

How To Study a Tone Language, with exemplification from Oku (Grassfields Bantu, Cameroon)

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In response to requests I have often got as to how one approaches a tone language, I present a personal view of the three stages involved, starting from scratch and arriving at an analysis: Stage I: Determining the tonal contrasts and their approximate phonetic allotones. Stage II: Discovering any tonal alternations (“morphotonemics”). Stage III: establishing the tonal analysis itself. While most emphasis in the literature concerns this last stage, I show how the analysis crucially depends on the first two. A detailed illustration is presented from Oku, a Grassfields Bantu language spoken in Cameroon on which I personally worked in the field. The paper concludes with discussion of issues arising in other tone languages, illustrated by Corejuage (Tukanoan, Colombia), Peñoles Mixtec (Otomanguean, Mexico), Villa Alta Yatzachi Zapotec (Otomanguean, Mexico), Luganda (Bantu, Uganda), Hakha Lai (Tibeto-Burman, Myanmar and Northeast India), and Haya (Bantu, Tanzania).

1. INTRODUCTION. On numerous occasions I have been asked, “How does one study a tone language?” Or: “How can I tell if my language is tonal?” Even seasoned field researchers, upon confronting their first tone system, have asked me: “How do I figure out the number of tones I have?” When it comes to tone, colleagues and students alike often forget everything they’ve learned about discovering the phonology of a language and assume that tone is somehow different, that it requires different techniques or expertise. Some of this may derive from an incomplete understanding of what it means to be a tone system. Prior knowledge of possible tonal inventories, tone rules, and tone-grammar interfaces would definitely be helpful to a field researcher who has to decipher a tone system. However, despite such recurrent encounters, general works on tone seem not to answer these questions—specifically, they rarely tell you how to start and how to discover. I sometimes respond to the last question, “How do I figure out the number of tones I have?”, by asking in return, “Well, how would you figure out the number of vowels you have?” Hopefully the answer would be something like: “I would get a word list, starting with nouns, listen carefully, transcribe as much detail as I can, and then organize the materials to see if I have been consistent.” (I will put off until §5 commentary concerning the use of speech software as an aid in linguistic discovery.) Although I don’t think the elicitation techniques that one applies in studying segmental vs. tonal phonology are really very different, what is needed is a general discussion and illustration of how tonologists go about their work from beginning to end. My goal here is to share my personal experience with tonal elicitation in hopes that it will be useful to field researchers and students who are lucky enough to face an unknown tone system. I will not claim that every tonologist adopts the same strategies as I do, some of which I learned directly or indirectly from my teacher, Wm. E. Welmers, but I believe that most Africanists do.

Logically, there are three separate tasks that one must take up in studying a tone system from scratch. Since these are necessarily ordered, with each one feeding into the next, I will refer to the three tasks as stages:

- (i) In Stage I the goal is to determine the surface tonal contrasts and their approximate phonetic allotones. This is first done by considering words in isolation.
- (ii) In Stage II the goal is to discover any tonal alternations (“morphotonemics”) which may exist in the language. This can be done either by putting words together to make short phrases or by eliciting paradigms.
- (iii) Stage III comprises the tonal analysis itself, the interpretation of what has been discovered in Stages I and II. At this point one typically draws on theoretical constructs and formal devices, e.g. autosegmental notation, to help express one’s insights as to how the tone system works.

Most works on tone are concerned with Stage III, which necessarily presupposes the first two: One cannot possibly analyze a tone system without understanding the surface contrasts and any occurring tonal alternations. Stage II is of course only relevant if the language has tonal alternations either word-internally or at the phrase level. While my impression is that most tone systems do have at least some morphotonemics, there are some languages like Tangkhul Naga, where a H(igh), M(id), or L(ow) tone just sits on its syllable and neither changes nor has any effect on other tones.

The above division into stages is of course highly simplified but is extremely important to distinguish. Pike (1948), for example, likes to emphasize discovering the (underlying) tonal properties of morphemes by establishing a “frame”, i.e. an utterance context in which all of the contrasts are overtly realized. For nouns this frame might be the word in isolation, or it might be as direct object following a L tone negative verb. But how does one discover such a frame? The answer is by going through stages I and II. Crucially, one should not pre-judge what the frame might be, as it varies from language to language. A special warning to phoneticians: “Say X again” is not guaranteed to be a neutral context either for the phonology or the phonetics

In the following sections I will discuss and provide illustrations for each of the three stages. For this purpose I have chosen to focus on Oku, a Grassfields Bantu language of the Ring subgroup on which I was able to do fieldwork in Cameroon in 1977,¹ although other languages will be mentioned, particularly in the appendix. In §2-4 I describe each of the three stages mentioned, followed by additional considerations in §5. The appendix consists of some brief mention of differences that can obtain between citation forms and forms in context.

¹ Subsequent unpublished work on Oku includes Blood & Davis (1999), Davis (1992, 1997), Mbibeh (1996), and Nforbi (1993). In this work I have generally left my transcriptions as originally taken down, pre-phonemically, as my interest was tone. Perhaps in a revised version of the paper I will phonemicize the vowels, e.g. the predictable variation between [e] and schwa on grammatical morphemes.

2. STAGE I: ESTABLISHING THE SURFACE CONTRASTS. In this section we discuss how to start. As mentioned in §1, the logical starting point is to get a list of words, just as one would do with a language not suspected of having tone. Since nouns are easiest to elicit in isolation, often without morphological complexities, this is how most researchers I know begin. (I have heard of field methods courses which begin by asking the speaker to count from one to ten. Since this is not practical in the Amazon, where numerical systems are more limited, and since numbers may get complex rather quickly, I recommend starting with nouns.) A basic word list, e.g. the Swadish 100 or something tailored to the specific linguistic area can be used. As in any field situation, in the early stages one exploits phonetic, e.g. IPA, notation to mark very fine detail, gradually working out the surface contrasts and a practical orthography. Ideally one would transcribe any pitch distinctions at the same time one is discovering the consonants and vowels vs. putting off the transcription of pitch until later.

So far so good, but three questions immediately arise: First, how does one recognize the different relative pitches? Second, how does one transcribe pitch? Third, what does one transcribe pitch on—vowels? syllables? The first issue has to do with the fact that pitch is relative: one therefore cannot expect to identify a particular pitch value as H, M or L. In addition, what may ultimately be analyzed as a level tone may in fact be realized as a contour, as when Ls so frequently “downglide” before pause (and hence on final syllables in citation forms). In approaching a completely unknown language, one does not know in advance which pitches will be analyzed as which tones, or even if the pitches correspond to tones or are realizations of stress or intonation. As Mark Donohue warns his students, “One does not hear tones, one hears pitches.” Therefore, what is needed is a neutral system for marking relative pitch—but on what? Although we have the convenient term *tone-bearing unit* (TBU), establishing whether the TBU is the mora, the syllable, or some subset of sonorant segments is typically a matter of analysis, not transcription. Since these early transcriptions will be subject to considerable reconsideration, one might initially adopt a strategy of marking a pitch on every vowel, and possibly, on every syllabic sonorant consonant. Although the IPA has made some suggestions, there is no universally accepted phonetic transcription for pitch. We do not know in advance how many contrastive pitch heights there will be, but we do know that the upper limit is five (Maddieson 1978). What is needed, therefore, is a continuous scale on which up to five tone heights and their combinations as tonal contours can be identified. A first possibility, following Chao (1930), is to use integers, e.g. 1-5, where a^5 = the highest pitch and a^1 = the lowest pitch, as in the following examples:

(1) a. Five levels: Kam (Shidong) [China] (Edmondson and Gregerson 1992)

ta^1	ta^2	ta^3	ta^4	ta^5
‘thorn’	‘eggplant’	‘father’	‘step over’	‘cut down’

b. Four level + five contour tones in Itunyoso Trique [Mexico] (Dicario 2008)

<i>Level</i>		<i>Falling</i>		<i>Rising</i>	
$\beta\beta e^4$	‘hair’	li^{43}	‘small’	$y\tilde{a}h^{45}$	‘wax’
nne^3	‘plough (n.)’	nne^{32}	‘water’	yah^{13}	‘dust’
nne^2	‘to tell lie’	nne^{31}	‘meat’		
nne^1	‘naked’				

Chao’s system, and the practice still used to describe tones in Chinese dialects, is to always use at least two integers, the first indicating the starting point, the second (or last) indicating the end point. Although rarely applied to languages outside East and Southeast Asia, this system would annotate the Trique level tone words in (1b) as $\beta\beta e^{44}$, nne^{33} , nne^{22} , and nne^{11} . If the tone is more complex (falling-rising or rising-falling), three integers would be used, e.g. ma^{214} , ma^{353} .

The IPA has proposed the equivalent system in (2a) where the five pitch levels are indicated along a vertical bar:

- (2) a. $\{a [\downarrow]$ $\{a [\downarrow]$ $\{a [\uparrow]$ $\{a [\uparrow]$ $\{a [\uparrow]$
 b. $\{a [_]$ $\{a [_]$ $\{a [_]$ $\{a [_]$ $\{a [_]$

I sometimes use the equally iconic system in (2b), which allows also for indications such as $[\downarrow]$ for a falling tone and $[\uparrow]$ for a rising tone. One also could use arrows ($\downarrow \uparrow \nearrow \searrow$) or any other system which allows the transcriber to know exactly what s/he meant. Thus, to summarize, we have any or all of the options in (3).

- (3) a. Integers, e.g. 1-5, where 5 = the highest pitch and 1 = the lowest pitch
 b. Drawings, e.g. $[_]$ = high pitch, $[_]$ = low pitch, $[\downarrow]$ = falling pitch, $[\uparrow]$ = rising pitch
 c. Arrows, e.g. $[\uparrow]$ = go up, $[\downarrow]$ = go down

Although I will ultimately use the standard accent notation in (4) throughout this work, one need not begin with these, as they represent an analysis, not a phonetic transcription:

- (4) High (H) tone: acute (´) accent HL falling tone: circumflex (ˆ)
 Low (L) tone: grave (˘) accent LH rising tone: hatchek (ˇ)
 Mid (M) tone: macron (¯)

If there is a need to transcribe other contours, the above accents can be combined, e.g. a rising-falling (LHL) or falling-rising (HLH) could be transcribed ($\overset{\sim}{\underset{\sim}{\uparrow}}$) and ($\overset{\sim}{\downarrow}$), respectively. The same downstep (\downarrow) and upstep (\uparrow) arrows can also be used to indicate that a specific tone has been slightly lowered or raised.

2.1. OKU NOUN CITATION FORMS. So, let's begin. Here are the first five nouns that I elicited in Oku, as I transcribed them in Bamenda, Cameroon, in 1977:

(5)	a.	'animal'	nâm	HL	pl.	nâmsē
	b.	'ant (sp.)'	fēmbá	M-H	pl.	m̄búa
	c.	'arm'	ēbkóì	M-HL	pl.	tākóì
	d.	'ashes'	kə̀b̄̀l	M-HL	pl.	ḕb̄̀l
	e.	'axe'	njàm°	L°	pl.	njàmsó

Some comments on (5), column by column:

(i) As can be seen, I began with a list of nouns, organized alphabetically. (I used this same list for all of the languages of the Ring subgroup of Grassfields Bantu which I investigated.) The first problem I encountered with the list was that Oku did not have a generic word for 'ant'. The form in (5b) describes a type which is found in trees and stings.

(ii) As seen, I transcribed three tone heights, H, M, and L. In addition, the H and L combined to form a HL contour tone. In (5a) and (5d) I wrote this with ^ written over the one short vowel. Since I had written a vowel sequence in (5c), I wrote it as a large ^ covering both vowels (but have reproduced it here as a ´+` sequence). (5e) seemed monosyllabic to me, so I did not write a tone over the initial nasal. I did however encode that the stem tone seemed a rather low tone, but one whose pitch was level, not falling (as low tones frequently are, especially before pause). I transcribed the level L tone with (°), which I have referred to as an "unreleased L tone", one which does not exhibit the typical "downgliding" before pause.²

(iii) Although not all languages have a plural, or an interesting plural that varies with the noun, I have long been accustomed to eliciting both since this not only makes a nice sg./pl. record for each entry, but is also sometimes helpful for other reasons, e.g. in figuring out the segments or tones by comparing the singular and plural. (It also makes the phonetic transcription less tedious in the sense that one can peek ahead to what's coming up in the morphology.) In the above examples, we see that (5a) and (5e) add a suffix sə to form a plural, with some tonal interest: In (5a) the noun root is H and the suffix is M; in (5e) the root is L and the suffix is H. On the other hand, (5b-d) form their plurals with a different prefix and no change in tone. One last observation: I wrote *m̄búa* for the plural in (5b), by which I meant a M-H sequence. Here I arbitrarily decided that it wasn't necessary to repeat the acute accent on the second vowel of the root, i.e. *m̄búá*. This is fine as long as one knows how to interpret the lack of an accent on a vowel or other tone-bearing unit.

²As in common practice in African linguistics, I used c and j to denote the affricates [tʃ] and [dʒ]. The IPA symbol [ɺ] in (5d) stands for a bilabial trill, which I originally transcribed as f with a dot under it.

The transcriptions in (5) are, of course, only a first attempt, and we do not know if the categorical interpretations will hold up against further data. For example, although the HL falling tones appeared to fall to a lower pitch than the level L° tone of *njàm*° ‘axe’, we don’t know if the different end points are due to the difference between a falling tone and a L tone, or whether we will have to distinguish between level and falling L tones. In other words, is ‘axe’ just a L tone, or is it a special kind of L tone?

Here are the next five nouns which I elicited:

- | | | | | | | |
|-----|----|----------|------------|--------|-----|--------------|
| (6) | a. | ‘back’ | jìm° ~ jím | L° ~ H | pl. | jímsá |
| | b. | ‘bag’ | kēbām | M-HL | pl. | ēbbúàm |
| | c. | ‘bamboo’ | ēbléj | M-H | pl. | iléj ~ tǎléj |
| | d. | ‘basket’ | kà | L | pl. | kàsè° |
| | e. | ‘bean’ | íkón | M-H | pl. | ēkón ~ tǎkón |

If we look first just at the singulars, we see that (6b) has the same M-HL and (6c,e) the same M-H sequences observed in (5). The noun ‘back’ has two variants, L° and H, while the other monosyllabic noun, *kà* ‘basket’, presents the only new tone, a falling L pitch, which I transcribed with the grave accent. At this point it would be natural to ask the speaker to pronounce the three monosyllabic nouns in sequence so as to compare their pitches and see if there really is a difference. (Since ‘back’ has a H alternate, one could just compare *njàm*° ‘axe’ and *kà* ‘basket’.) When asking a speaker to say one word first, and then the next, it is important to make sure that s/he does not add any intonational “list” or other intonation, as one might do with a rising tone if comparing one word with another in English: “axe... basket”. That is, one has to get the speaker used to the idea of saying the words in sequence as if each one were an utterance in itself.

By so doing, we determine that there is a phonetic difference between *njàm*° and *kà*. However, there also is a segmental or syllable-structure difference: Are they really two different contrastive “tones”, or are they both just L tones which are realized in a predictably different way: level L° on a CVC syllable vs. falling (or downgliding) L on a CV syllable? If we look at the plurals (which mostly show a number of different prefix changes), we observe that the plural of ‘basket’ is *kàsè*°, i.e. with ending with a level L°. Remember that our first goal is to establish the surface tonal contrasts. We still have two hypotheses to pursue in establishing whether the two types of L tone are contrastive:

- (i) There is one L tone which is pronounced as falling on a CV word, but level on a CVC or CVCV word.
- (ii) There are two different L tones, L and L°, which are contrastive, i.e. which can potentially occur on the same kinds of syllables and words.

Of course one of two things could quickly resolve the issue in either direction. First, the speaker be asked if it’s OK to pronounce *kà* as *kà*° or *njàm*° as *njàm*. If s/he finds them both successful, or if s/he responds by asking, “What’s the difference?” we can hypothesize that L° and L are free variants of the same tone. On the other hand, if the speaker volun-

teers that *kà°* and *njàm* mean something different from *kà* and *njàm°*, we would need to conclude that *L°* and *L* are not equivalent “allotones”. Linguists have long been trained to look for such minimal pairs. However, minimal pairs are a luxury. In the descriptions of tone systems one often reads statements to the effect that tone is contrastive, but that “there are few minimal tone pairs.” In other systems tonal pairs, triplets and even quintuplets can be produced as in Kam (Shidong) in (1a).

It will take some time to resolve the question (see below). In the meantime, here are the next ten nouns which were elicited:

(7)	a.	‘bed’	ēbkón	M-H	pl.	m̄kón
	b.	‘bee’	yúo(lé)	H(-H)	pl.	yúo(lé)sé
	c.	‘beehive’	m̄ŋwák	M-H	pl.	tēŋwák
	d.	‘behind’	ībám	M-H	pl.	---
	e.	‘belly’	ēblê	M-HL	pl.	m̄lê
	f.	‘belt’	kēkói	M-HL	pl.	ēbkói
	g.	‘bird’	f̄nón	M-H	pl.	m̄nón
	h.	‘blood’	m̄dúnj	M-H	pl.	---
	i.	‘body’	ēβwún	M-H	pl.	t̄wún
	j.	‘bone’	kēvóf	M-H	pl.	ēnvóf

At this point we haven’t obtained any new tone patterns. Except for ‘bee’ in (7b), which has a H tone (or H-H if the optional [lé] is also pronounced), all of the bisyllabic nouns have either M-H or M-HL tone. On the other hand, the monosyllabic nouns, which are fewer, have either H, HL, L or L° tone (the contrastiveness between the last two not yet fully established). Even though we have only twenty nouns (with 18 plurals), there seems to be some repetitiveness, which is good, since we can now test to see if we have been consistent.

To do a consistency test we arrange the data to check that we have always written the same sound the same way and different sounds in different ways. The above data, for example, raise a number of segmental questions. Concerning differences, we have for example written the root vowel of the nouns in (7g) vs. (7i) differently: [f̄nón] vs. [ēβwún]. Is there really a difference between [ɔ̄] and [u] in a CVn syllable? Similarly, we have transcribed CV prefixes sometimes with [e], sometimes with schwa, [ke] vs. [kə], [fe] vs. [fə], [te] vs. [tə], and similarly concerning the plural suffix [se] vs. [sə]. A further question is whether we have heard right in transcribing the differences between [ēb] in (7a), [ēb] in (7e), [ēβ] in (7i) and [ēv] in the plural of (7j). If so, can we freely substitute one for the other? These are common questions that one asks in doing phonological analysis, and so we must do likewise for the tone.

While the above questions address the issue of whether we have overdifferentiated, i.e. whether we have transcribed differences that are not contrastive, the reverse question is whether we have written different sounds the same way: It is rather striking that we have M tone prefixes, but no M tones on roots other than the HM in the plural form [jím̄só] ‘backs’ in (6a). Maybe some of the M prefixes are really H, or some of the HL falling tones are really ML. To best way to check this is to arrange all of the like-toned words in a list and have the speaker read them one after one, as in (8), where I placed only plurals whose tones are different from their singular:

(8)	M-H	M-HL	H-H	L-H	H	HL	L°	L
	fěmbá	ēbkóì	yúosé	njàmsó	jím	ɲâm	ɲàm°	kà
	ēbléɲ	kə̀bəl			yúo		jím°	
	íkón	kēbām	H-M	L-L°				
	ēbkón	ēblê	ɲámsē	kàsè°				
	m̄ɲwák	kēkóì						
	ìbám		HM-H					
	fə̀nón		jím̄só					
	m̄dúɲ							
	ēβwún							
	kēvóf							

The procedure is to have the speaker pronounce the words with each tonal pattern separately. If something is transcribed wrong from the others, it hopefully will jump out to the listener, who will then correct the transcription. Although I have not included any such “mistakes”, let me just say that they are not infrequent, particularly in a three-height tone system where it is often hard to tell the difference between L-H, L-M and M-H sequences, all of which involve a lower tone followed by a higher one.

Let us assume that we have checked all of the patterns and that there are no corrections to be made. As seen in (8), the tone patterns are largely skewed towards M-H and M-HL. Assuming that this would hold up with further elicitation of nouns, we don’t know if this is because these are noun-specific tone patterns, or if these patterns are also prevalent in verb and other forms. All we can do at this point is consider the distributional properties of tones on syllables and words in isolation. On single syllables we have lots of examples of H, M, and HL tones, fewer HM, L and L° tones and no cases of MH, ML, LH or LM. Monosyllabic words can be H, HL, L° or L, while bisyllabic words thus far can be M-H, M-HL, H-H, H-M, HM-H, L-H and L-L°. Let’s add another 20 nouns and their plurals to the database:

(9)	a.	‘bow’	inôn	M-HL	pl.	tênôn
	b.	‘branch’	ēbtâm	M-HL	pl.	itâm ~ tētâm
	c.	‘breast’	iyîn	M-HL	pl.	ēyîn
	d.	‘bridge’	ēbláà	M-HL	pl.	m̄láà ~ t̄lálà
	e.	‘bundle’	ntōk	ML	pl.	ntōksè°
	f.	‘buttock’	isàs	M-HL	pl.	tāsàs
	g.	‘cadaver’	kəŋkwū̀	L-ML	pl.	əmkwū̀
	h.	‘calabash’	fētēm	M-HL	pl.	m̄tēm
	i.	‘calabash’	ŋgīe	L	pl.	ŋgīesè°
	j.	‘canerat’	njī̀wìl	ML-L	pl.	njī̀wìlsè°
	k.	‘caterpillar (sp.)’	sói	H	pl.	sóisé
	l.	‘cave’	m̄bək	L	pl.	m̄bəksè°
	m.	‘ceiling’	iyúo	M-H	pl.	tēyúo
	n.	‘charcoal’	kéisé	H-H	pl.	---
	o.	‘cheek’	bóbók	H-H	pl.	bóbóksé
	p.	‘chest’	kəŋkəŋè̀	L-L-L-L	pl.	m̄kəŋè̀
	q.	‘chief’	ēffōn	M-HL	pl.	tōffōn
	r.	‘chief’s palace’	ntōk	ML	pl.	ntōksè°
	s.	‘child’	wān	M	pl.	yón
	t.	‘clay, mud’	kēcák	M-H	pl.	ēbcák

A number of new elements appear in (9). First, there are monosyllabic nouns of the shape M (9s) and ML (9e,r), the latter appearing for the first time. Second, ML occurs not only in monosyllables but bisyllables of the shape L-ML (9g) and ML-L (9j). Third, while we had had a potential trisyllabic noun in the plural of (7b), there now two more trisyllabic plurals (9j,o) and one noun which is quadrisyllabic in both the singular and plural (9p). Finally, more examples of the L and H monosyllabic patterns are found.

With the expanding number of tone patterns, the main question to ask is whether all logical combinations of tones occur in Oku. To make sure that nothing is overlooked, I like to make tables such as in (10) where I plot the tones of bisyllabic forms to see how many of each combination is found in the (thus far admittedly small) corpus. This not only reveals what is attested vs. unattested, but also points to patterns which are so slightly attested that they may even be considered exceptional (perhaps limited to a specific construction or to borrowings). The first tone is indicated in the first column, the second tone on the top row:

(10)

	H	HM	HL	M	ML	L°	L	<i>Monosyllabic</i>
H	3			1				3
HM	1							
HL								1
M	12		12					1
ML							1	2
L°								2
L	1				1	1		3

While all seven tones are realized on monosyllabic nouns except HM, bisyllabic nouns are significantly restricted: Of the 33 entries, 27 of them are H-H, M-H or M-HL. In addition to the poorly attested patterns with one example each, a number of logical combinations are not attested, e.g. H-HM, HL-H, M-L. The question is whether the above distributions and non-attestations are systematic, for example, why do so few bisyllabic nouns end L (or L°)? For this we would need to collect more nouns and expand to other parts of speech. Let us see what verbs look like in their citation form.³

2.2. OKU VERB CITATION FORMS. Verbs often present more complexity than nouns in general and with respect to tone. Some languages do not have a citation form of the verb, in which case the speaker may offer a relatively bare form that turns out to have a zero third person subject in a particular tense or aspect. While many languages have infinitive forms that can readily be elicited, the singular affirmative imperative is another possibility that one might get when asking “How do you say ‘to eat’?” In some cases the said imperative is the bare verb stem, and so this works out well.

In order to catch up rapidly with the nouns we have elicited, (11) presents the first 40 verbs that I obtained from the alphabetic verb list:

(11)

a.	‘accompany’	sējòmtè	L-L	u.	‘blow nose’	sēmìs	L
b.	‘admire, like’	sēyākòŋ	M-HL	v.	‘break, snap’	sēkòl	L
c.	‘answer’	sēbēmê	M-HL	w.	‘break wind’	sēfìès	L

³As was indicated, we started with nouns because they are typically easier to elicit in isolation than other parts of speech. Since nouns can appear as full utterances in many languages, it is quite natural to ask the speaker, “How do you say ‘animal’?” This will be especially true in languages which do not require an article or other determiner to appear with a noun. However, there are exceptions. Some languages require that one choose a form of the noun which is inflected for case or utterance function (e.g. focused), which can be tonal. It will be only later that one discovers that the noun list really consists of items such as ‘it’s an animal’, or that the nouns have been pronounced as they would only appear in utterance-final position.

yìtè ‘to begin’, we can establish the likelihood that L° and L are contrastive, i.e. we cannot predict the difference between the two on the basis of syllable structure or anything else.⁴

We have thus established that most monosyllabic verbs have a ML tone in the infinitive, a pattern which was rare on noun stems. The same can be said about L and L-L, which were in the minority in nouns. Clearly there is a skewing between nouns and at least infinitive verb tones. To figure out what this is requires analysis. For this purpose let us move on to Stage II, whereby we attempt to determine how tones affect each other when they are combined in context.

3. STAGE II: DISCOVERING TONAL ALTERNATIONS. Now that we have established the surface contrasts we move on to consider how the different tones behave in context. If tones undergo changes when they combine with each other, we want to know what these “alternations” are. We also want to be sure that all forms which we have identified with the same tone alternate in the same way. Below we will discover, for instance, that there are two kinds of M-H nouns as well as two kinds of M-HL nouns.

As was mentioned in §1, there are two places to look for tonal alternations: within the word and across words. For the first context one has to study the morphology, particularly paradigmatic relations between words. It is typically in the verb paradigm that one finds the most “morphotonemics”: Verb tones are frequently conditioned in part or in whole by inflection features such as tense, aspect, mood and negation. In some languages the tone changes according to the person or number of the subject, while in others transitive vs. intransitive contrasts can be tonally marked. Since verbs can become extremely complicated, we will instead first focus on singular-plural pairs in nouns. After this we will turn to modifiers and ‘noun of noun’ genitive constructions to investigate tonal alternations at the phrase level.

3.1. WORD-LEVEL ALTERNATIONS. Nouns which take their plural by adding the suffix *se* show significant tonal alternations. The patterns we have seen thus far are summarized in (13a-g).

(13)	<i>singular</i>		+ <i>plural -sə</i>	<i>example</i>			#
a.	L	→	L-L°	kà	kà-sè°	‘basket(s)’	15
b.	ML	→	M-L°	ntòk	ntòk-sè°	‘bundle(s)’	11
c.	L°	→	L-H	njàm°	njàm-sé	‘axe(s)’	5
d.	H	→	H-H	sói	sói-sé	‘caterpillar(s)’	7
e.	H-H	→	H-H-H	bóbók	bóbók-sé	‘cheek(s)’	2
f.	HL	→	H-M	nyâm	nyâm-sē	‘animal(s)’	11
g.	L° ~ H	→	HM-H	jìm° ~ jím	jím-sē	‘back(s)’	1
h.	M	→	M-H				4
i.	M	→	H-H				3

⁴ We will see that the difference between L° and L also cannot be attributed to nouns vs. verbs.

In the last column I have indicated how many such examples there are from a corpus of 225 nouns. It turns out that the two patterns in (13h,i) did not turn up in the elicitation of the first 40 nouns. Setting aside (13e), where the singular is bisyllabic, and (13g) of which there is only one example, there are seven common patterns, illustrated in (14).

- (14) a. L → L-L°
- | | | | | | |
|-------|-----------|--------------------|-------|-----------|-------------------|
| kà | kà-sə° | ‘basket(s)’ | ntɔ̀n | ntɔ̀n-sə° | ‘pot(s)’ |
| ŋgìɛ | ŋgìɛ-sə° | ‘calabash(es)’ | ndɔ̀n | ndɔ̀n-sə° | ‘potato’ |
| mɓə̀k | mɓə̀k-sə° | ‘cave(s)’ | bìŋ | bìŋ-sə° | ‘rainy season(s)’ |
| mbàk | mbàk-sə° | ‘cloud(s)’ | ŋjìɛ | ŋjìɛ-sə° | ‘sheep’ |
| lòm | lòm-sə° | ‘dry season(s)’ | ŋjàŋ | ŋjàŋ-sə° | ‘song(s)’ |
| mbòŋ | mbòŋ-sə° | ‘bushcow(s)’ | ŋgɔ̀k | ŋgɔ̀k-sə° | ‘stone(s)’ |
| mbàn | mbàn-sə° | ‘fence’ | wàk | wàk-sə° | ‘youth(s)’ |
| bòŋ | bòŋ-sə° | ‘marrow, brain(s)’ | | | |
- b. L° → L-H
- | | | | | | |
|-------|---------|-------------|-------|---------|--------------|
| ŋjàm° | ŋjàm-sé | ‘axe(s)’ | ŋkfù° | ŋkfù-sé | ‘rope(s)’ |
| bàì° | bàì-sé | ‘father(s)’ | ntèk° | ntèk-sé | ‘village(s)’ |
| ŋjà° | ŋjà-sé | ‘flesh(es)’ | | | |
- c. M → M-H
- | | | | | | |
|-------|----------|------------|-------|----------|--------------|
| ndə̀í | ndə̀i-sé | ‘cloth(s)’ | nthāk | nthāk-sé | ‘night(s)’ |
| ŋjɔ̀ŋ | ŋjɔ̀ŋ-sé | ‘moon(s)’ | ŋgɔ̀k | ŋgɔ̀k-sé | ‘termite(s)’ |
- d. M → H-H
- | | | | | | |
|------|---------|---------------------|-----|--------|-------------|
| sə̀ə | sə̀ə-sé | ‘fish’ | kān | kān-sé | ‘monkey(s)’ |
| kfən | kfən-sé | ‘hill, mountain(s)’ | | | |
- e. H → H-H
- | | | | | | |
|------|---------|------------------|------|---------|----------------|
| yúo | yúo-sé | ‘bee(s)’ | má | má-sé | ‘lake(s)’ |
| sói | sói-sé | ‘caterpillar(s)’ | gváì | gváì-sé | ‘maggot(s)’ |
| ŋkáŋ | ŋkáŋ-sé | ‘cornbeer(s)’ | ŋjáŋ | ŋjáŋ-sé | ‘xylophone(s)’ |
| jíŋ | jíŋ-sé | ‘hunger(s)’ | | | |

f.	ML	→	M-L°							
	ntōk		ntōk-sè°		‘bundle(s)’		ndōŋ		ndōŋ-sè°	‘horn(s)’
	ŋgvō		ŋgvō-sè°		‘chicken(s)’		ndā		ndā-sè°	‘house(s)’
	ntōk		ntōk-sè°		‘chief’s palace(s)’		ntūm		ntūm-sè°	‘message(s)’
	ntōm		ntōm-sè°		‘cooking stone(s)’		njōŋ		njōŋ-sè°	‘thorn(s)’
	ŋkāk		ŋkāk-sè°		‘crack(s)’		ŋgēk		ŋgēk-sè°	‘trouble(s)’
	ntīè		ntīè-sè°		‘ground(s)’					
g.	HL	→	H-M							
	nyām		nyām-sē		‘animal(s)’		fē		fē-sē	‘bush rat(s)’
	gîè		gîè-sē		‘bundle(s)’		gwúò		gwúò-sē	‘skin(s)’
	búò		búò-sē		‘dog(s)’		yúò		yúò-sē	‘snake(s)’
	bái		bái-sē		‘goat(s)’		cúì		cúì-sē	‘sun’
	nôŋ		nôŋ-sē		‘hair(s)’		gîè		gîè-sē	‘voice(s)’
	fê		fê-sē		‘hoe(s)’					

From the above we note the following concerning the tone of the plural suffix *-se*: (i) The tone can be H, M or L°. (ii) L° occurs only after a L or ML root. (iii) M occurs only after a HL root. (iv) H occurs after L°, M and H roots. It should also be noted that the first tone in (14a,b) is a level L tone, not a falling L, which contrasts with L° only before pause.

As in segmental phonology, when faced with alternations, one has to consider several alternatives. The first question is whether one should try to set up a single underlying form from which the surface allomorphs can be derived, or whether to assume allomorphy, e.g. assign *-se* with the L°, M or H tone allomorphs as per the preceding paragraph. Since these suffix alternants are so similar, differing only in tone, let us assume that we want to derive the three surface allomorphs from one underlying tonal representation. This naturally brings us to the question of what that tone should be: Should it be one of the three surface realizations (L°, M, H), or are these three tones all derived from a fourth, perhaps more abstract tonal representation?

If one considers the contexts in which these allomorphs are realized, it would appear that there is an assimilatory process at work: Level L tone *-sè°* is found only after L or ML, i.e. only when the stem ends L. On the other hand, H *-sé* is found in three contexts: after L°, M and H. (I will address M tone *-sē* momentarily.) If we started with the suffix having an underlying L tone of some sort, we would have to dissimilate */-sè°/* to H tone after another L°. While not unheard of, the reverse analysis, */-sé/* seems more plausible on two counts: First, the change of /H/ to L° after L° would be a case of assimilation, which is of course more common than dissimilation. Second, the disparate environments in which surface *-sé* is found, namely after (input) L°, M or H, suggests that it is the “elsewhere” case, i.e. the realization of the surface when not modified by context. As-

suming that this is correct, we can now consider the following tentative and informal rules, which will be modified in §4:⁵

- (15) a. H → L° / L ___ e.g. /njàm-sé/ → njàm-sè° ‘axes’
 / ML ___ e.g. /ndõŋ-sé/ → ndõŋ-sè° ‘horns’
 b. H → M / HL ___ e.g. /ɲâm-sé/ → ɲám-sē ‘animals’

The natural question to ask is why /-sé/ is realized sometimes L°, sometimes M, i.e. why isn’t the output in (15a) L-M, or, alternatively, why isn’t the output of (15b) H-L°? The latter, of course, cannot occur on nouns with a prefix (which can only be M or L), but this does not explain why it cannot occur on nouns which form their plural with the suffix /-sé/. Even the following exceptional patterns which each have one attestation in my corpus do not produce such an output:

- (16) a. LH → LH-H ncí ncísé ‘chief’s house(s)’
 b. H → H-M jém jémsē ‘dream(s)’
 c. HM → HM-H jí̄ jí̄ sé ‘path(s)’
 d. L-L → L-L-L° ndàakè ndàakè̀sè° ‘tobacco(s)’
 e. L° ~ H → H-H jìm ~ jím jí̄msé ‘back(s)’
 f. M-H → M-H-H ŋgōomé ŋgōomésé ‘locust(s)’
 g. H-H → H-H-H bóbók bóbóksé ‘cheek(s)’

In addition to the example in (16g) we can recall *yúolé* ‘bee’ (pl. *yúolésé*), also H-H, an alternate to the shorter form *yúo* (pl. *yúosé*). It is likely that *kéisé* ‘charcoal’ is an invariant plural.

Within my corpus of 225 singular nouns, only one has H-L° tone, *bílèŋ*° ‘groundnut’. Even more intriguing is the fact that singular nouns can be L-L° or L-ML, but not L-M: there is not a single example of the latter in my corpus of 225 nouns. We will account for this in §4, but first we need to consider alternations which occur at the phrase level.

3.2. PHRASE-LEVEL ALTERNATIONS. In many Niger-Congo languages interesting tonal alternations take place at the phrase level. Once one has collected and verified the tones of a reasonable number of nouns, it is customary to put them together with various modifiers and in different contexts within the sentence. The way to approach this is to first determine the range of tonal patterns on nouns in isolation, and then systematically combine every logical tonal sequence. In order to do this we need a bigger corpus than the 40 nouns we

⁵ Note that the HL of /ɲâm/ also has to simplify to H before M in (15b).

have considered thus far, particularly as concerns bisyllabic nouns, the majority of which are formed with a prefix + monosyllabic stem. In (17) I list all of the attested patterns with one or two examples of each and indicate in the last column how many nouns have each pattern. (I counted only singular bisyllabic nouns.)

(17)	a.	L-L	kètàm	‘elephant’	kə̀ŋgwì	‘stranger’	6
	b.	L-L°	kə̀ŋgòm°	‘plantain’	kə̀ncès°	‘cricket’	4
	c.	L-ML	kə̀ŋgèi	‘fence’	kə̀ŋkwū̀dò	‘cadaver’	7
	d.	M-H	kḗvóf	‘bone’	fḗnón	‘bird’	60
	e.	M-HL	kḗkòs	‘slave’	kētâm	‘trap’	69
	f.	M-HM	m̄m̄	‘water’			1
	g.	ML-L	nj̄w̄il	‘canerat’			1
	h.	H-L°	bílèŋ°	‘groundnut’			1
	i.	H-H	yúolé	‘bee’	bóbók	‘cheek’	3

For comparability, wherever possible I have given examples with a CV- singular prefix, mostly *ke-*. As seen in the last column, 129 out of 152 (84.9%) of the bisyllabic nouns have either a M-H or M-HL tone pattern. Usually when there is such a skewing, it means one of two things: The first possibility is that two patterns represent the basic underlying system, either directly or indirectly. For instance, perhaps the H and HL roots of M-H and M-HL nouns will ultimately be analyzed as /H/ and /L/, respectively. The second possibility is that one or both patterns represents a neutralization of different underlying forms. This in turn would mean that there were more patterns historically, but they have merged into these two surface patterns.

The way to test these (or perhaps other) hypotheses is to see what happens when representative token of each tone pattern occur in context. One cannot tell in advance what the best “frame” will be for discovering tonal alternations (if they occur) or if there will be more to learn from placing these tokens before vs. after another word. It is sometimes necessary to do both. Logical strategies are to get nouns with their basic modifiers: possessive pronouns, demonstratives, adjectives, numerals. In doing phrasal tonology, I try as much as much possible to start with forms which are framed by consonants. In this case this means nouns which have a CV- prefix and a root shape CVC. After getting the tone patterns with each syllable remaining distinct, one can go on to see what happens with V+V sequences, which potentially coalesce, perhaps producing further tonal complications.

Restricting ourselves first to M-H and M-HL nouns, (18) shows the two nouns followed by various modifiers:

(18)	<i>kēkōs</i>	‘slave’	<i>kēvóf</i>	‘bone’	
a.	<i>kēkōs</i>	<i>əkóm</i>	<i>kēvóf</i>	<i>əkóm</i>	‘my’
	<i>kēkōs</i>	<i>əkíè</i>	<i>kēvóf</i>	<i>əkíè</i>	‘your (sg)’
	<i>kēkōs</i>	<i>əkés</i>	<i>kēvóf</i>	<i>əkés</i>	‘our’ (excl)
	<i>kēkōs</i>	<i>əkén</i>	<i>kēvóf</i>	<i>əkén</i>	‘your (pl)’
b.	<i>kēkōs</i>	<i>ə wīn</i>	<i>kēvóf</i>	<i>ə wīn</i>	‘his/her’
	<i>kēkōs</i>	<i>ə ȳīn</i>	<i>kēvóf</i>	<i>ə ȳīn</i>	‘their’
c.	<i>kēkōs</i>	<i>kìn</i>	<i>kēvóf</i>	<i>kìn</i>	‘this’ (near speaker)
	<i>kēkōs</i>	<i>kì</i>	<i>kēvóf</i>	<i>kì</i>	‘that’ (near hearer)
	<i>kēkōs</i>	<i>kî</i>	<i>kēvóf</i>	<i>kî</i>	‘that’ (far from both)
d.	<i>kēkōs</i>	<i>kəm̀̀k°</i>	<i>kēvóf</i>	<i>kəm̀̀k°</i>	‘one’
e.	<i>kēkōs</i>	<i>kəkē</i>	<i>kēvóf</i>	<i>kəkē</i>	‘which’
f.	<i>kēkōs</i>	<i>kə̀̀gákkéné</i>	<i>kēvóf</i>	<i>kə̀̀gákkéné</i>	‘big’
	<i>kēkōs</i>	<i>kəláitáne</i>	<i>kēvóf</i>	<i>kəláitáne</i>	‘small’
g.	<i>kēkōs</i>	<i>é gwì mīn</i>	<i>kēvóf</i>	<i>é gwì mīn</i>	‘has fallen’

In (18a) we observe that the first and second person possessives begin with a L tone vowel $\dot{e} \sim \dot{\lambda}$.⁶ As seen, the HL of ‘slave’ simplifies to H, thereby merging tonally with the H input of ‘bone’. The two also merge before demonstratives in (18d) and before numerals, ‘which’, and adjectives in (18d-f). (Interestingly, the L of the HL in *kēkōs* has no effect on the following H of *kî* ‘that (far)’ in (18c).)

The remaining forms which show a difference between the two nouns concern the third person possessive pronouns in (18b) and the subject-verb agreement marker in (18g). In both cases the marker is M after *kēkōs* and H after *kēvóf*. The same difference is observed when the two nouns are possessed by a noun in a ‘N₁ of N₂’ genitive construction:

(19)	a.	<i>kēkōs</i>	<i>ə kə̀̀ngwì</i>	‘the slave of the stranger’
	b.	<i>kēvóf</i>	<i>ə kə̀̀ngwì</i>	‘the bone of the stranger’

⁶ Since this vowel drops out obligatorily after a vowel and optionally after a nasal consonant, as seen in below, the two nouns in (18) were chosen for illustration because they end in a fricative.

<i>kēfó</i>	+	<i>əkóm</i>	→	<i>kēfó kóm</i>	‘my medicine’
<i>kēkém</i>	+	<i>əkóm</i>	→	<i>kēkém kóm</i>	‘my crab’

In these cases the L part of the HL tone clearly causes the following H to become M, giving us a rather clear indication that at least some of our M tones come from the lowering of H. Although not shown here, it is important to note that all M-HL nouns have the same tonal properties with respect to the contexts in (18), as do all M-H nouns. We thus cannot yet say which of two hypotheses accounts for the preponderance of these tone patterns, i.e. whether they exhaust the tonal possibilities, perhaps being underlying /L/ and /H/, respectively, or whether they represent the merger of different historical tone patterns.

The question is resolved when we place M-HL and M-H nouns in the N₂ position of the ‘N₁ of N₂’ genitive construction. While one ultimately will want to establish a list of animate nouns which are semantically appropriate as N₂ possessors so that the N₁ of N₂ combinations make sense, one strategy I often use is to put the word ‘place’ in N₁ position, and then ask for ‘the place of ___’, filling in the blank with almost any noun in the corpus. I illustrate some of the results in (20), where H tone *á* (~ *é*) is the genitive marker for most noun classes:

- | | | | | | | |
|---------|-------|-------------|-------|---|--------|--------------------------|
| (20) a. | kēkòs | ‘slave’ | kēlík | á | kèkòs | ‘place of the slave’ |
| | kēták | ‘snail’ | kēlík | á | kèták | ‘place of the snail’ |
| | kēbám | ‘bag’ | kēlík | á | kèbám | ‘place of the bag’ |
| | fēyám | ‘mat’ | kēlík | á | fēyám | ‘place of the mat’ |
| b. | kētám | ‘trap’ | kēlík | á | kètám | ‘place of the trap’ |
| | kēbîn | ‘dance’ | kēlík | á | kèbîn | ‘place of the dance’ |
| | kēbân | ‘fufu’ | kēlík | á | kèbân | ‘place of the fufu’ |
| | fētêm | ‘calabash’ | kēlík | á | fètêm | ‘place of the calabash’ |
| c. | kēvóf | ‘bone’ | kēlík | á | kèvóf | ‘place of the bone’ |
| | kékém | ‘crab’ | kēlík | á | kèkém | ‘place of the crab’ |
| | kéfém | ‘cockroach’ | kēlík | á | kèfém | ‘place of the cockroach’ |
| | kékóf | ‘tick’ | kēlík | á | kèkóf | ‘place of the tick’ |
| d. | kēláj | ‘cocoyam’ | kēlík | á | kèláj° | ‘place of the cocoyam’ |
| | kéfó | ‘medicine’ | kēlík | á | kèfó° | ‘place of the medicine’ |
| | fēnún | ‘bird’ | kēlík | á | fènún° | ‘place of the bird’ |
| | tēvól | ‘feathers’ | kēlík | á | tèvól° | ‘place of the feathers’ |

Two things are rather remarkable in (20). First, the prefix of the N₂ noun is always L. There are no exceptions. Second, the M-HL and M-H nouns each show two different patterns in N₂ position: Specific M-HL nouns are realized as L-L in (20a), while others are realized L-ML in (20b). Similarly, the M-H nouns in (20c) are realized L-M, while those in (20d) are realized LL°. As seen, the four N₂ patterns are phonetically distinct: L-L, L-ML, L-M,

L-L°. Since we cannot predict which of the two possibilities will correspond to the M-HL or M-H isolation tone, we must assume that the differences between the four groups in (20) are contrastive.

I trust the reader will already have ideas how to analyze the nouns in (20). We will however put off an analysis until §4. For now we are content to conclude that the reason why 84.9% of the bisyllabic nouns are either M-HL or M-H in isolation is that these represent four historical patterns. This leaves the question about what to do with the remaining nouns. First, it can be noted that nouns which start with L or M root or a L prefix do not change in N₂ position:

- (21) a. kà ‘basket’ kēlík á kà ‘place of the basket’
 b. ntèk° ‘village’ kēlík á ntèk° ‘place of the village’
 c. ndāi ‘cloth’ kēlík á ndāi ‘place of the bag’
 d. ndōŋ ‘horn’ kēlík á ndōŋ ‘place of the horn’
 e. kètàm ‘elephant’ kēlík á kètàm ‘place of the elephant’
 f. kèŋgēi ‘fence’ kēlík á kèŋgēi ‘place of the fence’

On the other hand, the root H of a prefixless noun becomes M:

- (22) a. γón ‘children’ kēlík á γón ‘place of the children’
 b. búò ‘dog’ kēlík á bŭò ‘place of the dog’
 c. jí ‘road’ kēlík á jī ‘place of the road’
but: d. ŋkáj ‘cornbeer’ kēlík á ŋkáj ‘place of the cornbeer’

The noun in (22d) is an exception, and I suspect *ŋjáj* ‘xylophone’ may also be (cf. §4).

The data in (23) show how some of the longer forms are affected:

- (23) a. kēyékálí ‘cowry’ kēlík á kēyékálí ‘place of the cowry’
 b. kētóólé ‘ear’ kēlík á kètóólé ‘place of the ear’
 c. ēblómìn ‘man’ kēlík á blómìn ‘place of the man’
 d. búosē ‘dogs’ kēlík á bŭosē° ‘place of the dogs’
 e. kánsé ‘monkeys’ kēlík á kánsé ‘place of the monkeys’
but: f. ŋkájnsé ‘cornbeers’ kēlík á ŋkájnsé ‘place of the cornbeers’

In (23a,b) we see the lowering of *kē-* to *kè-*. The same occurs in (23c), where the prefix fuses with the genitive marker. In all three examples the root-initial H tone becomes M after the L N₂ prefix. In the case of ‘ear’ the HM of the root becomes ML; when the genitive *á* fuses with *èblōmìn*, the L of the prefix is not realized (see §4). In the plural forms in (23d,e) the H of the root lowers to M, and the H-M of ‘dogs’ is realized M-L°, i.e. with both tones being lowered. Again we see in (23f) that ‘cornbeers’ is exceptional, just as it was in the singular in (22d).

Finally, one last context we will consider is the realization of nouns after the prepositions *nà* ‘with’ and *sà* ‘to’:

(24)	a.	<i>kēkôs</i>	‘slave’	<i>nà kèkôs è°</i>	<i>sà kèkôs è°</i>
	b.	<i>kētām</i>	‘trap’	<i>nà kètām ē</i>	<i>sà kètām ē</i>
	c.	<i>kēvóf</i>	‘bone’	<i>nà kèvóf é</i>	<i>sà kèvóf é</i>
	d.	<i>kēláj</i>	‘cocoyam’	<i>nà kèláj é</i>	<i>sà kèláj é</i>

The nouns in (24) represent the four tone groups distinguished in (21). Most noun classes in Oku require an /*é*/ marker to follow the noun in a prepositional phrase. This marker shows the same L°, M, and H variations as the /-*sé*/ plural suffix and is hence appropriately recognized as underlyingly H. Interestingly, the two M-HL tone classes show different effects on the /*é*/ marker, which becomes L° in (24a), but M in (24b). While the prefixes have become L, the following H tones do not lower to M. Unlike the L of the prefixes in N₂ position, which is morphologically assigned early enough to lower H tone to M, the L of the prefixes in (24) is a result of a later assimilation to the (M)L of the preposition (see (38)-(40) below).

With the above alternations established, we are now prepared to move on to the analysis.

4. STAGE III: DEVELOPING A TONAL ANALYSIS. In order to construct an analysis, Stage III will draw on everything that has preceded: the surface contrasts, distributional constraints, alternations. In §2 and §3 we have established the following concerning the tone system of Oku:

- (25) a. surface contrasts
- i. three tone heights (H, M, L)
 - ii. a level L° tone which contrasts with L only before pause
 - iii. falling contours: HM, HL, ML
 - iv. no rising contours, with one exception (*ncìí* ‘chief’s house’)
- b. noun tone patterns
- i. 2/3 of the nouns are bisyllabic, consisting of a prefix and a monosyllabic root
 - ii. prefixes are mostly M, occasionally L, never H

- iii. M-HL or M-H in isolation
 - iv. prefixless nouns form their plural with the suffix /-sé/
 - v. there are both word- and phrase-level tonal alternations
- c. verb infinitive patterns
- i. infinitives take a *se*⁻ prefix plus a monosyllabic or bisyllabic root
 - ii. monosyllabic roots contrast ML vs. L
 - iii. bisyllabic roots contrast M-HL vs. L-L
- d. alternations
- i. the plural suffix /-sé/ and prepositional phrase marker /é/ alternate between H, M and L[°]
 - ii. M tone noun prefixes are /L/ as N₂ in the N₁ of N₂ genitive construction
 - iii. there are two subclasses of M-HL nouns, one which alternates with L-L and the other with L-ML as N₂
 - iv. there are two subclasses of M-H nouns, one which alternates with L-M and the other with L-L[°] as N₂

It is at this stage that the work becomes most theory-dependent: Does the analyst want to stay fairly close to the surface in developing an account, or is s/he willing to become abstract? Either way, the choice of framework can have a major effect on what the analyst pays attention to and hence the ultimate outcome—different frameworks are interested in different aspects of grammar/phonology. For our purpose, I will follow a classical autosegmental approach which turns out to be both revealing and description-friendly.

The key question which we have to resolve concerns the nature of underlying tonal representations. If the language distinguished only two tone heights, phonetic H and L, the question we would be asking is whether the underlying system contrasts /H/ vs. /L/, or whether one of the tones can be “zeroed” out rather than involving the two tonal values /H/ and /L/. An analysis of /H/ vs. \emptyset (more rarely, /L/ vs. \emptyset) is quite warranted in some languages. The major criterion is whether both or only one of the tone heights is “phonologically active”. That is, we seek to posit only those tones which are invoked by the language’s distributional constraints and rules. For instance, if the language allows HL and/or LH contours on a single tone-bearing unit (e.g. a syllable or mora), then both tones are needed. If, on the other hand, such contours are lacking, the distributions and constraints/rules refer only to H, and the L pitch shows no evidence of being phonologically active, we can entertain the possibility of a “privative” /H/ vs. \emptyset system.

When a system has three or more surface-contrastive tone heights, similar questions arise as to whether any one of the tones can be zeroed out, for example the M tone, which is the default pitch on noun prefixes in Oku. Both from a logical standpoint and from the presence of HM, HL, and ML contours, it is obvious that Oku tone cannot be analyzed as privative. A more basic question, however, is to ask whether the surface-contrastive H, M, L system requires an UNDERLYING ternary contrast in tone height, or whether one of the three heights is derived. I will now suggest that the underlying system is /H/ vs. /L/ in Oku, and that all M tones are derived, as is the contrast between L[°] and L.

Let's start with the alternations we saw in (20). Recall that the two surface noun patterns M-HL and M-H each divide into two subclasses, and that the forms these take as N_2 are as indicated in (26).

(26)	surface N_2	example	underlying		cf. citation	underlying
a.	L-L	kēkôš	/L-L/	'slave'	M-HL	/H-L/
b.	L-ML	kētâm	/L-HL/	'trap'	M-HL	/H-HL/
c.	L-M	kēvóf	/L-H/	'bone'	M-H	/H-H/
d.	L-L°	kēláj	/L-LH/	'cocoyam'	M-H	/H-LH/

Following the surface N_2 tone patterns are the proposed underlying representations. In order to derive the former from the latter, we need several rules, including the two in (27).

- (27) a. H → M / L ___
 b. LH → L° / L ___]_{pause}

The first rule converts H to M after L. This produces N_2 L-ML and L-M in (26b,c). The second rule simplifies a LH rising tone into a level L° when preceded by a L and followed by pause. This produces L-L° in (26d). Depending on whether (27a) applies before (27b), in which case /L-LH/ would first become L-LM, the rule might instead be written to simplify LM to L°.

The reason why the L occurs in the left environment in (27b) is that LH does not become L° after a H tone (see below). The citation forms and their proposed underlying representations are shown to the right in (26) above. The proposal is that the M of noun prefixes is underlyingly /H/ (and not toneless as was briefly entertained above). The reason is that we need its tone to spread onto the following /L/ root to produce M-HL in (26a). While the citation tones of (27a,b) are phonetically identical, they have different autosegmental representations:

- (28) a. ke - kôs [kē-kôš]
 | |
 H L
- b. ke - tam [kē-tâm]
 | ^
 H HL

The representations in (28) of course produce H-HL, rather than the desired M-HL. To achieve the latter, we need to say that the /H/ of the prefix first spreads in (28a), and then is subject to a rule lowering it to M. It is tempting to say that this is the same rule in (27a). For this to go through, we posit a %L boundary tone at the beginning of a small phonological phrase, perhaps the "clitic group", which affects /H/ prefixes. We also need to formulate the rule so that only the first link of the H will be lowered to M in (28a), a problem which

In (30a,b), the H of the genitive marker /ǎ/ is realized M, since it is preceded by a L. In (30b) the L of the ML becomes level L in the process. In (30c), on the other hand, where L° derives from final /LH/, the genitive marker is realized H.

From the preceding we are now in a position to hypothesize that every M tone comes from an underlying /H/ which is preceded by a L tone which must be present underlyingly, although not necessarily realized phonetically on the surface. Consider for example the tone patterns of infinitives which were seen in (11). As was summarized in (12), there are only two tone patterns which differ slightly on mono- vs. bisyllabic verb stems. An example of each is repeated in (31).

(31)	<i>monosyllabic</i>		<i>bisyllabic</i>	
a.	sē-tèl	‘to beat’	sē-jòmètè	‘to accompany’
b.	sē-lòm	‘to bite’	sē-bēmê	‘to answer’

As in most nouns, we assume that the infinitive prefix *sē-* is underlyingly H, but lowered to M after the %L boundary tone. This will not be sufficient, however, since it would be expected to spread onto a L root in (31a), yielding **sē-tèl* and **sē-jòmètè*. An underlying /H/ also does not explain why the first syllable of the stems in (31b) are realized M rather than H, i.e. why we do not obtain **sē-lòm* and **sē-bēmê*. To get the tones to come out right in (31), we need the infinitive prefix to be /sê-/ or /sé/ (with a “floating” L tone) so that the L can both block H tone spreading in (31a) and condition H → M lowering in (31b).⁷ We also assume that the root syllable of the verb is /H/ or /L/, but that there is a second /L/ tone, as shown in (32).

(32) a.	sē - tèl	b.	sē - jòmètè	c.	sē - lòm	d.	sē - bēmê
	^		^		^		^
%L	HL L L	%L	HL L L	%L	HL H L	%L	HL H L

The evidence for the final L is not seen in (32a), where the root is L, but it is needed in (32c), to combine with the H of the verb root to form a HL stem tone which lowers to ML. As elsewhere, the L of the HL contour delinks when followed by another tone. Finally, (32d) shows H tone spreading from the first to second syllable of the verb stem, thereby forming a contour tone. Since only the first H syllable is lowered, the verb ‘to answer’ is realized *sē-bēmê*, with a HL contour on the final syllable.

The same representations and rules can account for the alternations on the plural suffix /-sé/ seen in (13) above. The underlying and surface patterns of relevant examples are given in (33).

⁷ The infinitive prefix is likely related to the preposition /sê/ ‘to’ which was seen to be realized ML in (24) above.

(33)	<i>singular</i>		<i>plural</i>		#
	<i>underlying</i>	<i>surface</i>	<i>underlying</i>	<i>surface</i>	
a.	/ntòn/	→ ntòn	/ntòn-sé/	→ ntòn-sè°	‘pot(s)’ 10
b.	/njäm/	→ njàm°	/njäm-sé/	→ njàm-sé	‘axe(s)’ 4
c.	/ndói/	→ ndē	/ndói-sé/	→ ndāi-sé	‘cloth(s)’ 4
d.	/ntòk/	→ ntòk	/ntòk-sé/	→ ntòk-sè°	‘bundle(s)’ 11
e.	/kà/	→ kà	/kà-sé/	→ kà-sè°	‘basket(s)’ 5
f.	/bài/	→ bài°	/bài-sé/	→ bài-sé	‘father(s)’ 1
g.	/kán/	→ kān	/kán-sé/	→ kán-sé	‘monkey(s)’ 4
h.	/sói/	→ sói	/sói-sé/	→ sói-sé	‘caterpillar(s)’ 7
i.	/búò/	→ búò	/búò-sé/	→ búo-sē	‘animal(s)’ 11

Let us first consider (33a-d), which shows the four patterns that occur when a monosyllabic noun begins with an NC complex (additional examples were seen earlier in (14)). As indicated, the monosyllabic singular nouns have all four underlying tone patterns we saw with prefixed nouns in (26): /L, LH, HL, H/. In fact, they have the surface forms that the nouns in (26) have in N₂ position, where their prefix is /L/. Of particular note are the M and ML tones in (33c,d), suggesting that they are preceded by a L tone. Since the patterns in (33a-d) concern nouns with an NC complex, it is tempting to attribute the L tone effect to this nasal, which can be related to the Proto-Bantu L tone class 9 prefix. However, we see similar surface tones in (33e-g), where the nouns begin with a (non-nasal) root consonant.⁸ Here too we could posit a “floating” L prefix whose only effect is tonal, e.g. /[^]-kán/ → *kān* ‘monkey’. However, there are at least two complications. First, M tone nouns which do not begin NC have a H tone stem in the plural, e.g. *kān* ‘monkey’, pl. *kán-sé* (vs. *ndāi* ‘cloth’, pl. *ndāi-sé* in (33c)). Second, other prefixless nouns in the second group are pronounced H, e.g. *sói* ‘caterpillar (sp.)’. While HL nouns such as *búò* ‘dog’ (33h) are in complementary distribution with the ML of NC-initial nouns such as *ntòk* ‘bundle’ (33d), there is a clear contrast between H and M on non-NC-initial nouns.

How should we analyze the complexities in (33)? One solution is to posit a L- prefix on NC nouns, in both the singular and plural of (33e,f), and in the singular of (33g). Another would be to try to exploit the %L tone we set up to account for the lowering of a /H/ prefix to M. In this case, we would have to say that lowering occurs on NC-initial nouns (33c,d) and on some non-NC initial nouns (33g). To block its application in the plural of (33g) and both singular and plural of (33h,i), one could even posit a H- floating prefix. Or one could adopt both L- and H- floating prefixes. This latter move clearly mirrors the history: class 1 and 9 nouns were historically marked by a L prefix, while class 10 (the plural of class 9) was marked with a H tone prefix. However, there seem to be other things going on as well. Consider the contrast between the two HL nouns in (34a,b).

⁸ Since all ML nouns begin with NC, there is no corresponding ML example in this second set.

- (34) a. búò ‘dog’ ntòn è b̄ùò ‘pot of the dog’
 b. ɲâm ‘animal’ ntòn è ɲàm ‘pot of the animal’
 c. = ntòn è ɲâm
 d. búo-sē ‘dogs’ ntòn è b̄uo-sè° ‘pot of the dogs’
 e. ɲám-sē ‘animals’ ntòn è ɲám-sè° ‘pot of the animals’

As seen to the right, where the class 9 N_1 noun *ntòn* conditions a L tone genitive marker /è/, ‘dog’ is realized ML as N_2 , while ‘animal’ is realized L. We know from Proto-Bantu and from other Grassfields Bantu languages that ‘dog’ had a *HL monosyllabic stem, while ‘animal’ had a bisyllabic *L-L stem (which becomes monosyllabic L in almost all Grassfields languages). We see this difference in the N_2 realizations in (34a,b). However, notice that ‘animal’ is pronounced HL in isolation, indicating that it somehow picked up a H- prefix. This H- prefix seems also to stay in the alternate N_2 realization in (34c). In (34d,e), the corresponding plurals are both pronounced H-M in isolation, but there is again a difference in N_2 position: ‘dogs’ is M-L°, as expected, but ‘animals’ is pronounced HL-L°. If the H- prefix of ‘animals’ had been lowered in N_2 position, as elsewhere in the language, we would have obtained **ntòn è ɲám-sè°*. Instead, the H which comes historically from the prefix persists on the stem, as if resisting the morphological assignment of L to the N_2 prefix. The HL contour also fails to simplify before the L° suffix, such that we obtain HL-L° rather than H-L°. This too suggests that the H- is coming in late from the left, thereby escaping the rule.

Recall from (22d) that *ɲkáj* ‘cornbeer’ was reported also to resist lowering in N_2 position. Further evidence is presented in (35a,b).

- (35) a. ɲkáj ‘cornbeer’ ntòn è ɲkáj ‘pot of cornbeer’
 b. ɲkáj-sé ‘cornbeers’ ntòn è ɲkáj-sé ‘pot of cornbeers’

It turns out that *ɲkáj* ‘cornbeer’ and *ɲjáj* ‘xylophone’ are the only H tone nouns which begin with a NC sequence—and are possibly borrowed. As seen in (35) there is again inertia, a failure of a H tone to lower after L. As in the case of the HL on the root ‘animal’ in (34c,e), we need to block the rule in (27a). The most natural way to do this is to posit a floating H tone prefix wherever the H → M rule fails to apply, thus in (34c,e) and (35a,b).

This leaves one issue unresolved: We saw in (33d) that when the /HL-H/ sequence is preceded by the L prefix that accompanies NC-initial nouns, the result is M-L°, as schematized in (36).

- (39) (a) $n\bar{a}$ ke-k $\bar{o}s$ e \rightarrow $n\bar{a}$ ke-k $\bar{o}s$ e \rightarrow $n\bar{a}$ ke-k $\bar{o}s$ e \rightarrow $n\grave{a}$ k\grave{e}-k $\bar{o}s$ \grave{e}^{\circ}
 | | | | \rightarrow | | | | \rightarrow | | | | \rightarrow | | | |
 L H L H L H L H L H L H L H
- (40) $n\bar{a}$ ke-tam e \rightarrow $n\bar{a}$ ke-tam e \rightarrow $n\grave{a}$ k\grave{e}-t\bar{a}m \bar{e}
 | | | | \rightarrow | | | | \rightarrow | | | |
 L H H L H L H H L H

Starting with the different underlying tones in (39a) and (40a), the first rule which applies is H tone spreading in (40b). This is followed by L tone spreading in (39c) and in (40c), where it is assumed that only a linked L tone will spread. (This is known to be the case in neighboring Kom, for example.) At this point we can assume that the H \rightarrow M lowering rule applies, followed by simplification of contour tones: the H (now M) of /ke-/ delinks in both examples. In the (39c), the L of -k $\bar{o}s$ has to delink, as does the H of the marker /\acute{e}/.

There still is a problem, however: We do not expect the final L $^{\circ}$ in $nt\grave{\Delta}n \grave{\Delta} b\bar{u}o-s\grave{e}^{\circ}$ ‘pot of the dogs’, from (34d) above. Assuming the underlying representation in (41), the unlinked L of /b\bar{u}o/ ‘dog’ should not spread, and the output should be as indicated:

- (41) $nt\grave{\Delta}n$ \grave{\Delta} buo -se (expected: * $nt\grave{\Delta}n \grave{\Delta} b\bar{u}o-s\bar{e}$; obtained: $nt\grave{\Delta}n \grave{\Delta} b\bar{u}o-s\grave{e}^{\circ}$)
 | | | |
 L L L L H L H

The question is what the inputs (39) and (41) have in common that final L tone spreading should apply to them, but not to the input in (40). It would seem that for the L to spread onto the final H, it in turn needs to be preceded by a L+H sequence. Since the L is preceded by a L+H sequence in (39), L tone spreading does apply. Whether this is correct, and if so why this should be, are questions that cannot be fully resolved here. I have deliberately chosen to end the section in this way to indicate that parts of an analysis may be anything but fully straightforward. After carefully considering a wide range of facts, we have however been able to conclude with some confidence that the surface H, M, L $^{\circ}$ and L tones can be derived from an underlying binary system, /H/ vs. /L/, in most cases by completely general rules.

5. ADDITIONAL CONSIDERATIONS. In the preceding sections I have distinguished between three logical stages of tonal investigation: Stage I consists of establishing the surface contrasts, Stage II the alternations (if any), and Stage III the analysis. As we have seen Stage III is the most open-ended, subject to multiple interpretations, and most likely to be affected by new discoveries. In this last section I would like to briefly consider two additional questions: First, where does instrumental investigation of the tonal properties come in? Second, what about tonal orthography?

5.1. INSTRUMENTAL INVESTIGATIONS. As was seen in §2-4, the three stages that I envision have been presented without any reference to the instrumental investigation of tone. Stage I consists of basically listening and comparing the surface tones (itches), just as one would do to establish the consonant or vowel inventory. In my view students and field researchers alike are tempted to look at instrumental data too early. In my field methods courses I thus discourage using PRAAT, Wave Surfer etc. as a means of discovering the surface contrasts. Of course one may be interested in the precise acoustic properties of the surface-contrastive sounds, whether consonants, vowels or tones—and there are some questions and hypotheses that can only be addressed instrumentally. The problem with looking at the f_0 properties of tones too early is the tendency to interpret them literally. In one field methods class, for example, the picture was emerging that the language contrasted H and L on non-final syllables and, in addition, LH and HL contour tones in final position. At one point a quite capable graduate student argued with me that what we had established as a H tone was really a falling tone because there was a slight fall in the pitch traces. I admit I kind of lost it that time, having already warned them not to insist on such a literal interpretation. So, with perhaps inappropriate exasperation I asked, although I don't remember in which order: "How many H tones have you ever seen on a screen?" "What does it SOUND like to you?" I doubt that one can directly read the perceptual properties of tones from the acoustic record, but, whatever one can do, I am sure that it takes quite a bit of training.

In 2010 Katherine Bolanos showed me some wonderful spectrograms and pitch traces of word tokens from Kakua, a language spoken in Colombia, possibly belonging to the Kakua-Nukak family. Among the pitch traces which she subsequently sent to me were the following two, both concerning words which are segmentally *dawa*:

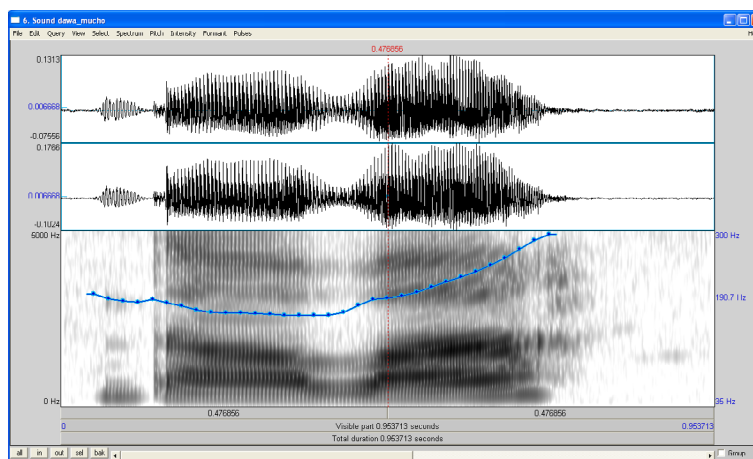


FIGURE 1. *dawa* ‘lots (quantity)’

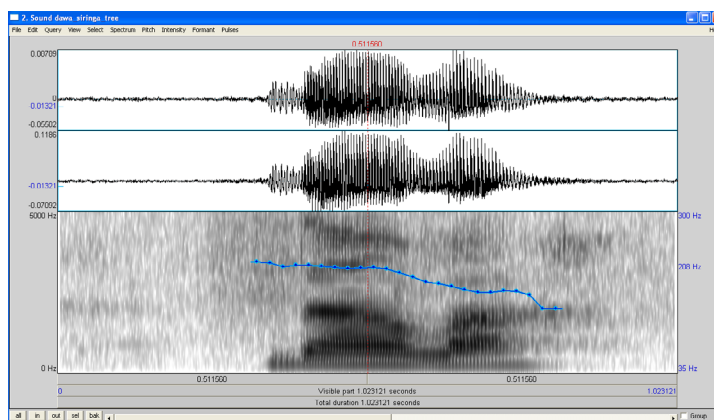


FIGURE 2. dawa ‘Siringa tree (rubber tree)’

If we look at Figure 1, it clearly starts out fairly low and ends rather high. However, the second syllable seems to have a continuous rise in it, suggesting maybe a L-LH transcription. Listening to it, however, it was clear that it was perceptually [L-H]. To have been L-LH, the transition from L to H would have had to take place later in the syllable. Figure 2 represents the reverse situation: In it there seems to be a higher pitch on the first syllable which falls throughout the second, perhaps suggesting a H-HL sequence. However, perceptually it is H-L. Had it been H-HL, the pitch change would have taken place later in the second syllable. Since we know that pitch targets are reached late on a tone-bearing unit, this is not surprising: Although the L-H and H-L sequences reach their second target (H and L, respectively) rather late in the second syllable the trajectories are not steep enough to be interpreted as a second syllable LH and HL.

The above examples are relatively clear, as far as pitch tracing goes. When looking at full sentences, the task of going from the pitch traces to the tones becomes even more difficult. Consider Figure 3, also provided by Katherine Bolanos:

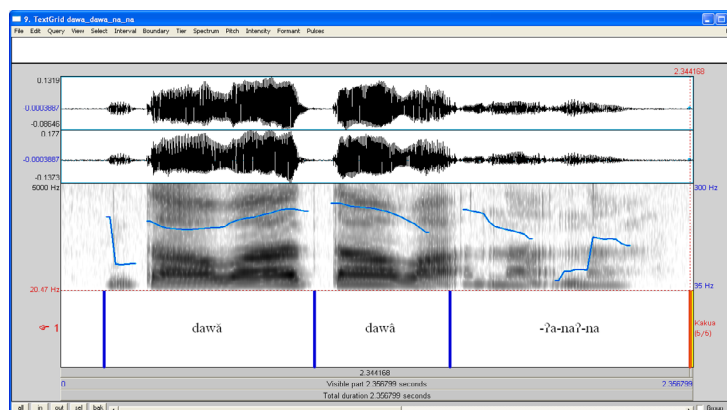


FIGURE 3. dawa (L-H) dawa (H-L)-/a-naʔ-na ‘There are a lot of rubber trees’

Again, L-H [dàwá] and [dávà], whose tones Bolanos marks on the second syllable, are fairly clear, but what are the tones on *-a-na/-na* (classifier.tree.like-progressive)? It may be a simple H-L-H sequence on short vowels, the first tone might be HL, or the last tone might be M or ML. The best way to solve this is to follow Stage I and carefully control for tonal possibilities. Only afterward will it make sense to do instrumental work—and especially only when the researcher wants to test specific hypotheses, e.g. is the last tone in Figure 3 lower than the first tone because of a non-contrastive downstep conditioned by the intervening lower pitch?

5.2. TONAL ORTHOGRAPHY. The other issue to discuss has to do not specifically with tonal transcription, which was discussed in §1, but with tonal orthography: Once a tone system is analyzed, how should tone be indicated in the written language? Unfortunately, there is a tendency to ignore tones in writing systems, as if they were expendable (cf. Hyman 2011a: 204-5). As a linguist I of course would ideally like all tones to be written, perhaps zeroing out one of them as an orthographic convenience. However, as we have seen in Oku, there are quite a few tonal contrasts that would have to be distinguished: H, M, L°, L, HL, ML. Given the motivation to keep orthographies as simple as possible, the question naturally arises as to how little of the tone system needs to be encoded—and in what form (underlying? phonetic?). Various researchers have approached the question experimentally, comparing the effects of writing all, some or no tones on reading comprehension (see Bird 1999a,b). Although the question goes beyond descriptive tonology, it seems intuitive that the importance of tone marking will vary with the importance of tone in the grammar and lexicon. As mentioned, some tone languages have few minimal pairs, while others have many. In Iau, a Lakes Plain language of New Guinea, eight different tone patterns are distinguished on monosyllabic words. As seen in (43), Bateman (1990: 35-36) shows that these tones have a lexical function on nouns vs. a morphological function on verbs:

(42) The 8 tone patterns of Iau (l' = a super-high tone)

<i>Tone</i>	<i>Nouns</i>	<i>Verbs</i>	
H	bé 'father-in-law'	bá 'came'	<i>totality of action punctual</i>
M	bē 'fire'	bā 'has come'	<i>resultative durative</i>
H ^l H	bé ^l 'snake'	bá ^l 'might come'	<i>totality of action incompleted</i>
LM	bè 'path'	bã 'came to get'	<i>resultative punctual</i>
HL	bê 'thorn'	bâ 'came to end point'	<i>telic punctual</i>
HM	bē 'flower'	bā 'still not at endpoint'	<i>telic incompleted</i>
ML	bè 'small eel'	bã 'come (process)'	<i>totality of action durative</i>
HLM	bê ⁻ 'tree fern'	bâ ⁻ 'sticking, attached to'	<i>telic durative</i>

It is hard to imagine not writing tone in an Iau orthography.

Inevitably the answer may depend on who the orthography is intended for. If for native speakers who know the language well, there is room to take advantage of the linguistic knowledge they bring to the tasks of reading and writing. If for linguists or language learners, it will be of course important to include as much detail as possible. As elsewhere in linguistics, spelling should not be confused with sounds, in this case tones.

APPENDIX: MORE ON CITATION VS. CONTEXTUAL TONES

In §1 it was suggested that the study of tone should begin by considering the properties of words in isolation. This is standard field practice, whether the object is to transcribe consonants, vowels, or other sound properties. However, it is known that citation forms do not necessarily reveal the full system. Although this also happens with segments, e.g. when voicing contrasts are neutralized word- or utterance-finally, as in German or Russian, most tonologists would probably agree that the problem is greater in the study of tone. We saw that there are two kinds of M-H in Oku, also two kinds of M-HL. That is, we could not establish the full range of underlying contrasts based on the surface contrasts of words in isolation. Still, it was important to start by identifying the different tone heights and the contour tones that they form. In this section I would like to briefly present some of the hidden properties of tone that one could not get from citation forms alone. I will then conclude with a final warning about contextual effects on tone.

Perhaps the most extreme case of neutralization in citation forms comes from Co-reguaje, a Tukanoan language of Colombia, where, as seen in (43), CVCV noun tones all merge as L-HL in isolation:

(43)

CVCV:	<i>Basic form</i>	<i>statement</i>	<i>question</i>	CVV:	<i>Basic form</i>	<i>statement</i>	<i>question</i>
	H-H	L-HL	H-L		HH	HL	HL
	H-L	L-HL	H-L		HL	HL	HL
	L-L	L-HL	H-L		LL	LH	HL
	L-H	L-HL	H-L				

As Gralow (1985:3) puts it: "...we found that in certain frames there were four contrasting sets, but in isolation phrase stress completely neutralized the contrasts, at least in CVCV nouns." (43) shows that CVV noun tones also merge except for /LL/ nouns, which remain distinct under statement intonation. It would appear that the statement and question intonemes are LHL% and HL%, respectively, although more information would be needed to confirm this.

It is more usual that a subset of tone patterns merge in citation forms. Several Grassfields Bantu languages show this property. Like Oku, in closely related Babanki, most

bisyllabic nouns show one of two tone patterns in isolation, L-L and L-H, where the first syllable is a (surface) L tone prefix. As in Oku, we expect four underlying tone patterns on the stem syllable: /H/, /L/, /HL/, and /LH/. Whereas Oku groups these as /H/, /LH/ vs. /L/, /HL/, i.e. two groups of two realized M-H vs. M-HL, respectively, Babanki groups them as /L/ vs. /H/, /HL/, and /LH/, realized L-L vs. L-H, respectively (Hyman 1979a). The same is true in Aghem, where /H-L/ is realized H-HL, but the other bisyllabic tone pattern, H-H, represents a neutralization of /H-H/, /H-HL/ and /H-LH/ (Hyman 1979b). In both languages, the four contrasting underlying tones are established on the basis of alternations, particularly in the N_1 of N_2 construction.

There are in fact two ways in which citation forms can diverge in context. The first is that they have different effects on neighboring tones. The second is that neighboring tones have a different effect on them. (Both may of course obtain in the same language.) A case of the former comes from Peñoles Mixtec, where the two groups of nouns in (44) are both pronounced with a gradually falling pitch throughout, which Daly & Hyman (2007: 167-8) analyze as toneless:

- | | | | | | |
|-------|----|--------------|---------------|--------------|--------------|
| (44). | a. | <i>kiti</i> | ‘animal’ | <i>nduʔu</i> | ‘tree trunk’ |
| | | <i>kolo</i> | ‘male turkey’ | <i>nduu</i> | ‘day’ |
| | b. | <i>njuši</i> | ‘chicken’ | <i>doko</i> | ‘well’ |
| | | <i>tjɲi</i> | ‘mouse’ | <i>kada</i> | ‘son-in-law’ |

While the two sets are both analyzed as being underlyingly toneless, with their pitches being assigned by context, they have a different effect on the next word. As seen in the representative examples in (45), the word /ditó/ ‘uncle’, analyzed as underlying /Ø-H/, has different realizations after each group:

- | | | | | |
|------|----|--------------|-------------|-------------------|
| (45) | a. | <i>kiti</i> | <i>ditó</i> | ‘uncle’s animal’ |
| | b. | <i>njuši</i> | <i>dító</i> | ‘uncle’s chicken’ |

In (45a) /*kiti*/ ‘animal’ has no effect on /*ditó*/ ‘uncle’, and the two-word sequence is pronounced as a sequence of four M pitches, conforming with the pitch realization rules described by Daly & Hyman. On the other hand, the *njuši* ‘chicken’, pronounced identically with *kiti* in isolation, causes the first syllable of /*ditó*/ to begin with a distinctive L pitch. The result is a sequence of three falling L pitches followed by a final M pitch. The analysis proposed by Daly & Hyman is that the nouns in (44b) are toneless, like those in (44a), but have a floating L tone after them, hence: /*njuši* `/, /*doko* `/, /*tjɲi* `/, /*kada* `/. It is this floating L which links to the first syllable of /*ditó*/ ‘uncle’ in (45b).

The second situation is where two identical citation forms are themselves realized differently in context. A good case of this comes from Villa Alta Yatzachi Zapotec (Pike 1948). In this language there are two kinds of L tone nouns: those which remain L in context vs. those which become M when followed by a M or H tone. A minimal pair is seen in (47).

- (46) a. *bìa* ‘cactus’ *bìa gōlī* ‘old cactus’
 b. *bìa* ‘animal’ *bīa gōlī* ‘old animal’

Both *bìa* ‘cactus’ and *bīa* ‘animal’ are pronounced L in isolation. However, when followed by *gōlī* ‘old’, ‘cactus’ remains L, while ‘animal’ becomes M. In this case a number of different analyses might be proposed (see Hyman 2011b: 64-5). One would be to give different features to the two types of L tone, perhaps treating those like ‘animal’ as having a fourth “lower-mid” pitch level (as they undoubtedly did, historically). Another would be a floating tone analysis: ‘animal’ may have a floating M after it. This time, however, the floating tone would not link to the following word, but rather to its own morpheme.

In both Peñoles Mixtec and Villa Alta Yatzachi Zapotec the different realizations of identical citation forms are discovered from their interaction with specific surrounding tones. There would be no differences between (44a,b) and (46a,b) if, for example, the words in question were followed by another word beginning with /L/. Another possibility is that two underlying tone patterns merge when they are adjacent to a phrase boundary, especially pause. For example, both of the Kinande nouns in (47a) are pronounced L-L-H-L in isolation (Hyman 1990: 117):

- (47) a. *è-kì-tábù* ‘book’ b. *è-kì-tábù* *kì-ríto* ‘heavy book’
 è-kì-ryátù ‘shoe’ *è-kì-ryátù* *kì-ríto* ‘heavy shoe’

When followed by the adjective ‘heavy’ in (47b), however, ‘book’ keeps the same tones, while ‘shoe’ is realized all L. The reason for the neutralization in (47a) is that there is a succession of two boundary tones H%L//, where H% marks the end of a phrase and L// the end of a declarative utterance. Since ‘shoe’ is underlyingly toneless, the two boundary tones map to the last two syllables. The underlying final /H-L/ tones of ‘book’, however, block the mapping of H% with L// linking vacuously to the final syllable.

While it is more common for the phrase-final position to alter and/or merge tones, the same can happen phrase-initially. A case in point comes from Hakha Lai (Hyman & VanBik 2005). As seen in (48) words, which are typically monosyllabic, can be either HL or L in isolation:

- (48) a. HL b. HL c. L
- | | | | | | |
|-------------|---------|-------------|----------|-------------|----------|
| <i>hmâa</i> | ‘wound’ | <i>kêe</i> | ‘leg’ | <i>sàa</i> | ‘animal’ |
| <i>lûŋ</i> | ‘heart’ | <i>hrôm</i> | ‘throat’ | <i>ràŋ</i> | ‘horse’ |
| <i>râal</i> | ‘enemy’ | <i>kôoy</i> | ‘friend’ | <i>kòom</i> | ‘corn’ |

However, as indicated, the HL words fall into two classes. As seen in (49), the group in (48a) remains HL after toneless pronominal proclitics such as *ka* ‘my’, while the group in (48b) is realized LH:

(49) a. /HL/	b. /LH/	c. /L/
ka hmâa ‘my wound’	ka kĕe ‘my leg’	ka sâa ‘my animal’
ka lûŋ ‘my heart’	ka hrôm ‘my throat’	ka ràŋ ‘my horse’
ka râal ‘my enemy’	ka kǒoy ‘my friend’	ka kòom ‘my corn’

As seen in (49c), the nouns in (48c) remain L. Since there is a contrast after such proclitics, we analyze the first two groups as /HL/ and /LH/, respectively. In order to get the LH to become HL, we assume an initial %H boundary tone: A /LH/ tone becomes HL after a H. Support from this is seen in (50), where a /LH/ is shown also to become HL after another /LH/:

(50) /ka + kooy + kee/	→	ka kǒoy kĕe	‘my friend’s leg’
LH LH			

In the cases considered thus far there is a two-to-one relation between tones in context vs. tones in isolation: We get the information we need to set up distinct underlying tone patterns by relying on the contextualized tones. It should however be noted that the relation between citation and contextual tones can be considerably more complex (and varied). Thus consider the following data from Haya (Hyman & Byarushengo 1984):

(51)	‘farmer’	‘woman’	‘snuff’
as subject:	ò-mù-lìmì	ò-mù-kázi	ò-bù-gòló
citation form:	ò-mù-lìmì	ò-mù-kâzi	ò-bù-gólò
‘... my’	ò-mù-límí wàngè	ò-mù-kázi wàngé	ò-bù-gòló bwàngè
‘... of Kato’	ò-mù-lìmì wà kátò	ò-mù-kàzi wà kátò	ò-bù-gòlò bwà kátò

Hyman and Byarushengo analyze the Haya tone system as privative /H/ vs. Ø. The first row not only presents the forms as pronounced as subject of a sentence, but is most direct in establishing the underlying tones of the noun stems, /-lìmì/, /-kázi/, /-gòló/, where toneless vowels receive L tone by default. As seen in the schemas in (52), something happens to these underlying stem forms in the other three contexts:

(52)	/Ø-Ø/	/H-Ø/	/Ø-H/
as subject:	L-L	H-L	L-H
citation form:	L-L	HL-L	H-L
‘... my’	L-H	H-L	L-H
‘... of Kato’	L-L	L-L	L-L

As seen, the citation forms do not merge the three stem-tone patterns, but these latter are realized differently: /H-Ø/ is realized HL-L and /Ø-H/ is realized H-L. When modified by the possessive pronoun ‘my’, /Ø-Ø/ becomes L-H, merging with /Ø-H/. Finally, all three patterns merge as Ø-Ø (→ L-L) by a process of H tone deletion as the N₁ of a N₁ of N₂ construction.

What emerges from the Haya example is that tones can merge not only in citation forms, but also in context. The data in (51) further establish Pike’s (1948) insistence on discovering the proper frame for determining tonal contrasts. One such frame in Haya would be subject position. However, as stated earlier, one cannot know in advance whether there are tonal alternations in phrasal contexts, and if so, which among the various contexts might provide the best frame for establishing the underlying tonal representations and the rules that account for alternations. By ordering the operations into Stages I, II and III, one has the best chance of discovering the crucial facts and arriving at an optimal solution.

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