect,

parallel to a-na suw-a sáháni, that when a high-toned noun follows a high-toned verb the first vowel of the noun will be high-toned.

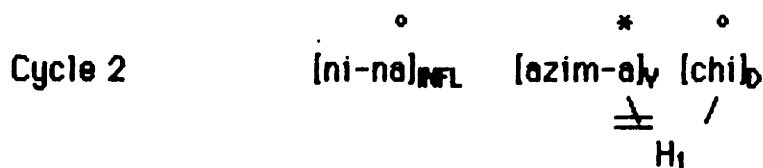
Instead, it appears as if the H tone of the verb shifts first to the noun class marker /chi-/, and then shifts to the first vowel of the noun; Spreading takes place after the second application of Shift.

This behavior can be explained by supposing that the noun class markers are not part of the noun word, but are separate words of their own. More precisely, I hypothesize that these noun class markers are not prefixes to the noun, but are independent determiners.

Following this hypothesis, a phrase such as ni-na azim-a chi-kárángô, is properly parsed into four words: an inflectional word, a verbal word, a determiner, and a noun. The rule of metrical structure assignment, however, stresses only the final vowels of lexical items, not of function words such as the postposition /-ni/ or the noun class markers.



The noun class marker is part of the cycle of the verb; in that cycle the H on the final vowel of the verb shifts to the noun class marker.



On the next cycle this H is eligible to shift again to the initial vowel of the noun.

The assumption that noun class markers are distinct words in the phonology, not nominal prefixes, allows for a simple account of the phrasal data in (79).⁴²

I turn now to phrases which contain three underlying H tones, one each from the inflectional word, the verb, and the noun. Data are shown in (80, K 176).

(80)	a-na áník-á má-pémbâ	'he's putting maize in the sun to dry'
	a-na tsún-á ñónzî	'he's skinning a sheep'
	a-ná vug-á dǒnâ	'he's cooking hard maize porridge'
	n-a ángámíz-a tánâ	'I lost a bow'
	n-á vugur-a fúndô	'I untied the knot'
	n-a tsúkúr-á má-pémbâ	'I carried the maize'

These forms are quite predictable. Voiced obstruents block shifting and spreading as seen in previous data.

The final set of data to be considered is found in (81). These phrases consist of three high-toned words, where the noun is neutralizing (i.e., has a high-toned final syllable in underlying representation).

(81)	a-na ézek-a ny-ûmba	'he's thatching the house' (K 175)
	a-ná vwar-a chi-tâmbi	'he's wearing a piece of cloth'
	a-na áfún-á chí-yogwe	'he's chewing a sweet potato'
	a-na ßírík-á sálamu	'he's sending greetings'

⁴²See Chapter Two for the arguments from Myers 1987 for considering noun class markers to be independent words in the syntax (but clitics in the phonology).

ni-ká vundz-a ru-kûni	'I have broken a piece of firewood'
ni-ka ón-á simba	'I have seen a lion'
n-á jit-a ma-rênje	'I cooked pumpkin'
n-á jit-á dzungu	'I cooked a (species of) pumpkin'
n-a tsóng-á gungûhi	'I carved a bed leg'

These forms are completely derivable from the rule system discussed so far. The H of the noun is deleted by LHL Levelling in cooperation with Neutralization and Boundary L-insertion. The H of the verb displaces to the penultimate vowel of the noun. Neutralization of this vowel creates a HL falling tone which will be simplified to L (i) by LHL Levelling if a voiced obstruent precedes, or (ii) by Fall Simplification (58) if a high-toned vowel precedes. Cf. (i) dzungu and (ii) sálamu and simba, respectively. This HL contour persists only when it is preceded by a vowel which ends up with a default L tone: e.g. ny-ûmba, chi-tâmbi, ru-kûni, ma-rênje, and gungûhi above. The H of the inflectional word shifts and spreads as far rightward as it can.

3.3 Summary and discussion

The final rule system is shown in (82). This theory of Digo tonology employs rather simple rules which depend only on local conditions, for the most part. This is a step in the right direction towards explaining how the complicated tonal system of Digo is acquired by native speakers.⁴³

(82) Word-level phonology

cyclic

Stress Erasure

Meeussen's Rule (32)

Metrical Boundary Insertion (38)

Imperative Deletion (62)

non-cyclic

Metrical Structure Assignment (10)

Phrasal phonology

cyclic

Stress Erasure

High Tone Displacement (12)

Obstruent L-insertion (13a)

High Tone Shift (39)

High Tone Doubling (74)

non-cyclic

Neutralization (26)

Boundary L-insertion (13c)

LHL Levelling (17)

High Tone Spread (13b)

Default L-insertion (13d)

Backwards Spread (13e)

Stress Decontouring (39)

Fall Simplification (58)

⁴³Kisseberth 1984, 182 (fn. 26) notes that phrases in Digo have a mid-falling contour tone on the phrase-penultimate vowel when it is low-toned. Little phonetic description is given, so I make no attempt to account for this datum in the analysis.

Although I have introduced quite a few rules to explain the tone patterns of Digo nouns and verbs, I have tried to show that many of these rules are necessary in any account of Digo tonology. It is difficult, for instance, to conceive of a theory for Digo which does not include rules analogous to Meeussen's Rule, Obstruent L-insertion, High Tone Doubling, High Tone Spread, Boundary L-insertion, Default L-insertion, and Backwards Spread. These latter rules are really more descriptive than explanatory; in my analysis these are rules which are mostly independent of metrical structure.

The real explanatory work in this theory is done by the rules of Metrical Structure Assignment, Stress Erasure, High Tone Displacement, Neutralization, and Fall Simplification, as well as by the assumptions regarding phonological phrasal structure defended above. On the whole these rules seem rather simple, even familiar in the cases of Stress Erasure and Fall Simplification.

The present analysis also allows some insights into questions of learnability for the complex tonal grammar of Digo. A few plausible principles get one a long way in figuring out the system. First, the familiar left-to-right Association Convention of Pulleyblank 1986 gives the learner all of the underlying representations except for those of neutralizing nouns. Second, any vowel which attracts a high tone over some distance must bear metrical prominence, i.e. be stressed. This sort of tone-to-accent attraction (in the sense of Goldsmith 1987b) – along with High Tone Shift and the inflectional word notion of Myers 1987 – unifies three rules of

Kisseberth's ground-breaking analysis: High Tone Displacement, Low Attraction, and Displacement-to-Stem.

A third aid in figuring out the Digo tone system is the simplicity of the metrical rules. Cyclic stress erasure, if not universal, is certainly the unmarked case in metrical systems. Right-headed and unbounded feet are also easily calculated from the persistent tendency of Digo tones to move rightward as far as possible. The penultimate stress in neutralizing nouns and verbs, idiosyncratic as it is, is nonetheless deducible from the way these vowels attract a preceding H, as in ku-afun-a nâzi 'to chew a coconut' (K. 169) and a-na hêg-a 'he is trapping' (K. 141). From this deduction it is but a single step to posit underlying accents for verb stems and finally-linked H tones for nouns.

The fourth learning principle is of particular interest here. This is the "division of labor" principle: in a metrical tone system, all rules of tone manipulation are phrasal rules, just as in English.⁴⁴ Furthermore, the phrasal tone rules are assumed to be non-cyclic unless there is compelling evidence – as shown above for Displacement, Obstruent L-insertion, Shift, and Doubling – to consider them to be cyclic rules.

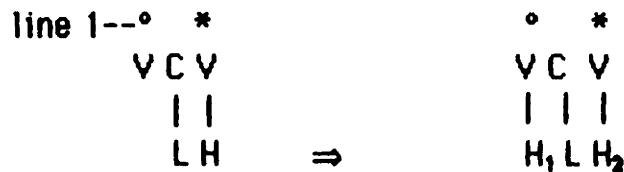
With these kinds of constraints and notions of modularity phonological theory can begin to explain the tone patterns of Digo.

⁴⁴The only two exceptions to this principle are Meeussen's Rule and Imperative Deletion. It is conceivable that both these rules are not in fact rules of tone deletion so much as rules of stem allomorphy. That is, every high-toned stem has an toneless allomorph when combined with object marking or imperative morphology.

Appendix: High Tone Doubling or High Tone Split?

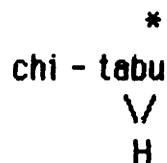
In earlier work on Digo I entertained a rather different conception of the rule which in the present analysis is formulated as High Tone Doubling. Recall that this rule inserts a copy of a H tone on a unstressed vowel preceding the high-toned stressed vowel only if a low-toned voiced obstruent intervenes. I repeat the statement of the rule here for purposes of comparison.

- (16) High Tone Doubling: insert a H on an unstressed vowel in a word if it is followed by a low-toned segment and a H tone.



As pointed out to me by Jim Harris, this rule is rather suspicious. Voiced obstruents must be mentioned twice in my rule system: once in the rule of Obstruent L-insertion and again for the purposes of High Tone Doubling. A Doubled H tone and a Backwards Spread H tone are in complementary distribution in Digo: is it possible to derive the former from the latter by a clever ordering of the rule of Obstruent L-insertion?

Suppose that Backwards Spread applied directly after Displacement in a noun such as chi-tabu. The intermediate representation would be as follows:



Suppose that Obstruent L-insertion applied next, linking an inserted L tone to the voiced obstruent [b].

*
chi - tabu
X/
L H

This linkage leads to a line-crossing violation of the Well-formedness Condition (cf. 4 above). Suppose then that this ill-formed representation is patched-up by a rule of High Tone Split. This rule splits the doubly-linked H tone into two singly-linked H tones.

*
chi - tabu
/ | \
H L H

The second H tone is eventually eliminated due to Boundary L-insertion and LHL Levelling. This sort of High Tone Split, then, comes closer to explaining the presence of a H before a voiced obstruent than does the merely descriptive rule of High Tone Doubling.

There are a number of reasons for discarding this analysis, nonetheless. The first set of arguments comes from the larger picture of Digo tonology. Suppose first of all that we adopt the Split analysis. It was shown above in connection with phrases such as a-na-pí-g-a gǒmâ (76) that the rule of High Tone Split must apply cyclically in the phrasal phonology, splitting the H at the end of the verb's cycle before displacing to the final vowel of the noun. Backwards Spread, however, must be a non-cyclic rule. If Backwards Spread applied to a H in every cycle, then we have no

explanation for why the first H in the phrase ni-ká gongomě-â 'I have hammered' (K. 131) has not spread backwards at the end of the first cycle: *ni-ká gongomě-â. In other words, Backwards Spread seems to apply only to a phrase-final H, not to a cycle-final H. This means that Backwards Spread is non-cyclic, whereas High Tone Split must be cyclic.

There are other cases where High Tone Split would have to apply, but where Backwards Spread clearly cannot apply. In a phrase such as ku-ar-a chí-demu 'to take a small rag' (K. 169) the H of the verb ku-ar-a has displaced to the stressed penultimate vowel of the neutralizing noun chí-demu. This H is eventually deleted by LHL Levelling, but not until after it is "split" onto the noun class marker chí. Yet Backwards Spread never takes place in this environment: consider the formally parallel form with a stem-initial voiced obstruent, a-na-ít-a ma-rênje 'he's cooking pumpkins' (K. 169). The penultimate H here is not spread back to the noun class marker; it is not deleted either because there is no preceding L tone at the time LHL Levelling applies. Here again Split is not derivable from Backwards Spread.

A second kind of evidence against the splitting analysis comes from Zulu. Laughren 1984 shows that Zulu also has depressor consonants. The effect of these depressor consonants is heard in the lowering of surrounding vowel tones. I repeat her examples (p. 210), where underscoring of a segment indicates a depressor consonant and underscoring of a tone indicates an extra-low tone.

isihlaalo	'seat'	izi hlaalo	'seats'
l / \ /		l / \ / \ /	
L H L		L H L	

isifuundo
 | \ | \ /
 H LH L

izi fu undo
 | \ | \ | \ /
 H L H L

The voiced obstruents [z] and [d] (i) cause the surrounding L tones to become extra L, and (ii) cause the H following the [z] in izi-hláalo to lose its first linkage: izi-hláalo.

However, when a voiced obstruent occurs between two vowels linked to the same H tone, the obstruent's extra-low tone is not inserted: there is no phonetic perturbation of surrounding tones (p. 219).

úrn-!fázi	'woman'	i 'nkúnzi	'bull'
/ /		\ /	
H L H		HL H	

If High Tone Split were a possible rule of grammar, one would certainly expect to see its effects in these cases as well.

I conclude, then, that the Doubling account is the only reasonable account of the Digo data. Further work on the historical reconstruction of the Eastern Bantu language group may perhaps yield more insights into the nature and origin of the rule.

Chapter 4

TONE AND METRICAL STRUCTURE IN SUKUMA

According to Richardson's 1971 description, the language **Ki-Sukúma** (also called **Ki-Gwè**, F. 21 in Guthrie's classification) has about one million speakers, dwelling between Lake Victoria and Lake Eyasi in Tanzania (formerly Tanganyika). Richardson's monograph was the first published description in English of Sukuma; Batibo 1976 and 1985 offers a description of a different dialect of Sukuma in a theoretical framework which is rather different from Richardson's. Sukuma shares many features with other Lacustrine Bantu languages, including the systematic rightward shift of high tones (cf. Goldsmith 1985a). Unlike its close relative **Ci-Ruri**, however, Sukuma high tones shift two or three vowels rightward, not just one.

The analysis below is a metrical model of Sukuma tone. I posit a two-way distinction in underlying tonal representations of morphemes, H vs. Ø. L tone is the default phonetic specification for vowels which receive no H tone in the phonological component of the grammar. High tones are attracted (via autosegmental spreading) to vowels adjacent to a metrical boundary, i.e. vowels which are on the left edge of an abstract constituent. Much of the analysis below is simply a reworking of Richardson's remarkable thirty-year old theory (Richardson 1959), which is autosegmental in spirit, if not in formalization.

4.1 An overview of Sukuma tonology

Goldsmith (1985b: 168, 169) offers paradigms of Sukuma verbs which demonstrate both the H vs. Ø tone contrast in verb stems and the rightward migration of underlying H tones. I repeat his data in (1) and (2), where the (a) examples are infinitives of unsuffixed verbs and the (b) examples are infinitives of derived verb stems with the suffix /-antj-/ 'simultaneously'.¹

(1)	a.	ku-sol-a	'to choose'	(G 168,9)
		ku-kaab-a	'to divide'	
		ku-lagal-a	'to drop'	
		ku-gaagaan-a	'to bustle about'	
		ku-si-a	'to grind'	
		ku-lb-a	'to forget'	
		ku-alul-a	'to dress up'	
	b.	ku-sol-antj-a	'to choose simultaneously'	
		ku-lb-antj-a	'to forget simultaneously'	
		ku-alul-antj-a	'to dress up simultaneously'	
(2)	a.	ku-bon-a + H	'to see'	
		ku-laal-á	'to sleep'	
		ku-tonol-á	'to pluck'	
		ku-baabáat-a	'to grope one's way'	
		ku-su-a + H	'to spit'	

¹My transcription conventions vary slightly from previous work on Sukuma. Richardson (1959: 105) describes the vowels /i/ and /u/ with cedilla as closer varieties of /i/ and /u/. By "closer" I understand him to mean more tense. For orthographic convenience I transcribe the tense vowels as 'i' and 'u' and their lax correspondents as 'ɨ' and 'ʊ'. To the right of numbered examples I give the number of the page from which the data have been taken. 'G.' stands for Goldsmith 1985b; 'R.' stands for Richardson. If an 'R.' number is between 1 and 124, the data are from Richardson 1959; if the 'R.' number is between 219 and 227, the data are from Richardson 1971.

	kv-ib-a + H	'to steal'
	kv-ogoh-á	'to fear'
d.	kv-bon-aníj-a	'to see simultaneously'
	kv-laal-ánj-a	'to sleep simultaneously'
	kv-tonol-ánj-a	'to pluck simultaneously'
	kv-su-aníj-a	'to spit simultaneously'
	kv-ib-aníj-a	'to steal simultaneously'
	kv-ogoh-ánj-a	'to fear simultaneously'

Following Richardson and Goldsmith, in (2a) I use the expression '+ H' to indicate that a H tone shows up on the following word, if possible. This behavior is seen in a phrase where a high-toned verb is followed by a toneless noun, as in (3).

(3)	ama-hagala	'the tree forks'	(R. 63)
	aka-bona áma-hagala	'he saw the tree forks'	(R. 11)
	ba-temi	'chiefs'	(R. 20)
	aka-bona bá-temi	'he saw chiefs'	
	aka-sola ba-temi	'he chose chiefs'	

Here the H from the verb stem /bon/ has shifted rightward in the phrase two syllables to the first vowel of the noun's determiner element (i.e. noun class marker or pre-prefix). The verb stem /sol/, however, has no lexical H, and so no H shows up two syllables to the right in phrasal contexts. This contrast between /bon/ and /sol/ shows up as well in derived infinitives, repeated in (4).

(4)	kv-bon-aníj-a	'to see simultaneously'
	kv-sol-anj-a	'to choose simultaneously'

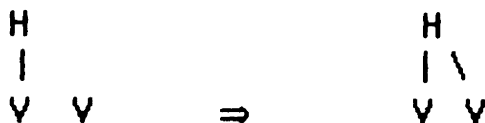
Once again, the H of the stem /bon/ appears on a vowel two syllables later; the toneless stem /sol/ contributes no H to the suffix /-anj/.

The rightward shift of H tones is common in the languages of Tanzania. For example, in Jita (Zone E. 20 in Guthrie's classification) the H tone associated with a verb stem usually surfaces on the next vowel to the right of the first stem vowel, as the data from Downing 1988a show.

- (5)
- | | | |
|-----------------|--|---------|
| oku-Bón-a | 'to get, to see' | (D. 29) |
| oku-Bon-ón-a | 'to get each other' | |
| oku-Bon-ér-a | 'to get something for someone' | |
| oku-Bon-ér-an-a | 'to get something for each other' | |
|
 | | |
| oku-í:g-a | 'to look for' | |
| oku-i:g-ána | 'to look for each other' | |
| oku-i:g-ír-a | 'to look for something for someone' | |
| oku-i:g-ír-an-a | 'to look for something for each other' | |

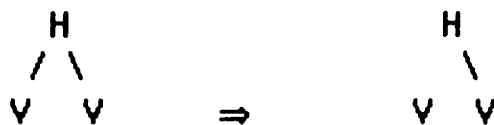
In these Jita verbs, the H of the stems /Bon/ and /i:g/ shifts over to the next vowel, unless that vowel is the final vowel of the phrase.² Downing (1988a, 32) formulates High Tone Shift in Jita as a two-step process: first, the H is spread to the following toneless vowel; second, the left association of the H tone is delinked. These rules are given in (6).

(6) Rightward Spread (Jita)



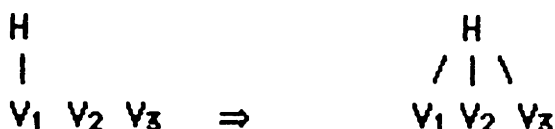
²In this case shifting is blocked by the presence of a phrase-final Boundary L tone on the vowel (similar to the Boundary L of Digo –see chapter 3). That is, Boundary L-insertion precedes and blocks High Tone Shift in Jita, where Shift is defined as moving H tones only to toneless vowels.

Leftward Delinking (Jita)

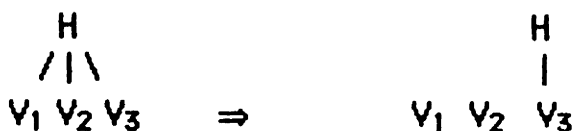


One might propose a similar pair of rules to generate the two syllable shift of H tones in Sukuma.

(7) Rightward Spread (Sukuma)



Leftward Delinking (Sukuma)



There are two problems with this approach to Sukuma tone shift. The first problem is a theoretical one: the rules in (7) require a grammatical ability to count up to three (at least) for the purpose of executing the correct number of linkings and delinkings. If grammars have the ability to count up to three, then in principle they have the ability to count up to any number desired. This counting ability is a powerful device to introduce into the theory of grammar.

Is there need for such an ability? Recent research by McCarthy and Prince (1986) suggests otherwise:

No language process, however, is known to depend on the raw number of segments in a form: a robust finding, given the frequency and pervasiveness of counting restrictions. (p.3)

Consider first the role of counting in grammar. How long may a count run? General considerations of locality, now the common currency in all areas of linguistics thought, suggest that the answer is probably 'up to two': a rule may fix on one specified element and examine a structurally adjacent element and no other. (p. 1)

Rules such as those given in (7) are therefore suspect: a theory which does not make recourse to counting mechanisms would be valued more highly than a theory employing such mechanisms.

A second problem with the rules in (7) is empirical: these rules do not explain the full range of Sukuma tone shift data. As shown in (8), the number of syllables by which a H tone shifts may range from zero to three.^{3,4}

(8) 0 syllables			
	aka-saŋga- <u>kó</u> giŋhi	'he found an owl there'	(R. 49)
1 syllable			
	aka-bɔŋá giŋhi	'he saw an owl'	(R. 18)
2 syllables			
	aka-bɔŋa áma-hagala	'he saw the tree forks'	(R. 11)
3 syllables			
	aka-bɔŋa ma-hóga	'he saw tree forks'	(R. 11)

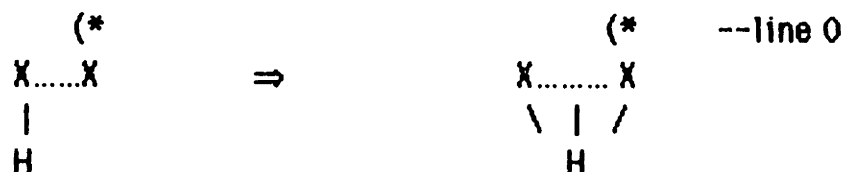
³One of the few shortcomings of Richardson's otherwise brilliant work is the paucity of glosses provided along with Sukuma forms. For this reason, I cannot always give glosses for cited forms. I am also restricted to citing forms in the mostly phonemic transcription that Richardson uses; he does not give a complete phonetic description of the Sukuma forms. Certain questions, therefore, cannot be answered at present.

⁴Following Richardson I will sometimes underline a vowel which bears a high tone in underlying representation.

A counting approach to tone shift does not seem feasible: there is no obvious way to modify the rules in (7) to generate the correct distance of shifting in each case.

Instead, I propose capturing the "counting behavior" of Sukuma H tones by positing an intermediate and abstract metrical structure. As in Digo, H tones are "attracted" to prominent vowels, vowels in certain metrical positions (cf. Goldsmith 1987b). Unlike Digo, however, Sukuma H tones do not undergo displacement, i.e. relinking to the next stressed vowel. Rather, Sukuma H tones are spread towards and across a line 0 left constituents boundary, across any number of vowels. The rule for Sukuma High Tone Spread is shown in (9).

- (9) High Tone Spread: spread H to the right as far as possible, up to a vowel following a left line 0 constituent boundary.⁵



This rule does not count syllables or vowels: it simply spreads a H tone rightward as far as possible or until a constituent boundary is reached and crossed. The operation of High Tone Spread will be demonstrated in the derivations below.

After High Tone Spread establishes multiple linkings between a H tone and the segmental tier, a second rule deletes all association lines but for the final one.

⁵Because H tones spread to nasal consonants as well as vowels, this rule is formulated in terms of segments (X's), not vowels (V's).

(10) Delinking: delink all but the rightmost association line of a H.

$$\begin{array}{ccc}
 (X)\dots(X)\dots X & \Rightarrow & (X)\dots(X)\dots X \\
 \backslash \quad | \quad / & & \underline{\pm} \quad \underline{\pm} \quad / \\
 \quad \quad \quad H & & \quad \quad \quad H
 \end{array}$$

Delinking, like High Tone Spread (9), is not a counting rule, but simply a local rule which removes an association line between a tone and a segment if there follows another segment linked to the same tone.

High Tone Spread and Delinking – rules of the phrasal phonology – do most of the work in Sukuma tonology.⁶ The missing piece of the puzzle is the rule of metrical structure assignment: how does one determine the constituency of vowels on line 0? This question will be addressed separately for nouns and verbs.

⁶This two-step technique of shifting H tones is borrowed from Goldsmith, Peterson, and Drogo, in press.

4.2 Metrical structure in verbs

As in the analysis of Digo, I assume for Sukuma verbs that a lexical H tone is associated in underlying form to the first vowel of the verb stem.

(11)	bon	tonol	laal	ogoh	baabaat
	H	H	H	H	H

It will be seen in the data to follow that this is a well motivated assumption.

Within verbal words of Sukuma, the distance of High Tone Shift is almost always two moras. (Again, the underlined vowel is the one bearing the H tone in underlying representation.)

(12)	aka-b <u>o</u> nelá	'he looked for (something)'	(R. 8)
	aka-b <u>o</u> naníja	'he saw at the same time'	
	u-a-b <u>o</u> na <u>g</u> á ⁷	'he saw (today)'	(R. 39)
	ku-l <u>a</u> al-á	'to sleep'	(G. 168)
	ku-t <u>o</u> no <u>l</u> -á	'to pluck'	
	ku-b <u>a</u> abáat-a	'to grope one's way'	

The two-step character of the shifting operation suggests that binary metrical feet (as opposed to ternary or unbounded) are present.

As a first approximation, I propose the following set of rules for metrical structure construction.

⁷Phonetically this is presumably [waa-bonagá]; cf. úésola --> [wáésola], R. 36.

(13) Metrical Structure Assignment

- i. Assign line 0 asterisks to timing slots linked to vowels.
- ii. Construct binary constituents from left to right.

Heads of line 0 constituents are not automatically located on line 1.

Constituent formation and head location are separate rules in metrical theory.⁸ Rule (13) assigns representations like those in (14), in which the binary constituents are headless.⁹

(14) (a ka) (bone) (la)
 |
 H

(a ka) (bona) (ni ja)
 |
 H

High Tone Spread (9) links the underlying H to vowels on its right until it crosses a left constituent boundary.

(a ka) (bone) (la)
 \ | /
 H

(a ka) (bona) (ni ja)
 \ | /
 H

Delinking (10) then erases all association lines but the final one.

(a ka) (bone) (la)
 /
 H

(a ka) (bona) (ni ja)
 /
 H

⁸The separability of constituent formation and head location is seen most clearly in Halle and Vergnaud's analysis of YidinꞤ; compare also the analysis of Kimatuumbi in Chapter Two above, where binary constituents were left- or right-headed depending on the tonal class of the noun.

⁹The infinitives in (12) will be handled in the section on nouns and adjectives below. The infinitive prefix /ku-/ is a noun class marker, as in many Bantu languages. That is, the infinitive is a nominalization of the verb. It will be seen below that such noun class markers are generally extrametrical in Sukuma.

The result is a surface H tone two moras to the right of its underlying position.

(a ka) (bone) (la)
 |
 H

(a ka) (bona) (ni ja)
 |
 H

High-toned stems are not the only source of H tones in verbal words. Object markers (15a) and subject markers (15b) may have H tones as well; these H tones shift two moras as well, as is seen in conjunction with the toneless verb stem /sol/ 'choose'.¹⁰

(15) a. a-kv-ba - sol-á 'he will choose them' (R. 45)
 SM-TM-OM-stem-FV

b. ba-kv-sól-a 'they will choose' (R. 35)
 SM-TM-stem-FV

mu-kv-sól-a 'you (pl.) will choose'

tu-kv-sól-a 'we will choose'

These forms can be contrasted with verbs which contain toneless object and subject markers.

(16) a-ku-ku-sol-a 'he will choose you (sg.)' (R. 225)
 na-ku-sol-a 'I will choose' (R. 35)
 u-ku-sol-a 'you (sg.) will choose'
 a-ku-sol-a 'he will choose'
 a-ka-sol-a 'he chose (yesterday)' (R. 38)

¹⁰The morphemes are identified with the following abbreviations: SM = subject marker, TM = tense marker, OM = object marker, FV = final vowel.

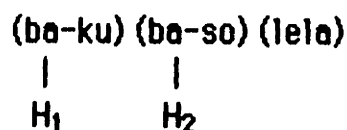
The derivation of the forms in (15) is straightforward. Metrical structure assignment builds binary feet across the word, and the H of the object or subject marker spreads to the next constituent, then delinks from the previous vowels.



If both a high-toned object marker and a high-toned subject marker are present in a verbal word, the distance of shift for the subject marker's H tone is reduced to one vowel.

- (17) **ba-kú-ba-alúla** 'they will dress up them' (R. 47)
 ba-kú-ba-soléla 'they will choose them for someone'
 ba-kú-ba-ibá¹¹ 'they will forget them' (R. 48)

The second verb in (17) has the following representation after the rules of metrical structure assignment.



High Tone Spread then links H₂ to the next two vowels, stopping at the vowel of [le]. H₁ can only be spread one vowel to the right, however, because the second vowel (of [ba]) is already linked to a H tone.

¹¹Presumably pronounced [bakúlibá] parallel to ku-ga-ib-á --> [kugibá] after coalescence of the adjacent vowels, R. 31.

(ba-ku) (ba-so) (lela)
 \ / \ | /
 H₁ H₂

Delinking (10) produces the desired surface form.

(ba-ku) (ba-so) (lela)
 | |
 H₁ H₂

The spreading of a subject marker H may likewise be limited to only one vowel when it precedes a verb stem with a H tone. Again as in (17) above, the one-step shift of the subject marker H is due to the fact that the second vowel after the subject marker (the verb stem's initial vowel) is already high-toned, and therefore a boundary to spreading.

- | | | | |
|------|---------------------------------|-----------------------------|---------|
| (18) | <u>ba</u> -kú- <u>ton</u> olá | 'they will pluck' | (R. 39) |
| | <u>ba</u> -kú- <u>ogoh</u> á | 'they will fear' | |
| | <u>ba</u> -kú- <u>laal</u> á | 'they will sleep' | |
| | <u>ba</u> -kú- <u>baab</u> áata | 'they will grope their way' | |

These verbs have a derivation which is formally parallel to the verbs in (17).

The shift of an object marker H tone is also limited to one vowel just in case the following toneless verb stem has a long vowel ([ii], [aa]) in the first syllable.

- (19) a-ku-ba-súga 'he will slander them' (R. 47)
 *a-ku-ba-súga
 *a-ku-ba-sugá
 cf. a-ku-ba - sol-ó 'he will choose them' (R. 45)
- ba-kú-ba-súga 'they will slander them'
- a-ku-ba-gáagaana 'he will bustle them about'
 ba-kú-ba-gáagaana 'they will bustle them about'

This behavior indicates that the first mora of a long vowel is always leftmost in its constituent, since it attracts a preceding H tone, preventing it from passing over to the second mora. The analysis captures this fact by the addition of a rule (20ii) which brackets a branching rime as a binary constituent on its own.¹²

(20) Metrical Structure Assignment

- i. Assign line 0 asterisks to timing slots linked to vowels.
- ii. Insert a left bracket on line 0 to the left of the first mora of a branching rime.
- iii. Construct binary constituents from left to right.

These rule have the following outputs.

- (21) i. * * * ** * --line 0
 a-ku-ba-siig-a --> a-ku-ba-siig-a
 | |
 H H

¹²Halle 1969b posits a similar rule for Cairene Arabic. The effect of this idiosyncratic bracketing rule is to prevent two moras of the same syllable from being in different feet.

It is worth noting that the tone patterns in (19) are evidence for a level of metrical structure in Sukuma: metrical systems are frequently sensitive to syllable weight, but feature spreading rules (such as High Tone Spread) are generally not sensitive to syllable weight, if ever. The fact that spreading in Sukuma is controlled by rime structure is *prima facie* evidence for the presence of metrical constituency.

ii.	* * * (** *	iii.	(* *) (**)(**)(*)
-->	a-ku-ba-siig-a	-->	a-ku-ba-siig-a
	H		H

Because the first mora [i] following the high-toned object marker /ba-/ is leftmost in the constituent, the H shifts only to that vowel and no farther.

* * * *
(* *) (**)(**)(*)
a-ku-ba-siig-a
<u> </u> /
H

4.3 Tone fusion

It was shown directly above that one H tone can inhibit the spreading of another H tone which is linked two syllables to the left. When the preceding H tone is in the neighboring syllable, however, something quite different happens. In the examples in (22) the high-toned object marker /ba-/ is adjacent to the high-toned verb stems. The H of the object marker does not surface in such cases.

(22)	a-ku-ba-bon-elá	'he will find them'	(R. 47)
	*a-ku-bá-bon-elá		
	ba-kú-ba-bon-elá	'they will find them'	
	a-ku-ba-ogoh-á	'he will fear them'	
	ba-kú-ba-ogoh-á	'they will fear them'	
	a-ku-ba-djimíla	'he will hold them tight'	
	ba-kú-ba-djimíla	'they will hold them tight'	

At first glance this disappearance of the object marker's H tone looks like a variation on the well-known Meeussen's Rule (see Goldsmith 1984b), where the H of the object marker is deleted when adjacent to the stem H.

a-ku-ba-bon-ela	-->	a-ku-ba-bon-ela
H H		Ø H

This cannot be the correct solution, judging from the tone patterns of forms with the high-toned subject marker /ba-/. The subject marker's H shifts only one syllable in these forms, not the expected two.

When the verbal word contains a toneless object marker such as /ku-/, for example, the subject marker's H shifts two syllables, to the vowel of the object marker.

(23) ba-ku-kú-bon-elá 'they will find you (sg.)' (R. 47)
SM-TM-OM-verb-FV

*ba-kú-ku-bon-elá

ba-ku-kú-ogohá 'they will fear you (sg.)'

ba-ku-kú-toolá 'they will marry you (sg.) a wife'

ba-ku-kú-djímíla 'they will hold you (sg.) tight'

If in the verbs of (22) the object marker's H has been deleted by Meeussen's Rule, then why does the subject marker's H not shift two vowels over to the now toneless object marker?

The object marker's H (in 22) must be present when High Tone Spread applies in order to block the further spread of the subject marker's H.

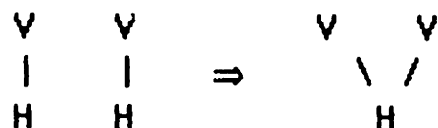
ba-ku-ba-bon-ela	-->	ba-ku-ba-bon-ela	-->	ba-ku-ba-bon-ela
		\ / \ /		
H H H		H H H		H H H

But if the object marker H is present at the time of High Tone Spread, then when is it deleted? Why does ba-ku-ba-bon-elá in (22) above not surface as *ba-kú-ba-bon-elá?

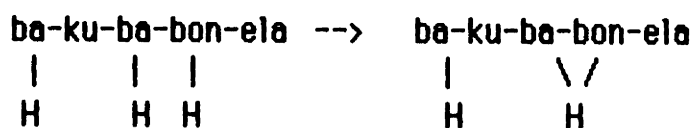
One might suggest that Meeussen's Rule applies after High Tone Spread but before Delinking, so that the first of two H tones in adjacent syllables is deleted. However, this ordering predicts that the H of the subject marker /ba-/ will be deleted in ba-kú-ba-bon-ela, seeing that the H of the subject marker and the H of the object marker are in adjacent syllables after spreading.

For reasons which will become clearer in the section on phrase-final tone phenomena, I propose the following rule of Fusion.¹³

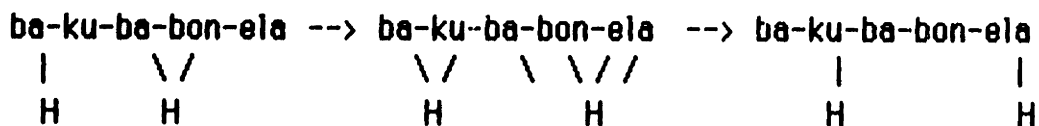
(24) Fusion: fuse H tones on adjacent vowels into a single h.



Fusion applies before High Tone Spread and Delinking, with the following result.

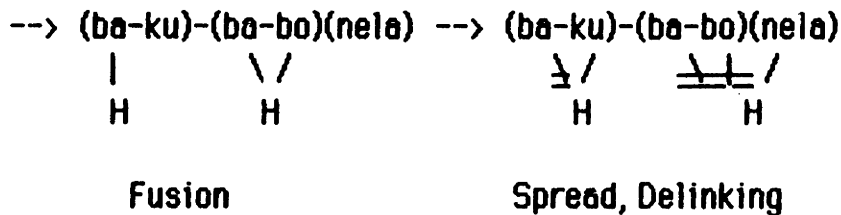
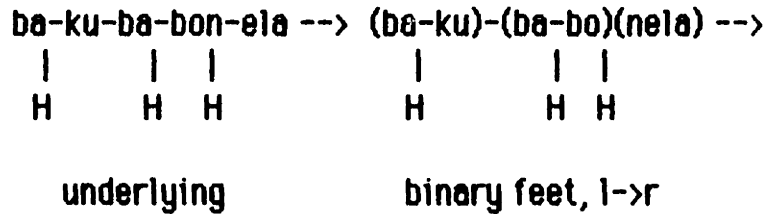


Spreading and Delinking then apply to the two remaining H tones.



¹³The idea of a rule of tone fusion comes from Odden 1986 for the analysis of Kipare.

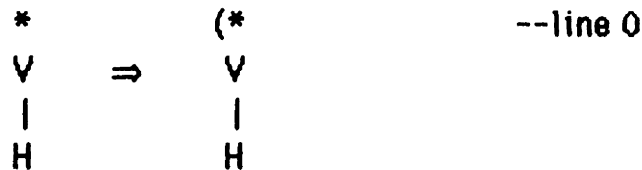
For the above derivation to work out, however, the final vowel must be leftmost in its constituent and the penultimate vowel must be rightmost. This is not the metrical structure that one expects from the rule system outlined above, by which binary feet are constructed from left to right.



Surface: * ba-kú-ba-bon-éla

Since a high-toned verb stem tends to realize its H tone at least two syllables to the right, I propose a rule which inserts a left metrical boundary (for line 0 constituents) before a high-toned vowel.¹⁴

(25) Metrical Boundary Insertion: Place a line 0 left bracket before a vowel linked to H.



¹⁴This rule of Boundary Insertion is suggested by the rule of Accent Placement in Goldsmith, Peterson, and Drogo (in press).

Boundary Insertion applies before the other rules of metrical structure; other high-toned morphemes in the phrase we are considering will likewise receive left brackets.

ba-ku-ba-bon-ela --> (ba-ku-(ba-(bon-ela

| | | | | |

H H H H H H

Hereafter, Metrical Structure Assignment will produce the desired constituencies.

ba-ku-ba-bon-ela --> (ba-ku)-(ba)-(bon-e)(la)

| | | | | |

H H H H H H

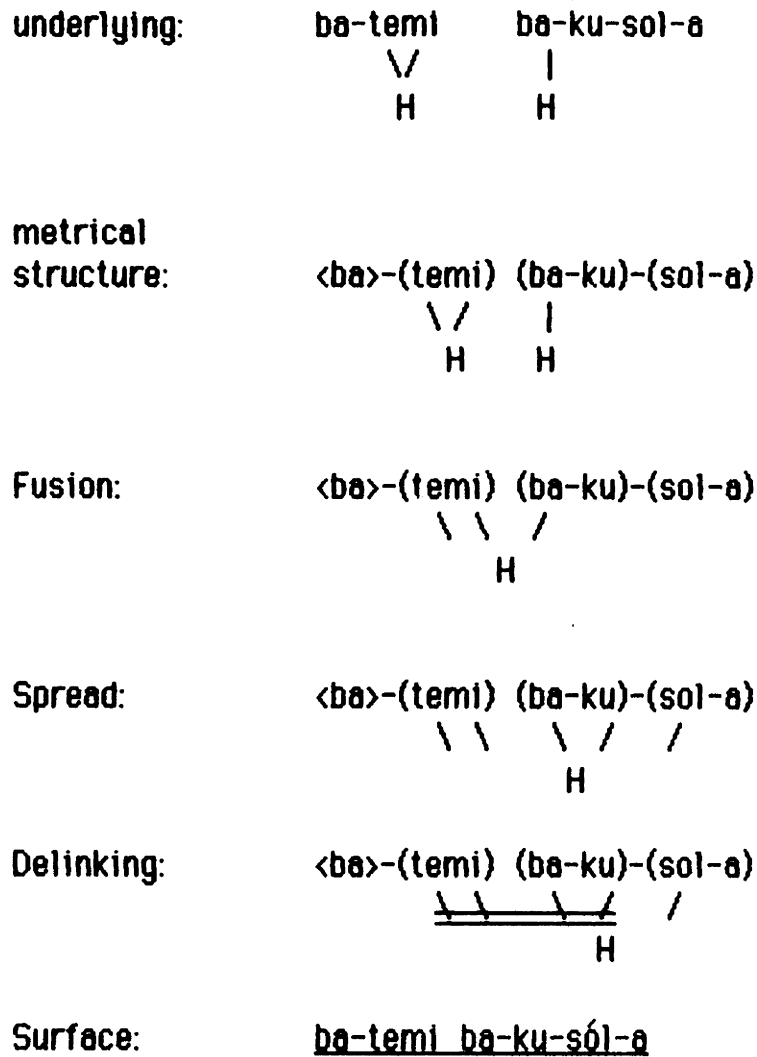
Fusion then applies along with the other rules to yield the correct surface form: ba-kú-ba-bon-elá.

Fusion, like the other tone rules of Sukuma, is a phrase-level rule which applies across words. The noun stem /temi/ has a single H tone linked to both stem vowels (as will be shown in the section below on nouns); this H spreads onto the vowel of the subject marker of the following inflected verb when that vowel is toneless (26a). When the subject marker has a lexical H tone, however, the two adjacent H tones fuse, and the entire phrase surfaces with a single H.

- (26) a. m-temi á-ku-sol-a 'the chief will choose' (R. 13)
- b. ba-temi ba-ku-sól-a 'the chiefs will choose'

The derivation is given in (27).¹⁵

(27)



The operation of Fusion will be seen repeatedly below.

¹⁵In order to avoid typographical clutter, I suppress the line 0 row of asterisks and represent constituency on the segmental tier. The metrical structure of the noun ba-temi will be explained below: nothing in this derivation depends on the noun's metrical structure.

4.4 Metrical structure and tone in nouns and adjectives

4.4.1 Underived nouns and adjectives

Sukuma nouns and adjectives have essentially identical tonal properties, as in many Bantu languages (cf. Kenstowicz and Kisseberth 1989, Massamba 1982). It is therefore appropriate to treat them together.

Nouns and adjectives may be either toneless or high-toned in underlying representation. The contrast between a toneless and high-toned noun is seen in the minimal pair in (28) from Richardson 1971.¹⁶

(28)	n-kolo	n-taale	'big sheep'	(R. 222)
	n- <u>kolo</u>	n-taalé	'big heart'	

Although the two nouns for 'sheep' and 'heart' have the same segmental makeup, they differ in that 'heart' has a H associated with it which shifts over to the final vowel of the adjective taale 'big' (via Spread and Delinking). The adjective itself is toneless. Because both nouns in (28) are class 9 nouns in Sukuma, the noun class marker for both the noun and the adjective is the nasal /n-/. This marker varies according to the class of the noun: in (29) I give examples of other class 2, class 4, and class 9 nouns with the same adjective taale 'big'.

(29)	bə-limi	bə-taale	'big cultivators' (class 2)	(R. 222)
	bə- <u>temi</u>	bə-táale	'big chiefs' (class 2)	
	bə- <u>dugu</u>	bə-táale	'big relatives' (class 2)	
	bə- <u>kóma</u>	bə-táale	'big lepers' (class 2)	

¹⁶Nasal class markers such as /n-/ and /m-/ are assimilated in place of articulation to the initial consonant of the following noun stem: /n-kalá/ → [ŋhalá] 'badger' (R. 108). However, following Richardson I transcribe data in the (unassimilated) phonemic form.

mi-úbu mi-táale 'big kind of tree' (class 4)

gĩghi n-taalé 'big owl' (class 9)

It appears from the data in (29) that a H tone from a preceding noun shifts to the second syllable of the adjective phrase (class marker + adjective): ba-táale, mi-táale, but n-taalé, where the initial [n] of the latter form is taken to be part of the rime of the preceding syllable, not a syllabic nasal (R. 108).¹⁷ If one assumes that the vowel to which a H tone is attracted is the left member of a binary constituent, then one can conclude that the second syllable of an adjective, not the first syllable, is always the leftmost element. This structure is derived by marking the first syllable extrametrical before building binary constituents from left to right. The rules of metrical structure assignment for nouns and adjectives are stated in (30).

(30) Metrical Structure Assignment (nouns and adjectives)

- i. Assign line 0 asterisks to the head of every rime.
- ii. Mark the first syllable extrametrical.¹⁸
- iii. Construct binary constituents from left to right.

Nominals differ from verbs in that rimes, not moras, are metrically significant. Thus, a long vowel [æ] counts for two line 0 asterisks in a

¹⁷The syllabic status of nasal consonants is discussed below.

¹⁸Only in nominal elements is the first syllable extrametrical; verbs have no initial extrametricality, as is evidenced by the fact that a preceding word's H tone shows up always on the first vowel of the verbal word, if that vowel is underlyingly toneless: m-temi é-kusola 'the chief will choose' (R. 13), cf. also R. 34-35.

Delinking: <ba>-{temi} <ba>-{taale}
 $\begin{array}{c} \underline{\text{H}} \quad \underline{\text{H}} \quad \underline{\text{H}} \quad / \\ \text{H} \end{array}$

Surface: ba-temi ba-táale

That the nouns also have extrametrical initial syllables is evident from contexts where the noun is preceded by a word which has a H tone to be spread, as in (33) with the high-toned verb aka-bona 'he saw'.

- (33) aka-bona n-koló n-taale 'he saw a big sheep' (R. 222)
 aka-bona ba-dúgu ba-táale 'he saw big relatives'
 aka-bona ba-ími ba-taale 'he saw big cultivators'
 cf. aka-sola ba-lumi ba-taale 'he chose big cultivators' (R. 18)

The last sentence with the toneless verb stem /sol/ contrasts with the first three sentences in which there is a H tone on the noun; this H must come originally from the verb stem /bon/. The verb stem's H spreads up to the second vowel of the noun, then delinks. The intermediate representation of aka-bona ba-dúgu ba-táale is shown below, after High Tone Spread but before Delinking.

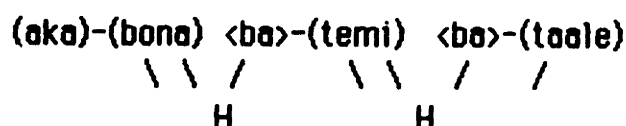
(aka)-(bona) <ba>-{du}(gu) <ba>-{taale}
 $\begin{array}{c} \backslash \quad \backslash \quad / \quad / \quad \backslash \quad | \quad / \\ \text{H} \qquad \qquad \qquad \text{H} \end{array}$

The noun /dugu/, I posit, has its underlying H tone linked to the second vowel (as is argued also in the section below on phrase-final tone phenomena). This H tone triggers Boundary Insertion (25) before the vowel of the syllable [gu]. The first syllable of /dugu/ is toneless and therefore eligible for linkage with the H of the verb. In a noun such as /temi/ or

/kolo/, however, where the lexical H is posited to be associated with the first vowel, the preceding verb's H can spread only as far as the noun class marker.²²

- (34) aka-bona n-kolo n-taalé 'he saw a big heart' (R. 222)
 aka-bona bá-temi ba-táale 'he saw big chiefs'
 aka-bona bá-kómá ba-táale 'he saw big lepers'
- aka-bona bá-buti ba-táale 'he saw tall passers-by' (R. 25)
 cf. aka-sola ba-buti ba-táale 'he chose tall passers-by'

The H of the verb aka-bona spreads only as far as the class marker because the first vowel of the noun stem, ai:ready has a H tone, and so spreading is blocked.²³ Spreading must stop, therefore, at the noun class marker.



The difference in tonal behavior between /dugu/ and /temi/, then, is a difference in lexical representation with respect to the linkage of the H tone (to the second or first vowel, respectively)

In fact, there is reason to believe that the H of /temi/ is linked to both vowels of the stem, and not the first vowel only. The evidence for this has already been presented in (26b) above, where the H of /temi/ is fused with the H of a following verbal subject marker.

²²Note in the first sentence that the [n] prefix to /kolo/, although non-syllabic, is nonetheless capable of bearing a tone. This will be discussed further below.

²³That a H tone may not be spread onto a vowel which already bears a H tone is plausibly due to a universal constraint prohibiting the multiple linkage of identical features to a single element.

- (26) a. m-temi á-ku-sol-a 'the chief will choose' (R. 13)
 b. ba-temi ba-ku-sól-a 'the chiefs will choose'

Yet Fusion occurs only with tones linked to adjacent vowels. If the H of /temi/ were linked to the first vowel only, it should not fuse with the H of the subject marker /ba-/. (Consider the derivation of (26b) in (27) above.)

Many other nouns (though not all, as will be shown) have multiple linkings of their underlying H tones. In this respect Sukuma nouns are similar to nouns of Shona. David Odden (1980, 1981, 1986) has convincingly argued that H tones in Shona nouns are often linked to more than one stem vowel in underlying representation.

- | | | |
|------|-----------------------|--------------------------|
| (35) | mbwá 'dog' | hóvé 'fish' |
| | | ∨ |
| | H | H |
| | badzá 'hoe' | hákáta 'diviner's bones' |
| | | ∨ |
| | H | H |
| | mbúndúdzí 'army worm' | sháwarí 'friend' |
| | \ / | |
| | H | H H |

When the high-toned associative prefix /ne-/ 'with' is added to these nouns, a H tone linked to the first syllable is deleted (36a). Any H tone which does not have an association with the first syllable remains (36b).

- | | | |
|---------|--------------|------------------------|
| (36) a. | né-mbwa | 'with a dog' |
| | né-hove | 'with a fish' |
| | né-hakata | 'with diviner's bones' |
| | né-mbundudzi | 'with an army worm' |

- b. né-badzá 'with a hoe'
 né-shawarí 'with a friend'

I posit similar representations for Sukuma nouns.

- (37) temi 'chief' kolo 'heart' kologoma 'sp. of tree'
 √ √ \ √ /
 H H H

Consider the noun stem /kologoma/. If the lexical H of this noun stem were linked only to the first stem vowel, then one would expect that H to surface always on the third stem vowel, i.e. two vowels to the right: mi-kologóma.

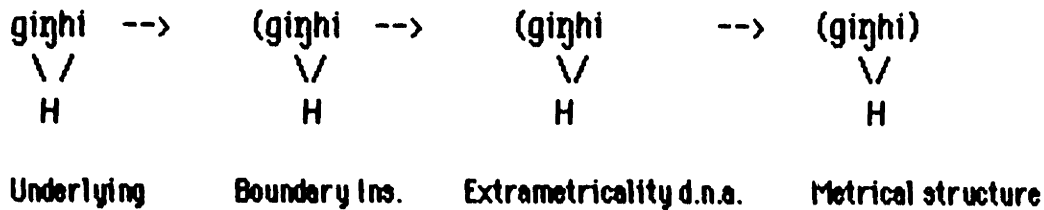
<mi> (kolo)(goma) --> <mi> (kolo)(goma)
 | ~~√~~ /
 H H

This is never the case: the H of /kologoma/ always shifts to the following word if it can.

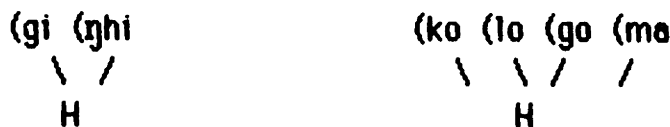
- (38) a. mi-kologoma mi-dóto 'wet mkologoma trees' (R. 66)
 b. mi-kologoma ími-doto
 c. mi-kologoma yi-apí 'black mkologoma trees' (R. 70)
 d. mi-kologoma gu-apí 'black mkologoma tree'

These various distances of shifting in (38) are discussed each in turn below. For now it suffices to note that the H of /kologoma/ ends up in the following word if it can, never on the third stem vowel. This fact follows from positing a multiple linking for the H of certain noun stems.

The linkage of a H tone to the first vowel of giŋhi prevents that syllable from being marked extrametrical. This is so because Boundary Insertion (25) precedes and bleeds the rule of extrametricality.

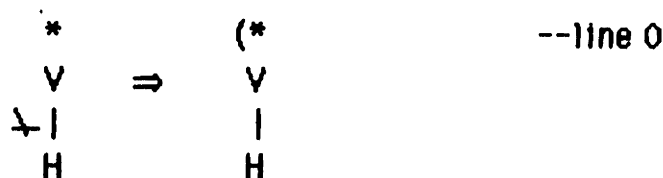


The application of Boundary Insertion must be restricted to apply only to the first linkage of an underlying H tone; otherwise, every vowel linked to a multiply linked H tone would be a unary line 0 constituent.



This is a useless multiplication of metrical feet. For this reason the statement of Boundary Insertion is modified so that it applies only to the first vowel of a multiply linked structure.

(25') Metrical Boundary Insertion: Place a line 0 left bracket before a vowel linked to H.



The revised statement of the rule requires the H to have no linkings to other vowels on the left.

Further justification for positing underlying representations with multiply linked H tone, such as are given in (37), is found in the section on phrase-final tone phenomena.²⁴

²⁴The idea of multiple autosegmental linkings for the lexical H tone of such nouns is Richardson's (already in 1959!).

4.4.2 Deverbal nouns

Unlike the noun H tones in (37) above, the lexical H tones of Sukuma verbs are linked only to the first vowel of the stem (cf. 11 above). The evidence for this assumption comes from the fact that a lexical H tone may show up on the third mora of the verb stem, as for example in ku-baabáat-a 'to grope one's way'. Richardson indicates (29-30) that it is the rule in trisyllabic stems for the lexical H to surface on the third mora of the stem: -tendeháí- 'to contract elephantiasis', -pilingít- 'roll along'. This fact follows if the lexical H is linked only to the first vowel. The initial high-toned vowel is a left element in a foot (due to Boundary Insertion); binary foot construction will therefore place the following left bracket two moras to the right, before the third mora.

Nouns derived from verbs also differ from the underived nouns in (37) (where the lexical H is linked to every vowel). Unlike the nouns in (37), whose lexical H shows up in a following word, the lexical H of deverbal nouns (39b) can show up on the third mora of the derived stem.

(39) a. n- <u>kolo</u> n-taalé	'big heart'	(R. 222)
mi- <u>kologoma</u> mi-dóto	'wet mkologoma trees'	(R. 66)
vs.		
b. ku- <u>saagá</u>	'to remain'	(R. 90)
bu- <u>saagó</u>	'remainder'	
ku- <u>baagá</u>	'to butcher'	
m- <u>baagí</u>	'butcher'	
i- <u>baagí</u>	'place/act of butchery'	
√ <u>bab-</u>	'to scorch'	(R. 93)
i- <u>babiló</u>	'something used for scorching'	

√lɛmb-
m-lɛmbagújɪ

'to lie'
'habitual liar'

(R. 92)

The contrast between (39a) and (39b) is a contrast between lexical H tones which are multiply linked and lexical H tones which are linked only to the first vowel of the noun. These forms also show that the metrical structure of nouns formed from verbs is sensitive to syllable weight, as in verbs. This is worked out directly.

It is important for the purposes of this thesis to spell out the implications of the contrast in (39). Because Sukuma is a language in which tonology is controlled by metrical structure, I hypothesize that the rules of tone manipulation are phrasal rules, rules which follow the construction of metrical constituents. At first glance, however, the nouns in (37) seem to be counter-examples to this claim.

kolo	'heart'	kologoma	'sp. of tree'
∨		∖ ∨ /	
H		H	

These nouns seem to have undergone a word-level rule of tone spreading which does not depend on metrical structure. This would then be a counter-example to the ordering hypothesis for metrical tone languages.

Nonetheless, the tone patterns of the nouns in (39b) show that there is no word-level rule of tone spreading in Sukuma. The word-level representation of the nouns in (39b) must be as in (40); the phrasal rules of High Tone Spread and Delinking²⁵ put the lexical H on the third mora.

²⁵These rules are clearly phrase-level, inasmuch as they operate across phrase boundaries.

(40) bu-saago i-baagi
 | |
 H H

If a word-level rule of spreading were to apply to the representations (41), then one would predict that the subsequent phrasal rules which shift tones would always realize the lexical H tones of these words on a following word, which is not the case.

(41) *bu-saago *i-baagi
 \ \ \ \
 H H

The representations of (37) must therefore be lexical ones, not derived. The multiple linking of the H in such words is stipulated in the lexicon. There is, then, no counter-example to the ordering hypothesis.

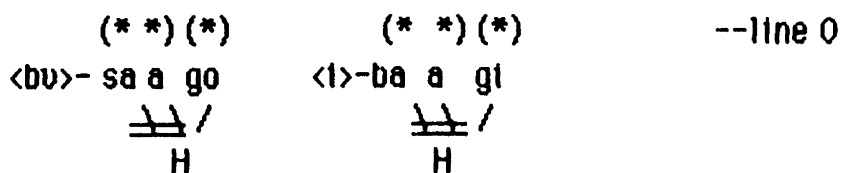
In order for the H deverbal nouns in (40) to surface on the final vowel, it is necessary for rule (20i) to apply, assigning two line 0 asterisks to the long vowels of the stem.

 * * * * * * * * --line 0
 bu-sa ago i-ba a gi
 | |
 H H

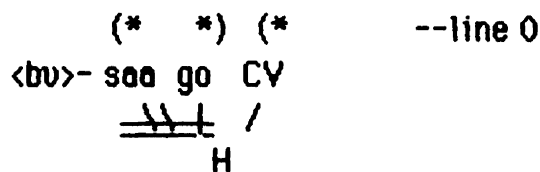
Extrametricity and binary foot construction on line 0 build two feet, one binary and one unary.

 (* *) (*) (* *) (*) --line 0
 <bu>- sa a go <i>-ba a gi
 | |
 H H

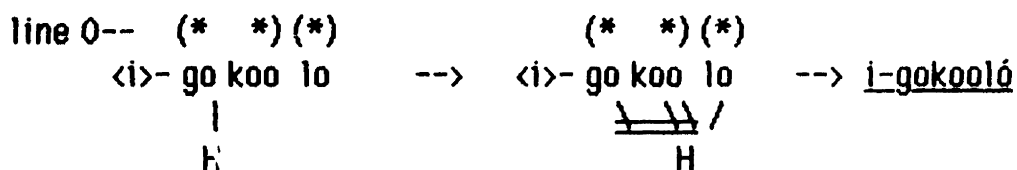
Spreading and Delinking shift the lexical H to the final vowel.



This derivation shows that in deverbal nouns every mora is assigned a line 0 asterisk, as in verbs. If line 0 asterisks were assigned to every rime, as in underived nouns, then the lexical H of these words would shift to the following syllable.



This is seen in the noun i-gokooló 'scoop net' (R. 117). In this word the long vowel is assigned only one line 0 asterisk, and so the H linked to the first vowel shifts to the final vowel, not to the first mora of the long vowel.



In the verb which is formed from this noun, however, long vowels count for two line 0 asterisks. The metrical structure rules in (20) apply to the verb ku-gokóola 'to draw in a scoop net' (R. 117), bracketing the long vowel as its own binary constituent.²⁶

²⁶The infinitive is in fact a deverbal noun, like the nouns in (40). The initial ku- of the infinitive is a noun class marker. Cf. Chapter Two.

4.4.3 Tone in concord elements

Along with the noun class markers discussed above (such as /n-/ , /ba-/ , and /mi-/), there are a number of other elements in Sukuma nominal morphology which mark concord between a noun and an adjective. Some of these concord morphemes play a more active role in the tonology than the toneless, extrametrical noun class markers. In this section I discuss representative cases of these concord elements.

Sukuma nouns may appear with a pre-prefix before the noun class marker.²⁷ These pre-prefixes correspond semantically to definite articles.²⁸

(42)	ma-hagala	'tree forks'	(R. 11)
	a-ma-hagala	'the tree forks'	
	ma- <u>sumbi</u>	'stools' (class 6)	(R. 65)
	a-ma- <u>sumbi</u>		
	mi- <u>kologoma</u>	'plural kind of tree' (class 4)	
	i-mi- <u>kologoma</u>		
	m- <u>kologoma</u>	'singular kind of tree' (class 3)	
	u-m- <u>kologoma</u>		

When a definite noun phrase follows a word with a H tone which shifts (e.g. aka-bona 'he saw'), the first vowel – that of the pre-prefix – ends up with the H tone on the surface.

²⁷Richardson calls these "double prefixes".

²⁸The noun stems /sumbi/ and /kologoma/ both have a lexical H tone linked to all the stem vowels: I will discuss below what happens to this H in phrase-final position (or citation form).

(43) aka-bona ma-hágala 'he saw tree forks' (R. 11)
aka-bona á-ma-hagala 'he saw the tree forks'

aka-bona má-sumbi (R. 65)
aka-bona á-ma-sumbi

aka-bona mí-kologoma
aka-bona í-mi-kologoma

aka-bona m-kologoma
aka-bona ú-m-kologoma

The fact that a preceding H is attracted to the pre-prefix indicates that this morpheme is the left element in a constituent, contrary to expectation. From the rule system above one would predict that the pre-prefixes would be extrametrical (30ii) and that the following vowel would attract the H tone: *aka-bona i-mí-kologoma.

The pre-prefixes must be lexically specified as exceptions to extrametricality. The output of Metrical Structure Assignment will be the following representations.

(ama)-(haga)(la)

(imi) (kolo)(goma)
 \ \ / /
 H

(ama)(sumbi)
 \ /
 H

(u-m-ko)(logo)(ma)
 \ \ / /
 H

Because the pre-prefixes are the left element in a binary constituent, their vowels are attractors of preceding H tones.

Certain other concord elements have lexical H tones. One example of such an element is the adjectival prefix /gy-/, shown in (44) with the

toneless adjective /api/ 'black' in phrasal combinations with the toneless noun stem /fuko/ 'bag' and the high-toned noun stem /kono/ 'arm'.

- (44) a. m-fuko gy-apí 'black bag' (Class 3) (R. 226)
 m-fuko u-gy-apí 'the black bag'
- mi-fuko yi-api 'black bags' (Class 4)
 mi-fuko i-yi-api 'the black bags'
- b. m-kono gy-apí 'black arm'
 mi-kono yi-api 'black arms'
- m-kono ú-gy-apí 'the black arm'
 mi-kono i'-yi-api 'the black arms'

Richardson does not give a phonetic transcription of the forms /gy-apí/ and /yi-api/, although he indicates that some sort of coalescence (glide formation and compensatory lengthening?) takes place between adjacent vowels.²⁹ In the phonetic forms of the adjective phrases /gy-apí/ and /yi-api/, I surmise, the vowel of the prefix and the stem have merged into a long [aa] vowel, forming a single syllable. This single, long syllable is extrametrical in the case of /yi-api/ (because it is toneless and not eligible for Boundary Insertion). The line 1 asterisk is assigned to the syllable [-pi], and so it is this syllable which attracts the preceding H tone from /mi-kono/: mi-kono yi-api.

<mi>-(kono) <ya> (pi)
 \ / \ / /
 H

²⁹E.g. /li-olelo/ --> [lyolelo], /mu-oto/ --> [mooto] (R. 109). The phonetic forms of /gy-api/ and /yi-api/ are perhaps [yaapi] and [gwaapi].

The preceding example shows that the second syllable of a noun phrase attracts a H tone, regardless of whether the first syllable (usually the noun class marker) is long or short. Compare the noun phrases in (33) – whose noun class markers have short vowels – with the noun phrases in (45), where the noun class markers have long vowels.

- (33) aka-bona ba-dúgu ba-táale 'he saw big relatives' (R. 222)
 aka-bona ba-ími ba-taale 'he saw big cultivators'

- (45) aka-bona lii-múnhu 'he saw a big person' (R. 65)
 aka-bona maa-múnhu 'he saw big persons'

The first syllable in these noun phrases contains two moras, but the entire syllable is extrametrical, as is demonstrated by the fact that the preceding verb's H shifts to the second syllable. These facts show that it is the first syllable, not simply the first mora, is the extrametrical element in Sukuma nouns.

The prefix /gu-/ has a lexical H as well, as is evident from the final H tone in the phrases 'black bag' and 'the black bag', (44a). In having a lexical H tone /gu-/ is different from most class markers. Richardson indicates that there are two series of class markers for Sukuma adjectives, and not just one set as for nouns (R. 223).³⁰ The adjective class markers of Series I are all toneless, like the noun class markers. The prefix /gu-/, however, is a Series II marker of class 3; Series II markers – except in classes 1, 4, and 9 – are all high-toned like /gu-/.

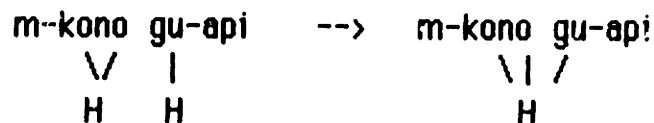
³⁰Richardson says nothing about the distributional or semantic differences between Series I and Series II concord elements for adjectives.

The H tone of /gu-/ is eligible for Fusion with a H tone linked to the final vowel of the preceding word, as (46a) shows, repeated from (44b).

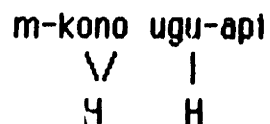
- (46) a. m-kono gu-apí 'black arm'
 b. mi-kono yi-apí 'black arms'
 c. m-kono úgu-apí 'the black arm'
 d. mi-kono íyi-apí 'the black arms'

Both /kono/ and /gu/ have lexical H tones: this fact is established by the surface tone pattern of (46c). Here the H of /kono/ is attracted to the lexically non-extrametrical pre-prefix /u-/; the H of /gu/ shifts to the final vowel /i/ of /apí/. (46b) and (46d) also show that /kono/ has a lexical H.

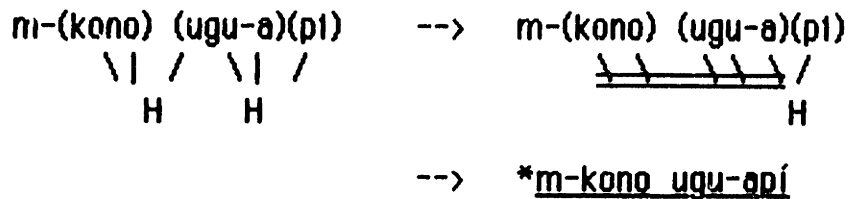
In (46a) there is only one surface H tone, despite the fact that there are two underlying H tones in the phrase. The reason for the disappearance of the H of /kono/ is the rule of Fusion. Because the H tones of /kono/ and /gu/ are linked to adjacent vowels at the beginning of the phrasal phonology, they are fused into one H with many linkages.



High Tone Spread and Delinking apply after Fusion to complete the derivation of (46a). Fusion does not take place between the two underlying H tones in (46c) because they are not linked to adjacent vowels: the toneless (but non-extrametrical) vowel of the pre-prefix /u-/ separates the two H tones.



This phrase also shows that Fusion must precede High Tone Spread. If the two H tones were spread first, they would be linked to adjacent vowels. If Fusion were then to apply, (46c) would be incorrectly derived with only one surface H tone.



Another high-toned concord element is the marker /j_i-a/ of the associative (genitival) construction.³¹ This construction has the meaning "Noun(1) of Noun(2)"; it is formed by prefixing a Series II class marker (CM) agreeing in class number with Noun(1) to the associative morpheme (AM) /-a/.³²

- (47) a. ...yi-a - madoto '(Noun, cl.9) of wet ones (cl. 6)' (R. 72)
 b. ...j_i-a - madóto '(Noun, cl.10) of wet ones'
- (48) a. ...yi-a - yi-ápí '(cl.9) of black ones (cl. 4)'
 b. ...yi-a - g_y-apí '(cl.9) of a black one (cl. 3)'
- (49) a. ...j_i-a - yi-apí '(cl.10) of black ones (cl. 4)'
 b. ...j_i-á - g_y-apí '(cl.10) of a black one (cl. 3)'

³¹Richardson calls this morpheme the "extra dependent prefix". Here again, the vowels of the associative morpheme coalesce somehow (R. 71), but Richardson does not provide the precise phonetic output of coalescence (perhaps [yaa] and [jaa]).

³²Again, the Series II class prefixes of classes 1, 4, and 9 are toneless (cf. /yi-/), whereas those of the other noun classes are high-toned (/j_i-/).

Noun(1) has been left out in the data above for the sake of simplicity, following Richardson. The lexical difference between toneless /yi-/ and high-toned /ji-/ is apparent in the contrasts between (47a) and (47b), and between (48) and (49). (47b) has the following intermediate representation after spreading. (The initial syllable, being high-toned in lexical representation, is not made extrametrical.)

(* *) (* *) --line 0
 ji-a ma do to
 | / / /
 H

The first syllable of the associative phrase is [ji-a] (prior to coalescence of the vowels into one long vowel). Boundary Insertion (25) places a left bracket before the syllable. Binary feet are constructed, making [do] a left element in the binary foot. This syllable attracts the preceding H tone of the prefix /ji-a/. Delinking yields the surface form in (47b).

The high-toned Series II prefix /gy-/ is present in the phrases in (48) and (49). The high-toned vowel of /gy-/ is subject to Boundary Insertion (25). The H of the prefix shifts to the final vowel of the word /api/, as discussed in connection with (44) and (46) above: yi-a - gy-apí. Because the /gy-/ prefix bears an underlying H tone, the H of the prefix /ji-/ may spread only as far as the following /-a-/ vowel of the associative morpheme (49b).

(ji-a) (gu-a) (pi) ⇒ (ji-a) (gu-a) (pi)
 | | √ \ \ /
 H H H H

Delinking applies to produce the surface form in (49b).

Now consider the associative phrase with Noun(1) present.

(50) a. n-gi yi - a lúsalo 'large biting housefly' (R. 71)
 'fly' CM(II) -AM 'madness' (lit. 'fly of madness')
 (cl. 9)

b. n-gi jǐ - a lusálo 'large biting houseflies'
 CM(II) -AM
 (cl. 10)

(51) n-gi jǐ-a yi-apí 'flies of black ones (cl. 4)' (R. 73)
 n-gi jǐ-á gǔ-apí 'flies of a black one (cl. 3)'

The derivation of (50a) is straightforward. The toneless first syllable of the second noun phrase is [yi-a]. This toneless syllable is marked extrametrical, making the following [lu] the target for Spreading of the H tone of n-gi 'fly'. The H of 'fly' shifts to [lu] via spreading and delinking.

In (50b) the Series II prefix is high-toned, and so Boundary Insertion applies to the first syllable [jǐ-a], blocking extrametricality. Binary feet are constructed as usual.

(n-gi)	(jǐ-a	lu)	(sa lo)
H	H		

Because the two H tones in the phrase are linked to adjacent syllables, Fusion (24) merges them into a single H tone which is doubly linked.

(n-gi)	(jǐ-a	lu)	(sa lo)
\	/		
H			

This H tone then spreads and delinks as expected to produce the surface form in (50b).

(n-gi) (ji-a lu) (sa lo)
 ⏟ ⏟⏟ ⏟ /
 H

The phrases in (51) have parallel derivations.

Yet another concord element which merits special attention is the class 5 marker and augmentative prefix, which Richardson transcribes as /i-/.³³ The metrical behavior of this prefix is similar to that of the nasal noun class markers in (28), (29), (33), and (34) above. The prefix /i-/ does not seem to count as a syllable, since it is the following syllable which is marked extrametrical. A preceding word's H tone is thus realized on the second syllable after /i-/, as is seen in (52).

(52)	i-hagala	'forked branch'	(R. 63)
	aka-bona i-hagála	'he saw a forked branch'	
	aka-bona ma-hágala	'he saw forked branches'	
	aka-bona i-ṅombé	'he saw a big ox'	(R. 65)
	aka-bona ma-ṅómbe	'he saw big oxen'	

These patterns are explicable if one construes the underlying form of this prefix to be the non-syllabic glide /y-/ rather than the syllabic vowel /i-/.³⁴ The rules of metrical structure do not see a non-syllabic element, and so the first syllable of the noun stem itself is the extrametrical syllable.

³³Welmers (1973, 165) reconstructs this class 5 prefix as *le- in Proto-Bantu.

³⁴By "non-syllabic," I mean that the segment does not project a line 0 metrical asterisk.

y - <hə> (gə lə)

y - <ŋə> (mbe)

The glide becomes vocalic before a consonant, or it coalesces with a preceding vowel. For this reason it is not realized as a semi-vowel in surface form. The facts of tone shift, however, lead the language learner to posit a non-syllabic element as the class 5/augmentative prefix.

4.5 Phrase-final tone phenomena

The noun stems /temi/, /dugu/ and /koma/ all have lexical H tones: this is apparent from the fact that they contribute a H to the following toneless adjective /taale/.

(53)	ba-temi	ba-táale	'big chiefs'	(R. 222)
	ba-dugu	ba-táale	'big relatives'	
	ba-kóma	ba-táale	'big lepers'	

These nouns differ, however, in citation form, as shown in (54). (These are also the tone patterns of these nouns when phrase-final.) In these forms, the grave mark indicates an extra-low tone, not simply a low tone.³⁵

(54)	ba-temi	'chiefs'	(R. 222)
	ba-dugù	'relatives'	
	ba-kómà	'lepers'	

Though /temi/ has a lexical H tone, this H tone surfaces only in a following word; if there is no following word the entire noun is low-toned. On the other hand /koma/ shows a H tone on the first syllable in both phrase-medial and phrase-final (isolation) forms, but an extra-low tone on the second syllable phrase-finally. The stem /dugu/ never exhibits its own H except phrase-medially; phrase-finally it bears a final extra-low tone like /koma/.

³⁵This extra-low tone has not been marked consistently in the data above, following Richardson's practice. That is, not every case of utterance-final H tone has been orthographically converted to extra-low. This is done for ease of exposition.

The stem /dugu/ differs from the other two also in that it allows a preceding word's H to spread to its first syllable, whereas /temi/ and /koma/ allow the preceding to spread only as far as the noun class marker.

- (55) aka-bona bá-temi ba-táale 'big chiefs' (R. 222)
 aka-bona ba-dúgu ba-táale 'big relatives'
 aka-bona bá-'kóma ba-táale 'big lepers'
- aka-bona n-bógò 'he saw a buffalo' (R. 86)
 aka-bona n-bógo n-taalé 'he saw a big buffalo'

In order to account for the differences between the stems in question I posit the following underlying forms.³⁶

- (56) temi dugu koma bogo
- \ / | | | |
- H H H H H

Because /temi/ and /koma/ have H tones linked to their first stem vowels, no preceding H is able to spread to these; the first vowels of /dugu/ and /bogo/ on the other hand are toneless and open for spreading. The first H of /koma/ may never spread rightward because the second vowel has its own H tone which blocks spreading of the first H. This second H of /koma/, however, is able to spread to following adjectives.³⁷

Both /dugu/ and /koma/ have a lexical H on the final vowel. This H is turned into an extra-low tone (abbreviated as 'X') when it stands at the end of an utterance by the following rule, due to Richardson (1959, 25).

³⁶Kenstowicz and Kisseberth 1989 posit similar representations for Chizigula nouns.

³⁷This representation for /koma/ violates the putative Obligatory Contour Principle; no other representation suggests itself, however. See Odden 1986 for arguments against the OCP as a principle of grammar.

(57) Final Lowering: H linked only to the final vowel becomes X at the end of the utterance.

$$H \Rightarrow X / \underset{\text{utterance}}{\overset{\text{---}}{\text{V}}}$$

Final Lowering applies before High Tone Spread and Delinking can link a H to the utterance-final vowel (which would create the context for Final Lowering). Thus, only H tones which are linked to the word-final vowel in the lexicon are eligible to undergo Final Lowering.

Final Lowering changes the final H tones in both /dugu/ and /koma/.

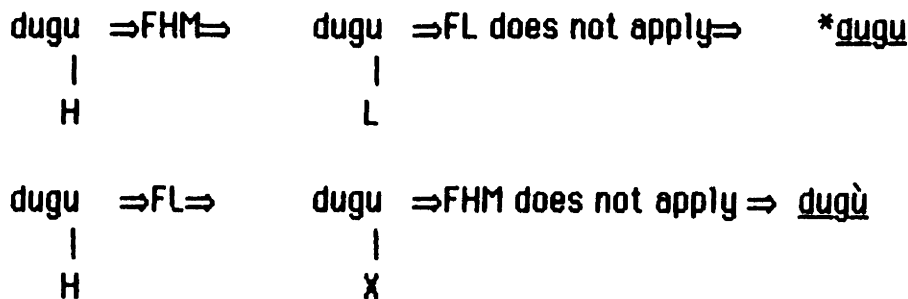
dugu	⇒ Final Lowering ⇒	dugu
H		X
koma	⇒ Final Lowering ⇒	koma
H H		H X

The first H of /koma/ is unaffected by Final Lowering. Likewise, the H of /temi/, not being solely linked to the final vowel, is also unaffected by Final Lowering. However, this H does not surface either: another rule which applies after Final Lowering changes the utterance-final H of /temi/ to a L tone.

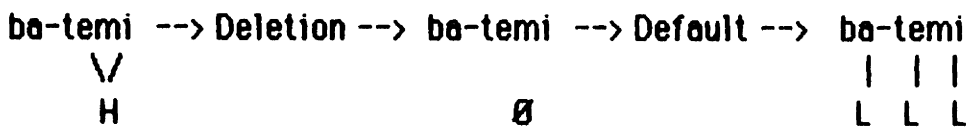
(58) Final High Modification: H linked to final V of the utterance becomes L.

$$H \Rightarrow L / \underset{\text{utterance}}{\overset{\text{---}}{\text{V}}}$$

Final High Modification must of course follow Final Lowering. If Final High Modification applied first, the lexical H of /dugu/ would be changed to L, and the final vowel would surface with a L tone, not an X tone.

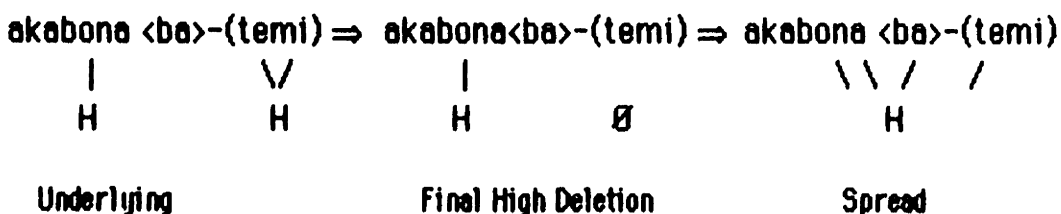


One might prefer to analyze the effect of Final High Modification as a rule of Final High Deletion. That is, instead of changing a H tone to L when linked to the utterance-final vowel, one might instead simply delete this H tone and let Default L tone insertion supply the surface L tones.



Let us pursue the Deletion analysis.

High Tone Spread must apply before putative Final High Deletion, as is shown by the phrase aka-bona bá-temi 'he saw chiefs'. If High Tone Spread were to follow Final High Deletion, then one would expect the H of /bon/ to spread to the first stem vowel of /temi/.



⇒ surface: *aka-bona ba-témi

It seems that the utterance-final H of /temi/ is still present at the time when the H of /bon/ is spread rightward. Otherwise one would expect the tone pattern of the phrase to be the same as with the toneless noun /limi/: aka-bona ba-limi 'he saw cultivators'. The ordering of rules must therefore be: Final Lowering, High Tone Spread, Final High Deletion.

akabona ba-temi ⇒ H H	akabona ba-temi ⇒ \ / \ H H	akabona ba-temi \ / H Ø
Underlying	Spread	Final High Deletion

⇒ Delinking ⇒ surface: aka-bona bá-temi

This ordering, however, runs into trouble with a phrase such as uabonaga gixhi n-taale 'he used to see a big owl' (R. 18). The underlying form of this phrase is as below.

u-a-bon-aga \ H H	gixhi \ H	n-taale
---------------------------------	-----------------	---------

Fusion (24) turns the three adjacent H tones into a single H.

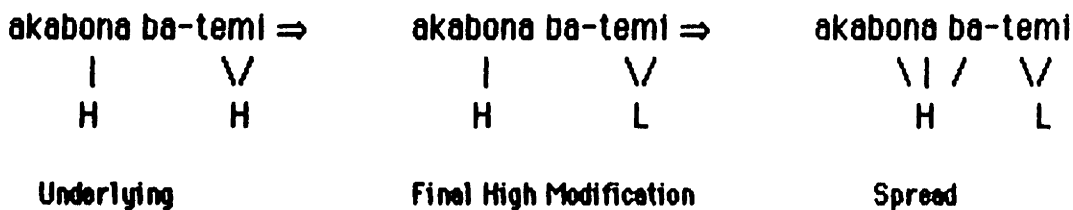
u-a-bon-aga \ \ \ H	gixhi / /	n-taale
-------------------------------	----------------	---------

High Tone Spread extends this linking of this single H to the final vowel of n-taale (cf. 29 and 31 above).



Final High Deletion must then apply after Spreading to wipe out the single H which is now linked to the utterance-final vowel. Default L-insertion fills in the toneless vowels with L tones, making the entire utterance low-toned: *uabonaga gighi n-taale. But this is incorrect: there should be a single H tone linked to the final vowel, according to Richardson.

The solution to this problem is to order High Tone Deletion before Spreading. However, this ordering predicts the incorrect form *aka-bona ba-témi, discussed above. For this reason I propose a rule which changes the H tone to L tone instead of a rule which deletes the final H tone. This rule of Final High Modification applies before and blocks the extent of High Tone Spread.



⇒surface: aka-bona bá-témi

Final High Modification cannot apply to the phrase uabonaga gighi n-taalé, because before Spreading the final vowel is toneless, and so there is no tone for the rule to modify.

u-a-bon-aga \ \ \	gɪŋhi / /	n-taale	Final High Modification does not apply
	H		
u-a-bon-aga \ \ \	gɪŋhi \ \	n-taale / ///	High Tone Spread
	H		
u-a-bon-aga	gɪŋhi	n-taale H	Delinking

The rule of Fusion (24) precedes and bleeds the rule of Final Lowering. The adjective /ŋgi/ 'other' bears a lexical H tone which is converted to extra-low at the end of an utterance.

- (59) mu-nhu u-ŋgì 'other person' (R. 67)
mi-banga yi-ŋgì 'other sp. of tree' (pl.)
n-gobo yi-ŋgì 'other hide'

When one of the high-toned Series II class prefixes is attached to /ŋgi/, however, there is no final X tone: the entire phrase is spoken on a L tone.

- (60) ba-nhu ba-ŋgi 'other person' (R. 67)
m-banga gu-ŋgi 'other sp. of tree' (pl.)
n-gobo ji-ŋgi 'other hide'

The H tones of the prefix and the stem are linked to adjacent moras. Fusion therefore applies.

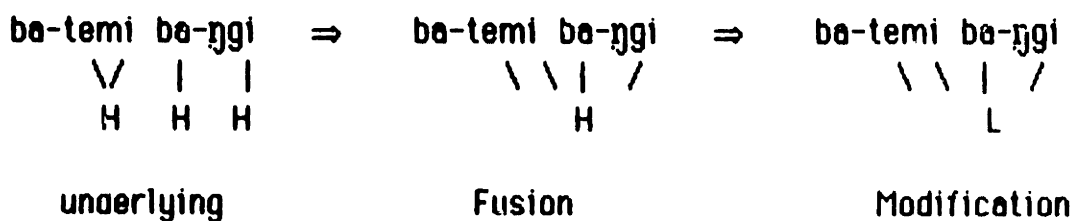
ba-ŋgi	⇒	ba-ŋgi	ji-ŋgi	⇒	ji-ŋgi
		\ /			\ /
H H		H	H H		H

After Fusion the relevant H tone is no longer linked solely to the final vowel of the utterance. Final Lowering is blocked, and Final Modification applies to the doubly linked H, just as it does in ba-temi.

Fusion feeds the rule of Final Modification in an interesting way: any number of lexical H tones can be changed by Final Modification if they are linked to adjacent moras in underlying representation. This fact is illustrated by the low-toned phrases in (61) (where underscoring still denotes a lexical H tone).

- | | | | | | |
|------|--------------------|---------------|--|-------------------------|---------|
| (61) | <u>ba-temi</u> | <u>ba-ŋgi</u> | | 'other chiefs' | (R. 68) |
| | m- <u>kologoma</u> | <u>gu-ŋgi</u> | | 'other sp. of tree' | |
| | n- <u>goko</u> | <u>ji-ŋgi</u> | | 'other fowls' | |
| | u-a- <u>bonaga</u> | <u>gɪŋhi</u> | | 'he used to see an owl' | (R. 25) |

Fusion of the three H tones in these phrases, followed by Modification, leaves the entire phrase with L tones after Default L-insertion.



The rule system developed so far has the following ordering.

- (62) Word-level
 Boundary Insertion (25)
 Metrical Structure Assignment (20), (30)
- Phrasal
 Fusion (24)
 Final Lowering (57)

Final Modification (58)
 High Tone Spread (9)
 Delinking (10)
 Default L-insertion

So far no arguments have been made about the cyclicity or non-cyclicity of any rule. The rule of Fusion raises an interesting question in this regard. Certain configurations of adjacent H tones are not fused, seemingly due to something like the Strict Cycle Condition, inasmuch as the environment for Fusion is underived. Examples of this are the words ba-kómà 'lepers' and mi-úbù 'species of tree'. Both words end in an X tone, indicating that they have a H linked solely to the final vowel, in contrast to ba-temi 'chiefs', whose H is linked to both stem vowels. The latter word surfaces with all L tones. In the words ba-kómà and mi-úbù there is a second lexical H tone on the penultimate vowel. The noun class markers /ba-/ and /mi-/ do not bear a lexical H tone in Sukuma: the penultimate H must be therefore an underlying H.³⁸

ba-koma	mi-ubu
H H	H H

These representations look like the context for Fusion to apply, seeing that the H tones are linked to adjacent moras. Recall the data from (60) above.

ba-ŋgi	⇒	ba-ŋgi	ji-ŋgi	⇒	ji-ŋgi
		\ /			\ /
H H		H	H H		H

³⁸This assumption will be modified below.

Why does Fusion not apply to ba-kómà and mi-úbù? In the next section I propose that only one of the H tones in each word is present in the derivation at the point when Fusion applies. The other H tone is inserted later in the derivation. The representations of ba-kómà and mi-úbù in the preceding paragraph, then, are not underlying representations, but rather show the forms after the application of Fusion and the insertion of one of the two H tones.

Forms such as ba-kómà and mi-úbù also raise questions about the Obligatory Contour Principle (OCP). The OCP prohibits adjacent linkages of identical autosegments, as for the H tones in the representations of ba-kómà and mi-úbù above. These derived representations cannot be ruled out by the OCP, since the data in (54) and (55) clearly indicate the presence of two H tones on two adjacent syllables. Spreading of H tones up to a H tone in Digo (Chapter Three) also shows that the OCP does prevent identical autosegments from being linked to adjacent units in the course of the derivation. The OCP, then, must apply only to underlying forms, not to forms derived in the grammar.

4.6 Inalterable tones in Sukuma nouns

Up to now the tonology of Sukuma has been derived from only an underlying H vs. Ø opposition in lexical tones. However, there are a number of words and morphemes which do not participate fully in the rule system developed above. Goldsmith 1984 proposed the introduction of L tones into underlying representations to explain such forms, which are illustrated below. My analysis does not invoke lexical L tones.

Consider the noun talá 'lamp'. This noun is peculiar in many ways. First, its lexical H tone never shifts away from the second vowel of the noun stem (63a). Second, this noun shows no overt class marker such as /mi/ or /ba/. That this noun belongs to class 9 is evident from the concord marker on following adjectives. Third, the first vowel of talá resists linkage (by spreading) to a preceding word's H tone (63b), contrary to expectation (63c). Fourth, the H tone of talá does not undergo Fusion with a preceding word's H as do other high-toned words (63d). Finally, Richardson indicates that the final H tone of this word never undergoes Final Lowering (63e).

- (63) a. talá n-taale 'big lamp' (R. 223)
b. aka-bóná talá n-taale 'he saw a big lamp'
*aka-bóna tálá n-taale
- c. aka-bóna ba-dúgu ba-táale 'he saw big relatives' (R. 222)
aka-bóna ba-kómá 'he saw lepers'
- d. uabonagá talá 'he used to see a lamp' (R. 25)
uabonaga ginhi 'he used to see an owl'
- e. *talà

There are other nouns in Sukuma which display idiosyncratic behavior similar to talá. Examples are shown in (64).

- (64) a. góodi n-taale 'big poll tax' (R. 223)
 b. aka-bóná 'góodi n-taale 'he saw a big poll tax'
 c. mi-gómba mi-ta'e 'big husks of banana palm'
 d. aka-bóna mí-'gómba mi-taale 'he saw ...'

Nouns like góodi and mi-gómba have a lexical H tone associated with the first vowel of the noun stem. This H never shifts, however. (64b) and (64d) show also that when two H tones are linked to adjacent tone-bearing units in surface form, the second H is downstepped.

Richardson indicates (101) that loan-words from Swahili also have fixed tonal contours in Sukuma.³⁹

- (65) bu-lengéedi 'blanket'
 balabála 'main road'

One solution which suggests itself for the words in (63-65) is to posit underlying L tones before and after the H tone in each word.⁴⁰

- (66) tala gomba goodi balabala
 | | | | | | \ | |
 L H L° L° H L L° H L L H L

³⁹Note that the first consonant of the English word blanket has been parsed as a noun class marker in Sukuma. This is not uncommon in Bantu languages; Digo, for example, has taken Arabic kitabú 'book' into the language as chi-tabu. Swahili shows many instances of this reparsing strategy as well: ma-tini is a drink served by the mu-tenda or if there is more than one server, by the ba-tenda.

⁴⁰The raised circle '°' indicates a floating tone.

In an analysis which introduces L tones into lexical representations, High Tone Spread is blocked from applying to the H tone in each word by the L tone which follows the H. The L tone preceding the H tone blocks Fusion of the H tone with the H from a preceding word. This preceding L also causes the downstepping of the second H in the data in (64).

There are problems with such an analysis, nonetheless. Consider the word talá, represented in (66) with a linked L, a linked H, and a floating L tone. It is not obvious in the first place that the final floating L tone is sufficient to block the rule of Final Lowering (57), the rule which converts a H tone to an extra-low tone when it is linked only to the final vowel.⁴¹ The rule of Final Lowering would have to be altered to include the condition that the H tone to be lowered must not be followed by any floating tones. Secondly, it is not clear how this final floating L tone blocks the spreading (and Delinking) of the H tone of talá in a phrase such as (63a), talá ntoale. Presumably some phrase-level rule docks the final floating L tone of talá to the next available tone-bearing unit. Subsequent to this special docking, High Tone Spread tries to apply to the H tone but cannot, due to the (newly) linked L tone which follows.

The L-tone analysis quickly runs into difficulties. Consider the noun góodi 'poll tax' (64a), which also has an inalterable tone contour. Because its H tone does not undergo Fusion with a preceding H tone, and because its H tone is downstepped before another H tone (64b), one is led to posit a preceding floating L tone for this word. The L must be floating because

⁴¹But see Hyman 1985 and Spreda 1986 for a similar proposal in Western Grassland languages.

góodi never takes a noun class marking prefix. A linked L tone after the H tone blocks High Tone Spread.

goodi
 ||
 L° HL

The same arguments hold for the class 4 noun **mi-gómba** 'husks of banana palm' (64c). This noun has an overt class marker /mi-/, but this class marker is demonstrably toneless in underlying form and not L-toned, since a preceding word's H tone may shift on to /mi-/ (cf. **akabona mí-kologoma**). The L tone preceding the H tone in **mi-gómba** must then be floating in underlying form, not linked to /mi-/.

mi-gomba
 ||
 L° HL

Consider next the phrases in (64b) and (64d), represented in underlying form below (without a following adjective).

aka-bona	mi-gomba	aka-bona	goodi
H	L° HL	H	L° HL

The special rule which docks floating L tones should apply before the other phrase-level rules. This rule should presumably link the initial floating L tones of the nouns to the nearest available vowel.

aka-bona	mi-gomba	aka-bona	goodi
		\	
H	L HL	H	L HL

High Tone Spread then attempts to spread the H of the verb stem /bon-/. In the first phrase spreading only goes as far as one vowel; in the second phrase no spreading is possible.

aka-bona	mi-gomba	aka-bona	goodi
∨			
H	L HL	H L	HL

Delinking yields incorrect surface forms for both phrases.

aka-bona	mi-gomba	aka-bona	goodi
/			
H	L HL	H L	HL

*aka-bonó mi-gómba

*aka-bóna góodi

cf. aka-bona mí-'gómba

aka-bonó 'góodi

The initial floating L tones of these nouns, when docked, prevent the preceding H from shifting as far as it should (i.e. to the vowel preceding the noun's high-toned vowel), just as the linked initial L tone of talá blocks spreading of a preceding H to the first vowel of that word (63b). Yet this blockage of spreading gives incorrect results for the phrases containing góodi and mi-gómba.

The next move one might make is to say that there is no floating L tone in góodi and mi-gómba; rather, the downstep is simply a phonetic

effect arising in Sukuma from the collocation of two H tones.⁴² No floating L tone is necessary for the downstepping.

mi-gomba	goodi
H L	H L

The problem with this move is that it fails to explain why the H of góodi, unlike the H of ginhi, fails to undergo Fusion with a preceding word's H tone (cf. 63d).

ginhi
|
H

There is no formal difference between the representations of ginhi and góodi such that the former should undergo Fusion and the latter should not.⁴³

⁴²Richardson does not describe any process of downdrift in Sukuma.

⁴³Both of these class 9 nouns lack an overt noun class marking prefix, such as /n-/ or /m-/. However, one might suppose that góodi has a null prefix consisting of an empty timing slot. This toneless vowel would suffice to block Fusion of the H of góodi with a preceding word's H tone, since then the H of góodi could not be adjacent on the segmental tier to any preceding H, but would be separated by at least one toneless vowel.

Positing such a null prefix actually explains one aspect of Sukuma phonology to which Richardson briefly alludes in an appendix (115): in phrases with prefixless nouns, the vowel before the noun is heard as a long vowel. This lengthening could be due to the spreading of a preceding vowel to the empty prefix of the noun. However, whatever the merits of positing zero prefixes for class 9 nouns, this move still fails to differentiate góodi and ginhi for the purposes of Fusion, since both nouns must have the same zero prefix which allows Fusion in one case but blocks it in the other.

Supposing that góodi has a zero prefix but that ginhi has none is unsatisfactory as well, since it fails to explain why the nouns with inalterable tone contours always have zero prefixes (which block Fusion). That is, such a theory predicts that there should be nouns like s-ginhi with H tones which spread to following words, but which do not fuse with the H tones of preceding words. There are no such nouns, according to Richardson.

Finally, one might decide that góodi and mi-gómba both have lexical floating L tones before the H tone, but that this floating L tone does not get linked at any point in the derivation. It remains floating, blocks Fusion, and triggers downstep between adjacent H tones. If there is no rule which docks floating L tones to the segmental tier, however, then one is left without an explanation for the failure of Spread and Final Lowering to occur with the H tone of talá (see 66 above), where one must posit a final floating L tone. Why should the final floating L of talá dock, but not the initial floating L tones of góodi and mi-gómba?

There are a difficulties, then, with the L tone approach to inalterable tone contours. One cannot consistently use L tones – floating or linked – to explain the various rule failures in nouns.⁴⁴

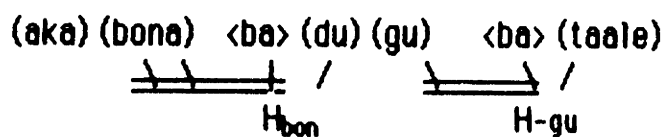
Another conceivable approach to the inalterable H tones in (63–65) is to simply mark these words (with diacritics) as exceptions to Fusion, High Tone Spread, Final Lowering, and Final High Modification. Of course, such an approach is not only a resort to brute force, but it fails to explain why an inalterable H tone is always an exception to each one of these rules. That is, if one allows words to be exceptions to particular rules, then it should be possible for a word to be an exception to Fusion, for instance, but not an exception to High Tone Spread. Or a word might be an exception to the rule of Final Lowering but not to the rule of Fusion. Such words are not found in

⁴⁴One might entertain a more rococo analysis employing underlying contour tones (LH, HL, or LHL) associated with single vowels. The linked L tones would block the various rule applications and then be delinked and left floating (to cause downstep), so that only level H tones are found in phonetic form. It is hard to see how this approach would be compatible with principles of Structure Preservation. There are no surface contour tones on single (i.e. short) vowels in Sukuma, so underlying contour tones would always be neutralized. See Odden 1984, however, for such an analysis of Shona.

Sukuma, according to Richardson's description. An approach using rule exception diacritics is therefore disfavored.

This brings us back to considering Richardson's 1959 proposal for the analysis of inalterable tones. He proposed, in essence, that H tones which do not participate in the regular rule system are a different kind of H tone from those that do participate.⁴⁵ The inalterable tones are different in that the tones themselves do not undergo certain rules, but also in that the words containing these tones are not applicable domains for the rules.

That is, not only does the H tone of the Swahili loan-word balabála 'main road' not shift, fuse, etc., but the vowels preceding the high-toned vowel are also not available for spreading of a preceding H tone. This word contrasts with a word such as ba-dugù 'relatives', which has a lexical H on the final vowel of the noun stem (which undergoes Final Lowering in isolation). The preceding toneless vowels of the stem are available for the spreading of a preceding H tone, as for example the H of the verb stem /bon-/ 'see': aka-bona ba-dúgu ba-táale 'he saw big relatives' (R. 222).



Richardson states clearly, however, that in a word with an inalterable H tone, the preceding toneless vowels are outside of the domain for spreading of a preceding H tone. Richardson delimits the ends of domains with the mark 'v'.

⁴⁵In fact, Richardson notates regular H and L tones as [H] and [N], respectively (where N = 'normal' pitch for a segment). However, he notates inalterable tones as (H) and (L). As one gets a grasp on the whole of Sukuma tonology, one senses increasingly that Richardson is correct: there are two different kinds of H tones in Sukuma.

- (67) a. aka-bɔna mí-_v'góm̩ba_v mi-taale 'he saw big husks of banana palm' (R. 223)
- b. aka-bɔná _vm-kubá_v m-taale 'he saw a big species of tree' (R. 115)
- c. aka-bɔná _vmi-andu_v mi-taale 'he saw big baobab trees' (R. 114)

Whether the noun class prefix such as /m-/ or /mi-/ forms part of the inalterable domain (67b,c) or not (67a) depends on whether or not it forms part of the first syllable of the stem through vowel or consonant coalescence (67c, 67b, respectively). That is, if the initial nasal prefix is merged with the stem-initial consonant, as in (67b), then the nasal consonant takes on the feature of tonal inalterability from the rest of the word. Likewise, in (67c), vowel coalescence between the prefix's vowel and the stem-initial vowel causes the prefix to become part of the first syllable of the stem, and therefore impregnable to the advance of a preceding H tone.

This behavior contrasts with that of a noun with a regular H tone; in such a word the nasal prefix is available for spreading to a preceding H tone.

- (68) a. m-gɔtɔ 'kind of tree' (R. 115)
- b. aka-bɔna m'-gɔtɔ m-taalé 'he saw ...'

The H tone of /gɔtɔ/ undergoes Final High Modification in isolation (68a), changing the doubly linked H to a doubly linked L tone. In (68b) the H of /gɔtɔ/ has shifted to the following adjective, showing that this H tone is not an inalterable one. The initial nasal then, is not part of an inalterable

domain. Therefore, the H of the verb stem may shift to the nasal segment of the onset to the first syllable of the noun.

(aka) (bona) (m- gota) <m-taa> (le)
 ± ± / ± ± ± H /
 H_{bon} H_{gota}

Recall that the noun /koma/ was posited to have two underlying H tones.

koma
 | |
 H H

The second H tone may shift or undergo Final Lowering, but the first H does not shift or fuse with a preceding H.

(69) ba-kómà 'lepers' (R. 222)
 ba-kóma ba-táale 'big lepers'
 aka-bona bá-√kóma ba-táale 'he saw big lepers'

Furthermore, the initial H tone shares its inalterability with a preceding nasal prefix. The nasal prefix acquires the feature of inalterability from the stem syllable with which it has fused.

(70) aka-boná √m-kóma m-taalé 'he saw a big leper' (R. 115)
 *aka-bona √m'-kóma m-taalé

I conclude, therefore, that /koma/ not only has two H tones, but that it has two different kinds of H tones, one regular and one inalterable.

Three observations must be made about inalterable domains.

First, note that the second H tone of /koma/, though it is in the same word as an inalterable H tone, does not share the feature of inalterability: it may spread, lower, etc. This indicates that the domain of inalterability does not extend to the right of an inalterable H tone, only to the left.

Second, the domain of inalterability is not syntactically conditioned. The inalterable nouns are no different from regular nouns syntactically: it cannot be argued that they are in adjunct positions as opposed to argument positions, etc. The domain of inalterability is phonologically determined.

Third, a fully syllabic noun class marker prefixed to an inalterable noun does not form part of the domain of inalterability: it is available for spreading just as with a regular noun. This is seen in (69) with the inalterable noun /koma/. The fully syllabic prefix /ba-/ is open for shifting to the preceding H tone of /bon-/: aka-bona dá-_v kóma ba-tóole. However, as seen in (70), if the noun class prefix is not a syllable on its own, it becomes part of the inalterable first syllable: aka-bonó _vm-kóma m-taalé.

The facts described above are somewhat complicated; nevertheless, they all boil down to the claim that there are two different kinds of H tones in Sukuma. The difference is not in the featural make-up of the H tones, i.e., there is not a tone H₁ and a distinct tone H₂. Rather, the difference in H tones concerns the point in the derivation at which a H tone is present. Regular H tones are underlying H tones, present throughout all stages of the phonology. Inalterable H tones are introduced late in the derivation, after the rules such as Spread, Fusion, Lowering, and Modification have already

Vowels assigned a H tone have a lexical line 1 asterisk. Such vowels are toneless in underlying representation. The inalterable words represented with L tones in (66) above are instead represented as toneless words with line 1 asterisks.⁴⁶

(72) * * * * --line 1
 tala gombi goodi balabala

Fusion, Final Lowering, and Final High Modification do not affect the toneless words in (72). After these rules apply, High Assignment links a H tone to the stressed vowels.

 * * * * --line 1
 tala gombi goodi balabala
 | | | |
 H H H H

These late H tones are as a matter of course not subject to the previous tone rules.

Line 1 asterisks are not simply metrical heads floating around in space, but are themselves grouped into constituents. The facts discussed in

⁴⁶The appeal to underlying stress marks rather than to underlying H tones for these words also explains another fact: nasal consonants never bear inalterable H tones. This is because nasal consonants in Sukuma are tone-bearing, but not stress-bearing (see the following section). If inalterable H tones are to be represented as underlying tones, then there is no reason why a nasal consonant cannot bear an underlying inalterable H tone. Richardson gives no examples, however, of an inalterable H tone on a nasal. The fact that nasal consonants cannot bear inalterable H tones follows, on the other hand, from a theory which represents inalterable H tones as underlying stress marks, inasmuch as nasals are not stress-bearing elements, and so cannot be represented with an underlying stress mark. Although not shown in the previous discussion, Richardson indicates that nasal consonants may bear regular H tones in underlying form; examples are the class 1 verbal subject marker of the 1st person, /n-/, or the class 2 subject marker of the 2nd person, /m-/ (R. 120). This shows that there is no general prohibition in Sukuma against nasals bearing lexical H tones.

connection with (69) and (70) above and the stem /koma/ seem to suggest that line 1 asterisks are heads of right-headed constituents, not left-headed constituents. These facts will be worked out directly below.

Let us assume for the moment that the metrical structure rules for nouns are the following, copied from (30) above with the addition of line v.

(73) Metrical Structure Assignment (nouns and adjectives)

- i. Assign line 0 asterisks to every vowel.
- ii. Mark the first syllable extrametrical.
- iii. Construct binary constituents from left to right.
- iv. Construct right-headed, unbounded constituents for line 1 asterisks.

It will be shown now that an "inalterable domain" is simply the domain defined as a line 1 constituent: the tone rules of Sukuma operate within line 1 constituents, but the rules may not cross the left bracket of a line 1 constituent. (Although the rules must be able to cross a line 0 constituent bracket). Therefore, any segmental material which is part of a metrical constituent headed by a line 1 asterisk is untouched by tonal operations on elements outside of the constituent.⁴⁷

Rule (73ii), the extrametricality rule, operates only on syllabic noun class prefixes. It is a solid generalization that the stem itself of an inalterable noun can never have its first syllable marked extrametrical. The loanwords in (65) above, bu-lengéedi and balabála, show this clearly. The first syllable of bu-lengéedi is not parsed as part of the noun

⁴⁷This notion of impermeability of a line 1 constituent boundary is meant to mirror the Hale and Selkirk (1967) notion that phonological domains are marked off by certain boundaries. Hale and Selkirk propose that the right or left brackets of certain syntactic constituents (X-max or X^o) are significant for the formation of phonological domains. The present analysis of Sukuma suggests that the right or left brackets of metrical constituents are potentially significant as well for the formation of phonological domains within which rules operate.

stem itself, but is extrametrical and therefore not part of the inalterable domain established by the line 1 constituents. It is therefore open to a preceding H tone (R. 101). The first syllable of $\sqrt{\text{balabála}}$, on the other hand, is part of the stem itself, and so its first syllable is not marked extrametrical and is part of the inalterable domain. If the noun class prefix is merged into the first syllable of the stem, it becomes part of the first syllable metrically, and thus falls into the inalterable domain of the line 1 constituent. Consider the differences in tone patterns of the noun class prefixes /mi-/ and /m-/ with regular (74a,b) and exceptional (74c,d) stems. (Recall that the vowel of /mi-/ undergoes coalescence with a vowel-initial stem.)

- | | | | | |
|------|----|--|-------------------------|----------|
| (74) | a. | mi-obo | 'holes' | (R. 114) |
| | | aka-bɔna mi-obó mi-taale | 'he saw big holes' | |
| | b. | mi-ɔto | 'fires' | |
| | | aka-bɔna mí-ɔto mi-táale | 'he saw big fires' | |
| | c. | $\sqrt{\text{mi-úbu}}$ | 'species of tree (pl.)' | |
| | | aka-bɔná $\sqrt{\text{mi-úbu}}$ mi-táale | 'he saw ...' | |
| | d. | $\sqrt{\text{mi-andú}}$ | 'baobob trees' | |
| | | aka-bɔná $\sqrt{\text{mi-andú}}$ mi-taale | 'he saw ...' | |
| | e. | $\sqrt{\text{m-kubá}}$ | 'sp. of tree (sg.)' | (R. 115) |
| | | aka-bɔná $\sqrt{\text{m-kubá}}$ mi-taale | 'he saw ...' | |
| | f. | mi- $\sqrt{\text{kubá}}$ | 'sp. of tree (pl.)' | (R. 114) |
| | | aka-bɔna mí- $\sqrt{\text{kubá}}$ mi-taale | 'he saw ...' | |

In a regular stem (74a) the noun class prefix forms part of the first syllable of the noun stem, and the whole first syllable is extrametrical, so it is the second syllable which attracts the preceding H tone: $\langle \text{mi-o} \rangle$ (bo).

(74b) also shows that the coalesced prefix is available to a preceding tone, although the phonetic form of this phrase is unclear.

In (74c) and (74d) the H of the verb stem /bon-/ may shift no further than the final vowel of the verbal word, since the noun class prefix has become part of the first stem syllable of the exceptional noun. (74e) and (74f) show the contrast between a noun class marker which forms its own syllable and one that does not, both in connection with an exceptional noun stem.

In the light of these data I posit that the special class of noun stems with line 1 asterisks must be marked as lexical exceptions to extrametricality (and the exception feature percolates to a prefix just in case the prefix is merged with a stem syllable).

Rule (73iv) builds feet on the line 1 tier of asterisks just in case there is an asterisk present. It is the presence or absence of constituent brackets for line 1 heads which determines the phonological domains within which rules operate.

Nouns with lexical line 1 stresses are given the following metrical structure by the rules in (73). Line 1 constituents are delimited by square brackets '[']. Recall that Metrical Boundary Insertion (25) applies to high-toned vowels, as in the stem /koma/.

underlying:

*	*	*	--line 1
ba-koma	mi-gombi	m-kuba	
H			

Metrical Boundary Insertion:

*	*	*	--line 1
ba-ko(ma	mi-gombi	m-kuba	
H			

Extrametricality:

*	*	*	--line 1
<ba>-ko(ma	<mi>-gombi	m-kuba	
		(e.m.'ity does not apply)	
H		(to a stem syllable)	

Binary feet on line 0:

*	*	*	--line 1
<ba>-(ko)(ma)	<mi>-(gombi)	(m-ku ba)	
H			

Line 1 constituents built:

[*]	[*]	[*]	--line 1
<ba>-(ko) (ma)	<mi>-(gombi)	(m-ku ba)	
H			

An initial extrametrical syllable is not part of the line 1 constituent; on the phrasal level the extrametrical syllable is adjoined to the preceding foot.⁴⁸ High Tone Spread applies in the phrasal phonology, but it may not spread a H tone across a line 1 constituent boundary, only across line 0 constituent boundaries.

⁴⁸Adjoining the extrametrical syllable to the following foot would cause it to be inside the line 1 constituent boundary, which is not the desired result. I do not know enough to say whether an extrametrical syllable is always adjoined to the preceding foot, or whether adjunction depends on right- or left-headedness.

(75) aka-bqna bá-_v!kóma ba-táale
 aka-bqna mí-_v!gómbe_v mi-taale
 aka-bqna_v m-kubá_v m-taale

The rules of Fusion, Final High Modification, and Final Lowering are all ordered before High Assignment (71). The H which is introduced by High Assignment does not therefore undergo any of these rules.

Let us return now to the noun tala, with which this section was introduced. According to the present analysis, this noun must have a lexical line 1 asterisk on its second syllable.

* --line 1
 tala

Binary foot construction will build a binary foot on line 0. The second syllable is marked as a head on line 1.

[*] --line 1
 (* *) --line 0
 ta la

This noun shows that line 1 constituents must be right-headed, not left-headed. If they were left-headed, then the second syllable [la] would constitute the leftmost element in the line 1 constituent. This would entail that the first syllable [ta] is not part of the line 1 constituent.

* --line 1
 * [*] --line 0
 (ta)(la)

But such a case the first syllable of talá is not in the inalterable domain established by a line 1 constituent bracket. It should thus be available to a preceding H tone for spreading. The fact that it is not (cf. 63b, aka-boná talá n-taale) shows that line 1 constituents are right-headed. In this case the line 1 constituent contains both line 0 asterisks.

```
[ *] --line 1
(* *) --line 0
ta la
```

Right-headed line 1 constituents explain the inalterability of the first syllable of words such as talá and mi-andú.

Class 9	aka-bɔ́ná	yɔ	+ h	'he saw it'
Class 10	aka-bɔ́ná	ɔ́yɔ	+ h	'he saw them'
Class 17	aka-bɔ́ná	kɔ	+ h	'he saw that place'

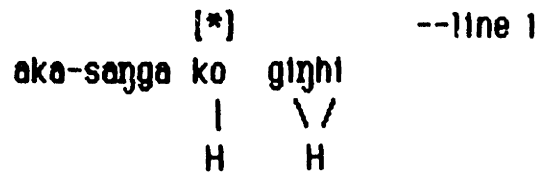
The H tone of these pronouns does not fuse with an adjacent H tone, nonetheless.

(78) aka-saŋga kó gɪŋhi 'he found an owl there' (R. 49)

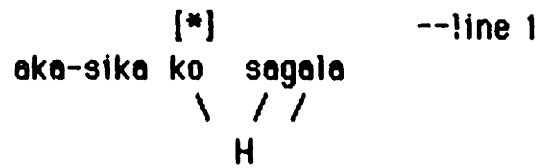
In (78) the doubly linked H tone of gɪŋhi 'owl' undergoes Final Modification, whereby it is turned into a doubly linked L tone for being linked to the utterance-final vowel. The H tone of kɔ remains, however: it has not been fused with the H of the following noun, and so is immune to Final Modification (cf. 60, 61 above).

This immunity to one of the tone rules is reminiscent of the inalterable tones discussed in the previous section. Yet inalterable tones were analysed as late-coming tones, introduced after the rules which shift H tones to following words. The H tones associated with these pronouns, in contrast, are able to shift to a following word.

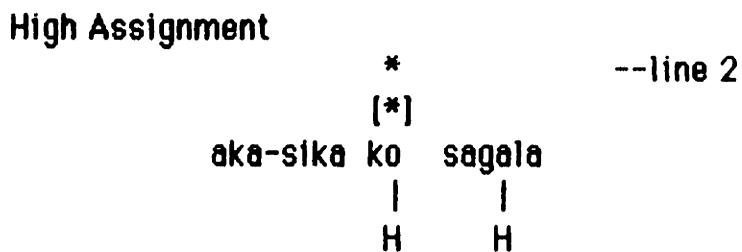
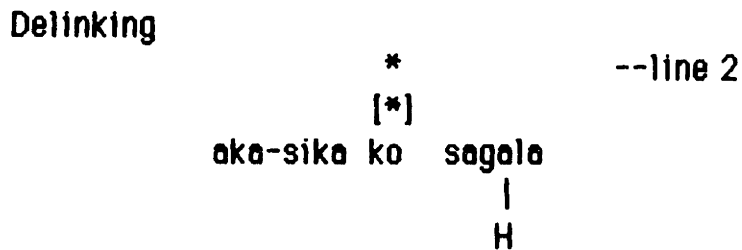
Taken together, these facts suggest that the pronouns in (77) have a lexical H tone. This H tone is extant at the point in the derivation when High Tone Shift and Final Lowering apply (76). However, these pronouns also bear an inherent line 2 asterisk, putting them inside the "inalterable" domain of a right-headed line 1 constituent. The presence of a line 1 constituent bracket prevents Fusion with another H tone, since Fusion cannot operate across a line 1 boundary.



High Tone Spread may spread a H tone over the right boundary of a line 1 constituent, but not across the left bracket (as discussed above).



The rule of Delinking must apply after High Assignment tries to insert a H tone on the stressed vowel. Because the vowel is still linked to its own lexical H tone before Delinking, High Assignment is not able to add another H tone to it. This ordering – High Assignment before Delinking – ensures that only one H tone shows up in the phrase above. If Delinking preceded High Assignment, then one would expect two surface H tones in this phrase.



Surface: *aka-sika kó sagála

When two of these stressed, high-toned pronouns occur in a row, a downstep occurs with the second of the two adjacent H tones.

- (79) aka-sika ko ! ho 'he arrived there at that place' (R. 49)
aka-bona ! ko ! ho 'he saw over there at that place' (50)

This downstep is familiar from the other line 2 accented morphemes above (cf. 64).

Consider next the Dependent/Subjunctive tense of Sukuma (tense number 14 in Richardson's classification, 124). This tense is marked by the final vowel /-e/ following the verb stem. One finds the following paradigm in this tense, where /a-/ is a high-toned class 1 subject marker and /ba-/ is a high-toned class 2 subject marker.

- (80) \checkmark a-sól-e + h 'let him choose' (R. 27)
 \checkmark a-bón-e + h 'let him see'
 \checkmark ba-sól-e + h 'let them choose'
 \checkmark ba-bón-e + h 'let them see'

Recall that the symbol '+ h' indicates that a H tone shows up in a following word (according to the regular patterns established above). The arrow 'v' before the verbs indicates that these verbs fall outside of the regular rules of the grammar; in particular, the H tones associated with the first morphemes of these verbs does not undergo Fusion with an adjacent preceding H tone (cf. 26, 27 above).

The fact that the word a-sól-e contributes a H tone to the following word leads one to suspect that the final vowel /-e/ has its own lexical H

tone. The verb stem /sol-/ is toneless, and the H tone linked to the subject marker /a-/ should shift two vowels at the most in a verb (in fact it shifts only one vowel). Therefore, the H tone which shows up on the following word cannot originate from /a-/. It must be associated somehow with the morpheme /-e/.

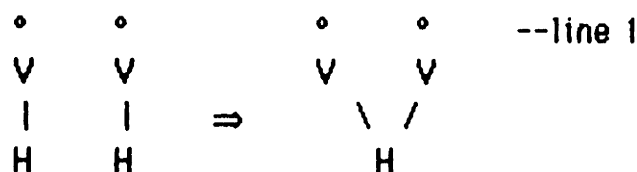
However, if the final vowel /-e/ has its own H tone, one would expect this H to fuse with the preceding adjacent H tone of the verb stem /bon-/.



The application of Fusion predicts the surface forms *abone + h and *babone + h, with no surface H tone on the verb stem itself. This is not the case, however (cf. 80); the H of /-e/ does not fuse with the preceding H tones (although the H tones of the verb stem and the subject marker do fuse).

A possible move to make is to stipulate that Fusion occurs only between H tones linked to vowels which do not have a line 1 stress. Adding this condition to the rule of Fusion yields the following statement.

(81) Fusion: fuse H tones on adjacent vowels into a single H.



This solution is more descriptive than explanatory, but it must suffice for the present.

4.8 The status of tone-bearing consonants

Richardson gives a rather puzzling description of the syllabicity of nasal consonants in Sukuma. In essence, he says (115) that a nasal consonant (such as the noun class prefixes /n-/ and /m-/) is syllabic if it bears a H tone in surface form, else it is non-syllabic. Examples of his definition are the following.

(82) "non-syllabic" nasal:

aka-bɔna m-gonó m-taale 'he saw a big trap'

"syllabic" nasal:

aka-bɔna m-gota 'he saw a sp. of tree'

Nasal consonants which are incorporated into an inalterable domain (presumably by coalescence with the initial consonant) are undefined for syllabicity in Richardson's system.

(83) aka-bɔná √m-kóma m-taalé 'he saw a big leper'

aka-bɔná √m-kubá√ m-taale 'he saw a big sp. of tree'

Richardson's definition of nasal syllabicity is functional rather than phonetic. Another example of this is the fact that he classifies the nasal portion of an underlying prenasalized stop as "syllabic" just in case it bears a H tone on the surface.

(84) m-temi u-ɲgì 'another chief' (R. 118)

aka-bɔna n-numbà 'he saw a house'

In the examples in (84), the prenasalization of the monosyllabic segments [ŋg] and [mb] is syllabic in Richardson's terms, simply because it bears a surface H tone.

The prenasalization is not prosodically syllabic in the sense of forming its own syllable, however. This is apparent from the shift of tone in the stem /pɪlɪŋɡit-/ 'to roll along'. Sukuma metrics treats this stem as trisyllabic (pɪ-lɪ-ŋɡi-t) and not quadrisyllabic (pɪ-lɪ-ŋ-gi-t). The H tone linked to the initial vowel of this stem surfaces two syllables to the right, as expected, on the third vowel [pɪlɪŋɡɪt]. If the prenasalization of the third consonant counted as a syllable, one would expect the initial H tone to shift to it *[pɪlɪŋɡɪt]. This shows that the nasal segment is not metrically significant (which is what syllabicity is all about). The nasal is not considered a stress-bearing element for the purposes of metrical structure assignment, else it would be the head of the second binary foot – (pɪ-lɪ)-(ŋ-gi) – and the attractor of the H tone.

That nasal segments are not metrically significant has been shown above in the discussion of extrametricality in nouns. The first syllable of a Sukuma noun is extrametrical; the second syllable attracts the preceding H tone.

- (85) aka-bona ba-dúgu ba-táale 'he saw big relatives'
 aka-bona ba-ími ba-taale 'he saw big cultivators'

If a nasal prefix were syllabic, it would count as the extrametrical syllable, and H tones would shift to the syllable following the syllabic nasal (86b). However, this is clearly not the case in Sukuma: the H tone shifts to

the second syllable after the nasal (86a). (The salient nasal is marked with dotted underlining.)

- (86) a. giŋhi n-taalé 'big owl'
 aka-bona n-koló n-taale 'he saw a big sheep'
 aka-bona ń-kolo n-taalé 'he saw a big heart'
 aka-bona m-gonó m-taale 'he saw a big trap'
 aka-bonó √m-kóma m-taalé 'he saw a big leper'
- b. *giŋhi n-taale
 *aka-bona m-góno m-taale

This shows clearly that the nasal consonant is not metrically significant: it does not count as a separate syllable for the purposes of extrametricality.

The question that arises is this: what is the syllable structure of a nasal-obstruent cluster? Does the nasal close the preceding syllable, or does it form part of the onset of the following syllable?

- (87) a. σ σ b. σ σ
 | \ | | /
 a n t a n t

The phonetic data are unclear. Richardson states that a nasal noun class prefix assimilates in place of articulation to the initial consonant of the stem. If the stem consonant is a voiced obstruent or a sonorant, the output of assimilation is a modification of the second consonant (which, following Richardson, is transcribed by a line over the segment). "In some cases this [modification] may be heard as length, e.g. in nasals, but in others a consonant cluster or devoicing may be heard e.g. [\bar{w}] = [vw], [\bar{z}] = [zz] (106)."

(88)	m-βoni	'onlooker'	[m̃oni]	(R. 107)
	m-bipi	'one who sucks'	[βipi]	
	m-getá	'awl'	[g̃etá]	
	m-daki	'ill-tempered person'	[ðaki]	
	m-jundu	'kind of tree'	[jundu]	
	m-vule	'kind of tree'	[vule]	
	m-zengo	'habitat'	[zengo]	
	m-lage	'soot'	[lage]	
	m-lyango	'door'	[lyango]	
	m-wiiǰí	'one who tells news'	[wiiǰí]	
	m-yegi	'happy person'	[yegi]	
	m-mani	'knowledgeable person'	[mani]	
	m-noge	'blood from nose'	[noge]	
	m-nyeeci	'stealthy person'	[nyeeci]	
	m-Nwi	'drinker'	[Nwi]	
	n-begesó	'firestick'	[begesó]	
	n-βogò	'buffalo'	[βogò]	
	n-dama	'calf'	[dama]	
	n-gobo	'skin'	[gobo]	
	n-jigu	'reparation'	[jigu]	
	n-vi	'white hair'	[vi]	
	n-zobe	'donkey'	[zobe]	
	n-lobi	'kingfisher'	[lobi]	
	n-lyeehu	'gentle creature'	[lyeehu]	
	n-wa	'dog'	[wa]	
	n-yango	'black ant'	[yango]	
	n-mamba	'kind of fish'	[mamba]	
	n-noni	'bird'	[noni]	
	n-nyaji	'one who runs away'	[nyaji]	
	n-ŋwiina	'crocodile'	[ŋwiina]	

This phonetic description does not help decide the syllable structure of nasal-obstruent clusters. A long consonant or a cluster could be either

tautosyllabic or heterosyllabic. The fact that Sukuma does not otherwise allow closed syllables (e.g. *[bab]) suggests that nasal-obstruent clusters do not close the preceding syllable (e.g. [a-nta], not [an-ta]). Homorganic clusters might be exceptions, nonetheless, just as they are in Japanese.

It seems more likely that the segments in a nasal-obstruent cluster are heterosyllabic in those cases where a nasal prefix stands before a voiceless consonant. Richardson notes (106) that in this context the nasal segment is heard only if the word is preceded by a vowel. (Disappearing nasals are enclosed in parentheses '()'; voiceless [ŋ] is transcribed with a line: [ŋ̥]).

(89)	m-peeji	'good runner'	[(m) peeji]
	m-temi	'chief'	[(n) temi]
	m-kómà	'leper'	[(ŋ) kómà]
	m-ci	'dead person'	[(ɲ) ci]
	m-fumu	'medicine man'	[(m) fumu]
	m-sumbi	'maker'	[(n) sumbi]
	m-hayo	'word'	[(m) hayo]
	m-hoja	'pacifier'	[ŋhoja]
	m-halalɔji	'argumentative person'	[ʒhalalɔji]
	m-híndi	'an Indian'	[ʒhíndi]
	n-pala	'antelope'	[ŋhala]
	n-tala	'platform'	[ŋhala]
	n-kala	'badger'	[ʒhala]
	n-cilu	'stupid creature'	[ŋilu]
	n-fu	'dead thing'	[(m) fu]
	n-sununu	'bamboo cane'	[(n) sununu]
	n-hayo	'proverbs'	[(ŋ) kayo]
	n-himbɔji	'kind of snake'	[ŋhimbɔji]

Note that the nasal segment is always realized – even when no vowel precedes – just in case the nasal assimilates in voicing (i.e. devoices) to the following voiceless consonant: [m̥hala], [m̥hoja], [m̥hala]. If the nasal retains its voicing before the voiceless consonant, then it is realized phonetically only after a vowel (i.e. phrase-medially): [(m) peeji], [(n) sumbi], [(n) sununu].

In those cases where there is complete assimilation – in both voicing and place of articulation – the nasal-consonant cluster has merged into a single consonant, together forming the onset of a syllable (87b). Because the cluster constitutes a single consonant, it is fully realized even when no vowel precedes. Where the assimilation is only in place of articulation but not in voicing, the consonants remain separate and are heterosyllabic (87a). In the latter cases, the nasal is part of the rime of the preceding vowel. If there is no preceding vowel, the nasal cannot be syllabified and so is not realized in phonetic form.

Significantly, the nasals which precede voiceless consonants are not syllabic themselves. If there were syllabic nasals in Sukuma, then one would expect to find voiced nasals preceding voiceless consonants even where there was no vowel preceding the cluster: e.g. *[ŋ-ta]. Such clusters are not found, entailing that there are no syllabic consonants in Sukuma.

This brings the discussion to a minor but interesting point: segments which are capable of bearing tones are not necessarily metrically significant ones. That is to say, there is a mismatch in phonology between tone-bearing units and metrical units. A segment which is not metrically significant (i.e. does not project a line 0 asterisk) may nonetheless be linked to a tone.

This fact appeared also in Digo, where voiced obstruents acquired L tones at some point in the derivation of the phrase-level phonology. This acquired L tone was present on the tier of tone units and able to block spreading of a H tone. (Data are from Kisseberth 1984, 172.)

- (90) a-na chékéch-á ú-ngâ 'he's sifting flour'
 a-na ézék-a bǎndâ 'he's thatching a shed'
 a-na tsíndz-á má-dzogôř 'he's slaughtering roosters'

In the first phrase where there are no voiced obstruents, the first H tone (from the morpheme /a-/) is able to spread all the way across the phrase up to the final vowel. In the second and third phrases the spread of this H tone is blocked at some point in the phrase by the L tone of a voiced obstruent. In the second phrase it is the L tone of [z] which blocks spreading; in the third phrase it is the L tone of [dz] of ma-dzogoro.

The voiced obstruents which are linked to L tones in Digo are clearly not metrically significant. They are onset consonants, and only segments in the rimes of syllables count in metrical systems. Thus, Digo provides another example of a tone-bearing unit which is not a metrical unit.

These facts are significant for the theory of phonology. The theory must be able to make a distinction between stress-bearing and tone-bearing segments. Digo and Sukuma both have tone-bearing segments which do not count in the metrical structure of the language.

4.9 Spread/Delink vs. Displace

I have proposed that the shifting of tones in Sukuma be analyzed as a two step process: first, a H tone is spread rightward as far the vowel immediately to the right of a line 0 constituent boundary; second, the association lines of the H tone are delinked, save for the final one.

Underlying

(a ka) (bone) (la)
 |
 H

(a ka) (bona) (ni ja)
 |
 H

High Tone Spread

(a ka) (bone) (la)
 \ | /
 H

(a ka) (bona) (ni ja)
 \ | /
 H

Delinking

(a ka) (bone) (la)
~~\ | /~~
 H

(a ka) (bona) (ni ja)
~~\ | /~~
 H

Surface

(a ka) (bone) (la)
 |
 H

(a ka) (bona) (ni ja)
 |
 H

This two step technique of shifting a tone to a stressed vowel is taken from the analysis of Xhosa given by Goldsmith, Peterson, and Drogo (1986). In Xhosa (Republic of South Africa) the rule of Delinking is in some sense optional: association lines are deleted from left to right, but it is not

necessary to delete all but the final line. One may stop Delinking at any point in the string. This gives rise to variant tone patterns for the same word. (The following data are from Downing 1988a).

- (91) ukú bala 'to fight'
 úkú bala
- uku shukúmisa 'to shake'
 uku shúkúmisa
 ukú shúkúmisa
 úkú shúkúmisa

The H tone of the pre-prefix /u-/ is spread across the string until it reaches the antepenultimate vowel. Delinking then proceeds optionally from left to right, yielding various surface forms for the same word.

Why adopt the same analysis for Sukuma? Why not rather adopt a tone displacement approach as was suggested for Digo (chapter 3)? That is, instead of spreading to a following stressed vowel, a H tone would simply delink from its original vowel and relink with a following left-edge vowel.

Underlying

(a ka) (bone) (la)	(a ka) (bona) (ni ja)
H	H

Displacement

(a ka) (bone) (la)	(a ka) (bona) (ni ja)
H	H

The reason for not adopting the displacement approach to tone shift in Sukuma is that there is independent need for rules of spreading and delinking. If a H tone is followed by a vowel which already has a H tone, then no displacement could occur. H₁ cannot displace because the leftmost vowel of the next constituent is already linked to H₂.

(ba-ku) (ba-so) (lela)
 | |
 H₁ H₂

The second H may displace and does.

(ba-ku) (ba-so) (lela)
 | |
 H₁ H₂

The first H then spreads to the next vowel and undergoes Delinking, although the second H does not undergo subsequent spreading.

(ba-ku) (ba-so) (lela)
 ̤ / |
 H₁ H₂

This yields the surface form ba-kú-ba-soléla 'they will choose them for someone'.

Note that Spread and Delinking are needed in the derivation anyway to explain the shift of the first H tone to the following syllable. Under the displacement analysis, however, there is no explanation for why the second H is not also shifted one vowel over after displacing: *ba-kú-ba-soléla. The displacement analysis (i) requires an extra rule, the rule of displacement,

and (ii) requires a complication of the rules of Spread and Delinking so that they do not apply to a previously displaced H tone. These two considerations lead me to favor the Spread/Delink analysis above.

Perhaps, in fact, there is no rule of grammar like High Tone Displacement, as was proposed for Digo. Perhaps Digo displacement is accomplished by a two step spreading and delinking process just as in Sukuma and Xhosa. Resolving this question requires further research into the variety of tone shifting processes in natural language.

Chapter Five

Further Theoretical Considerations

In this chapter some conclusions are drawn from the preceding analyses of Digo, Sukuma, Kimatuumbi, and Ci-Ruri. Specifically, these analyses have ramifications for the general theory of generative phonology, autosegmental linkage of tones to vowels, the theory of Moraic Phonology, and for a typology of tone and accent interactions.

5.1 The rule-driven nature of tonology

The foregoing descriptions of Digo and Sukuma tonology lead to a conclusion which is rather simple – perhaps uncontroversial for some – but nonetheless profound. Simply put, it seems unlikely that a behaviorist or connectionist approach to the theory of language could account for the way in which High tones skip around through words in Sukuma and particularly in Digo. In Digo, for example, a noun at the end of the sentence may show a surface High tone or not, depending on the morpheme at the beginning of the sentence. (Recall that a phrase-final High tone in Digo is realized phonetically as a rising-falling contour on the last two vowels.)

- (1) a. ni-na píg-a goma 'I'm beating a drum' (K. 162)
b. a-na píg-a gǒmâ 'he's beating a drum'

In terms of generative phonology, sentence (1b) shows the shift of an underlying High tone from the third-person Subject Marker /a-/ to the final vowel of the sentence. It does not make sense, however, to say that the High tone which appears on the noun in (1b) is produced on analogy to, or from memory of, other similar sentences, for it is hopeless to attempt to define "similarity" for such sentences of Digo. Sentence (1b), for example, has the same tone pattern as sentence (2a), yet it is not at all obvious in what way (1b) is more similar to (2a) than it is to (2b-d).

- (2) a. a-na ragíz-a kalǎmû 'he's ordering a pen' (K. 162,176)
 b. a-ná vug-á dǎnâ 'he's cooking hard maize porridge'
 c. a-na jit-a ma-rênje 'he's cooking pumpkins' (169)
 d. a-na jit-a mu-gǎngâ 'he's cooking cassava' (163)

In fact, it is difficult to see why (2c) and (2d), although very "similar", should have different tone patterns.

In the account of Digo tonology given in Chapter Three, certain abstract counting procedures were invoked to account for the surface differences in tone. Knowledge of these procedures – the metrical structure rules – is assumed to be part of the cognitive endowment of human beings, an essential piece of their language faculty. A difference in abstract metrical structure accounts for the phonetic difference in tone pattern between fumǒ-rî 'spear (loc.)' and doná-rî 'hard porridge (loc.)'.¹

¹The penultimate vowel of the first locative phrase is unstressed, whereas the penultimate vowel of the second phrase is stressed and undergoes Stress Decontouring, which turns the rising tone into a level High tone.

In a behaviorist/connectionist framework, symbolic mental constructions such as metrical structure are disallowed. Instead, sub-symbolic, non-linguistic mechanisms of stimulus and response are supposed to supply native speakers of Digo with the correct patterns of tone production. However, the stimuli, or input to language learning, seem quite inadequate to provide the learner with distinguishable analogic forms, such that the learner is then able to generate an infinite number of sentences in the same way that another speaker will utter the same sentences, tone for tone. Suffice it to say, the facts of Digo tonology lay down quite a challenge for a non-mentalistic theory of language learning and production.

5.2 Tone linkage to the segmental tier

Within an autosegmental model of phonology, the languages investigated above provide some useful clues as to the nature of phonological representations. Specifically, the Sukuma data show quite clearly that tones must be linked directly to the skeletal tier of timing slots, and not to the segmental or syllable structure tiers.

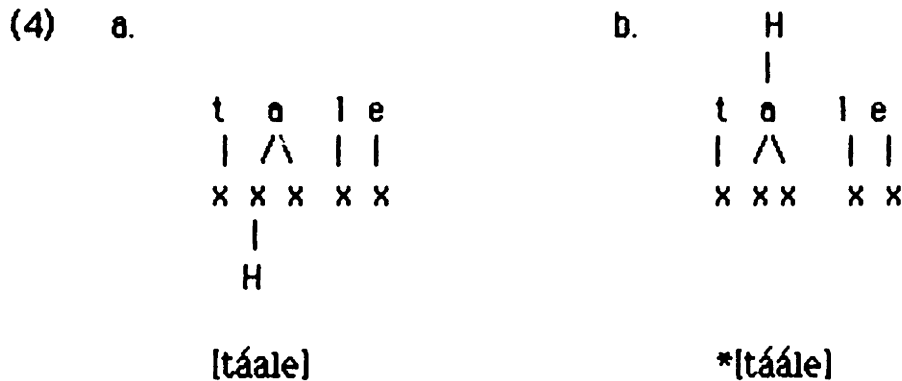
Consider the Sukuma data in (3) once again. Recall that the adjective ba-taale 'big (class 2)' is analysed as a toneless word: in underlying representation neither the class marker ba- nor the stem -taale is linked to any feature specifications on the tonal tier. For this reason the High tone of the preceding noun temi is free to spread to the first mora of the long stem vowel of the adjective, as in (3b) – [táale]. After a toneless noun (3a) the entire phrase surfaces with low-toned vowels; the Low tones are assigned by a default rule.

- (3) a. bə-limi bə-taale
 b. bə-temi bə-táale

'big cultivators'
 'big chiefs'
 (from Richardson 1971, 222)

In (3b) the second mora of the adjective stem's long vowel is low-toned in the phonetic output; this Low tone is assigned by the rule of default Low insertion, yielding a HL falling contour on the long vowel as a whole, [áà].

The second mora of [aa] may receive a default Low tone only if the shifted High tone is linked to the timing tier, and not to the segmental tier. The two representations in (4) show the structure of the syllable prior to default Low tone insertion.

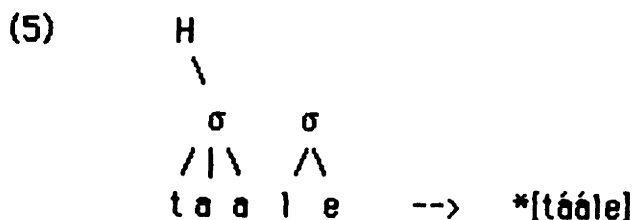


In (4a), where tones are linked to the timing tier, the default rule may apply to the toneless second mora of the long [aa] vowel to produce the falling tone. In (4b), on the other hand, the default rule will not apply, since the relevant element – the segment /a/ – is already specified for a tone. (Recall from Chapter Two (3) that long vowels are represented as a single segment linked to two timing slots).

Because the second mora of the long [aa] vowel receives its Low tone by a default rule – one which applies to segments unspecified for tone – the High tone must be linked to the first mora only. This linkage of a tone to the

first mora but not the second is accomplished by associating tones to the skeletal tier of timing slots, and not to the segmental tier of consonants and vowels.²

By the same argument tones should not be linked to the syllable structure tier either. Linking a tone to the syllable node of a representation causes the same problem of failure of default Low tone insertion for the second mora of a long vowel.



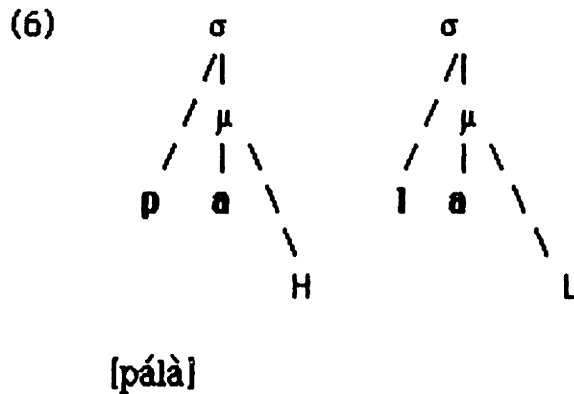
For this reason I have proposed in the foregoing study that tone linkages are to the skeletal tier of timing slots.

5.3 Digo voiced obstruents and Moraic Phonology

In recent work a number of linguists (Hyman 1985, McCarthy and Prince 1986, Hayes 1989) have suggested replacing the skeletal tier of timing slots with a moraic tier. The moraic tier encodes timing relations, but only for elements in the rime of the syllable: other elements of the syllable (onsets, codas) are prosodically dependent on nuclear elements.

²Of course, this argument collapses if one opts to represent long vowels as two separate vowels. There are a number of arguments against such representations: cf. Clements and Keyser 1983.

In his recent article in Linguistic Inquiry on Moraic Phonology, Bruce Hayes points out that in this theory of prosodic structure autosegmental tones should be represented as linked to the moraic tier (1989, 287).



Linking tones to moras is the only reasonable choice. The only other option is to link tones to the vowels on the segmental tier. This latter option is untenable, however, as shown above with the default assignment of Low tones in Sukuma. Since tones must not be linked to the syllable tier or the segmental tier, one is forced to link tones to the moraic tier in Moraic Phonology.

This theory has a certain consequence for analyses of tone: only segments dominated by moras may be tone-bearing. In particular, onset consonants may not be distinct tone-bearing segments, inasmuch as they are not dominated by a mora whereto a tone may be linked (7b). In Skeletal Phonology (CV Phonology), on the other hand, there is no principled reason for prohibiting an onset segment from bearing a tone, if tones are linked to the skeletal tier (and not to the segmental tier or the syllabic tier, 7a). Consider the hypothetical examples in (7).

(7) a.

b	a
x	x
L	H

[bá]

b.

σ
/ \
μ
μ-----H
/ \
b a

[bá]

The two theories clearly make different predictions about the tone-bearing ability of onset consonants. Moraic Phonology disallows distinct tone linkages to onset consonants: any such linkage must be mediated through the mora node of the following nuclear segment.

However, the so-called "depressor consonants" of Digo and Zulu are clear examples of onset consonants which bear Low tones (or extra-low tones – see the appendix to Chapter Three). For the sake of simplicity let us consider Digo once again. There it was shown that voiced obstruents acquire a specification on the tonal tier at some point in the derivation. Expressly, Digo voiced obstruents are assigned a Low tone. This Low tone behaves just as one would expect a Low tone to behave: it blocks the spreading of High tones (8a) and affects the tone contour of preceding vowels in some cases (8b).

(8) a. [g] blocks spread of High tone of /-ka-/

ni-ka kúmbúkír-â	'I have remembered' (K. 128)
ni-ká gongomé-â	'I have hammered' (131)
*ni-ka góngomé-â	

b. [d] induces a rising contour on following vowel

batá-nî	'duck (loc.)' (K. 161)
bádǎ-nî	'cassava meal (loc.)'

It is hardly controversial, then, that these voiced obstruents are onset consonants which bear a tone which is distinct from the tone of the following nuclear segment, as in (7a). It is not clear what the range of behavior is for L tones associated to "depressor" consonants. For example, such tones spread to neighboring vowels in Zulu (cf. Chapter Three, Appendix), but I know of no examples of depressor L tones displacing, as do the H tones in Digo.

It is not within the scope of this discussion to present alternative representations for tone-bearing onsets in the theory of Moraic Phonology. It must suffice simply to point out the problem for such a theory.

5.4 A catalogue of tone-accent interactions

In the foregoing investigations of Tanzanian tone languages, a variety of rules were posited to mediate tones and metrical structures. Two types of tone-accent interactions have been illustrated above; a third type has not yet been discussed.

- (I) Attraction of tones to accented vowels, metrical boundaries;
(via spreading or displacement)
- (II) Phonetic interpretation of accents as tones;
- (III) Phonetic distinction in tone T as linked to accented or unaccented vowels.

Interactions of type I are the rules of High Tone Displacement in Digo and Ci-Ruri and the rules of spreading to a boundary in Sukuma and

Kimatuumbi. Type I interactions are phonological rules whereby toneless vowels are associated in some way to an existing tone.

Type II interactions are rules such as the High Tone Insertion/Assignment rules of Kimatuumbi and Sukuma. These rules link a stressed toneless vowel to a tone which did not exist at any earlier stage in the derivation, but is introduced to give a certain tonal interpretation of a stressed vowel. For instance, a toneless vowel in Kimatuumbi with line 2 stress is assigned a High tone when the word is final in the utterance. It is not obvious that Type II rules are phonological rules: they may rather be rules of phonetic interpretation of metrical structure. Further research will perhaps decide the question.

There is a third type of tone-accent interaction which has not yet been touched upon. Type III interactions are phonetic rules. These are rules which make an articulatory distinction between two segments which differ only in metrical structure. Consider, for example, the representations in (9). The vowel in (9a) is stressed and is pronounced with a H tone; the vowel in (9b) is unstressed, so the phonetic rules interpret the phonological High tone as a phonetic Mid tone.

(9)	a.	*	°	b.	°	--line 2
		a			a	
		H			H	
		= [á]			= [ã]	

particularly as concerns the multi-levelled tone systems of the Grasslands Bantu languages.

5.5 Bantu tone systems and metrical theory

One final point must be raised. Briefly put, the foregoing investigations of metrical dependencies in Bantu tone assignment demonstrate the general adequacy of the present theory of metrical structure. That is to say, the parametrized theory of Halle and Vergnaud 1987 has proven sufficient for the analysis of metrical structure in Bantu languages, a language family which has hitherto received less attention in metrical theory than many others. No recourse was made in the studies of these Tanzanian languages to novel sorts of metrical constituents or rules. Familiar tools of metrical theory, such as binary feet and Stress Erasure, were adequate for the task.

This is a pleasant result. The fact that current metrical theory extends naturally and insightfully to new domains lends confidence to the enterprise, and encourages research into other sorts of metrical dependencies in tone assignment, and in phonology in general.

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