Tone in Saxwe

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Tone in Saxwe

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For Keith and Mary Beavon,
who set the irresistible example of being
passionate about their work.

Contents

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Abbreviations

1	first person
2	second person
3	third person
°	non-falling pitch frequency
↓	non-automatic downstep of pitch frequency
´	high tone
`	low tone
¯	mid tone
ˇ	low-high tone
ˆ	high-low tone
᷆	mid-falling tone
AM	associative marker
ANT	anterior (aspect)
CG	clitic group
COMPL	completive (aspect)
CONJ	conjunction
DEM	demonstrative
DET	determiner
DS	different subject
F_0	pitch frequency
FOC	focus
FUT	future (tense)
GEN	genitive
H	high tone
^{H}	floating high tone
H_{ω}	high tone phonological word boundary
HAB	habitual (aspect)
HORT	hortative (modality)
IMP	imperative (modality)
INDEF	indefinite
IPFV	imperfective (aspect)
IP	intonational phrase
IRR	irrealis (modality)
JUSS	jussive (modality)
L	low tone
^{L}	floating L tone
$L_{\%}$	low tone intonational phrase boundary
M	mid tone
^{M}	floating mid tone
M-	left floating mid tone on nouns
NA	not applicable
NEG	negation marker
NP	noun phrase
OCP	obligatory contour principle
OUTC	outcome projection (modality)
PART	second half of two-part morpheme
PhP	phonological phrase
PL	plural
POSS	possessive
PROG	progressive (aspect)
PROH	prohibitive
PROSP	prospective (modality)
PW	phonological word
Q	question
R	raised (feature)
^{R}	rising upglide of pitch frequency
RED	reduplication prefix
REL	relativizer
REPET	repetitive (aspect)
SBJV	subjunctive (modality)
SUB	subordination marker
SG	singular
SS	same subject
TAM	tense, aspect, and modality
TBU	tone-bearing unit
U	upper register (feature)
YNQ	yes-no question

1 Introduction

This study addresses the tone system of Saxwe, a Kwa language of the Gbe continuum spoken in the country of Benin. In this study, I describe tonal data observed in the Saxwe language and account for these data using a derivational, rules-based approach. Evidence throughout this study shows that in order to explain the Saxwe tone system, one must take into account not only lexical and grammatical tone, but also structurally-driven tone—tone which is conditioned by the presence of certain prosodic or morphosyntactic structures. Aboh (2004) remarks that there is a shortage of comprehensive tone studies of Gbe languages. In reference to certain of the Gbe variants, he states, "Even though a non-native speaker could find it somehow easy to identify the two register tones…as long as words are kept in isolation, he needs a rather sophisticated machinery once words are put together to form a sentence. Tones can undergo both syntactic and phonetic changes…" (p. 28). A single study cannot cover every topic related to tone production in a language, particularly in the domain of phonetics, but this study has as its aim to describe the basics of the "sophisticated machinery" that produces Saxwe sentences and to describe how the historical development of the current tone system helps us to understand its present state.

Saxwe displays a number of interesting tonal complexities which make it worthy of detailed study, and I briefly highlight a few of those complexities here. To start with, Saxwe has a history of phonological consonant-tone interaction that can still be easily observed in the present-day lexicon. A depressor consonant will almost always be followed by an underlying L tone, but L also exists in a number of words in the absence of a depressor consonant. While some of the neighboring Gbe languages have been analyzed as having a two-way underlying tonal contrast with a third surface height derived as a result of consonant-tone interaction (Ansre, 1961; Bole-Richard, 1983; Stahlke, 1971), Saxwe clearly has a three-way underlying tonal contrast. In this respect, it resembles Yoruba (Akinlabi, 1985; Pulleyblank, 1986). There are historical claims that the Saxwe ancestors migrated from the Yoruboid-speaking area into the Gbe-speaking area (Pazzi, 1979). The present-day Saxwe tone system shows many indications of being the product of contact between a language with two underlying tones and a language with three underlying tones.

A further interesting observation is that specific prosodic and morphosyntactic structures are responsible for certain tonal phenomena in Saxwe. This is relevant at boundaries at the level of the phonological word as well as at the level of the intonational phrase.

The Saxwe tonal system consists of a three-way underlying contrast between /H/, /M/ and /L/, but postlexical rules of tonal spread dictate that both H and L spread onto M tone-bearing units. In part because of this tonal spread, both automatic and non-automatic downstep of H are observed in Saxwe—the former triggered by a surface L between Hs and the latter triggered by a floating M between Hs. What is especially noteworthy in the description of these two types of downstep is that there is fairly significant interspeaker variation in the phonetic implementation of downstep within a single dialect.

The following is the structure of this study. Chapter 1 gives an overview of the Saxwe language and the methodology used for this study. In this chapter, I also outline the basic phonology, morphophonology and syntax of Saxwe, highlighting information that is useful in interpreting the data given in this study.

In chapter 2, I provide a survey of some of the theoretical frameworks in which this study is anchored. This includes a review of topics such as tonal underspecification, as well as a look at some of the ways in which consonantal segments affect tone in various languages. It also includes a review of some of the ways in which tone can be sensitive to prosody and how this prosody relates to syntactic structure. There is a final summary of the tone analyses that have been proposed for related Gbe languages.

The next three chapters work from smaller to bigger units of language and touch on three kinds of tonal input that are brought into the phonological component—lexical tone, grammatical tone, and tone which is conditioned by the presence of certain prosodic or morphosyntactic structures. Chapter 3 presents the basic underlying monomorphemic noun and verb tonal patterns. I also give the set of rules which derive surface forms from underlying forms in simple utterances. The processes of automatic and non-automatic downstep in Saxwe are first discussed in this chapter. In chapter 4, I look at tonal phenomena in words that are more complex than monomorphemic C(C)V verbs and V.C(C)V nouns. This includes polymorphemic forms and borrowed nouns. In the course of this chapter, I describe a structurally-driven tonal boundary at the level of the word. Chapter 5 describes ways in which grammatical tone—tone which carries specific meaning without the support of segmental-level phonemes—is used to make clause-level morphosyntactic distinctions. In addition, this chapter looks into tonal boundaries assigned at the level of the intonational phrase.

Having examined the data presented in chapters 3 through 5, I describe in chapter 6 how the Two-Feature model can offer explanation for certain observations within the Saxwe tone system. We see in a number of cases that H, M and L tones display certain asymmetries in the Saxwe data. The Two-Feature model of tone provides explanations for these asymmetries and its application to the Saxwe tone system simplifies the formulation of some of the derivational rules.

Chapter 7 touches on phonetic implementation and gives instrumental support for claims made in previous chapters regarding surface forms. Focus is particularly placed on baseline F_0 production of H, M, and L; the automatic and non-automatic downstep of H; and the surface realization of monomorphemic nouns.

Finally, chapter 8 concludes this study with summaries of the major findings of this study, as well as suggestions for further work and a discussion of the implications of what is seen in the Saxwe system.

1.1 Language background

Saxwe is a Kwa language in what is labelled as the Gbe continuum (Capo, 1984, 1991)—a group of languages including Ewe, Fon, Gen, and Gun. Saxwe is spoken in the southern part of the country of Benin. The name given by Saxwe speakers for their language is [sáxwέ-gbè]; its ISO code is [sxw]. In the Ethnologue (Eberhard, Simons, & Fennig, 2019), the language is listed as Saxwe. Various spellings that have been used for the name of this language include the following.

- Saxwe (Beavon-Ham, 2012; Johnson & SIL International, 2011)
- Saxwɛgbe, Saxwɛ (Capo, 1984; Dotouve, 2013)
- Sahoué, Sahoe, Sahouè (CENALA, 1995)
- Sahwe, Sáhwè (Pazzi, 1979)

The 2003 government census recorded the Saxwe population as being approximately 170,000 (INSAE, 2003). Current population figures are estimated at 279,000 (Eberhard et al., 2019). A map of the geographical distribution of Saxwe speakers is found in Appendix A. This map identifies the towns where Saxwe is spoken, as well as where its closest neighboring variants, Daxe and Se, are spoken.

Saxwe is identified by Capo as belonging to the sub-group Phla-Pherá within the Gbe dialects (1991). According to Capo, the other of the five sub-groups are Ewe, Gen, Aja, and Fon. Kluge (2007), using the results of linguistic surveys of the Gbe languages, identifies three major divisions among the Gbe languages—Western Gbe, Central Gbe (limited to Aja), and Eastern Gbe. Under this analysis, Saxwe fits among the Eastern Gbe languages, along with Fon and Gun.

Speakers of Saxwe and consultants I have worked with informally identify several subdivisions of spoken Saxwe. These include:

- the variety spoken in Houeyogbe and surrounding towns, including Zoungbonou, Adrome and Doutou (Houeyogbe district)—known by some as the [dű̃tȕ] subdivision
- the variety spoken in Lobogo and surrounding towns (north-western side of the Bopa district)—included by some in the [dàkplâ] subdivision
- the variety spoken in Bopa and surrounding towns (south-eastern side of the Bopa district); a variety identified in some documents with its own label, Gbokpa (Kluge, 2007)—also included as part of the [dàkplâ] subdivision

This being said, practically every major village is said to have its own slight particularities of speech. I am unable to verify to what extent this is the case.

The early history of the Saxwe people is documented by Pazzi (1979) and Kpinso (2006). Pazzi describes the Saxwe-speaking people as a group of immigrants who relocated among the Gbe peoples of Tado. According to Pazzi, the Saxwe claim to be originally part of the Sabe kingdom (north of the Gbe-speaking areas), descendants of the Ife kingdom (located in present-day Nigeria). Pazzi writes that it is not clear exactly when they settled in the "terres noires" or marshland regions called the Ko. The reason for their inhabitation of this area seems to have been that this land was not wanted by the Gbe groups already present. The Saxwe established their royal village on the border of the Ko region in the town called Houeyogbe, which means "new home" (Pazzi, 1979).

Karl-Augustt (1984) notes that the first recorded interaction of a Saxwe person among the Gbe-speaking groups was in 1727. He relates that the Yoruba historian Moulero (citation not given) estimated that over half the words in Saxwe were of Yoruba origin. Local tradition (Kpinso, 2006) affirms that the Saxwe have their origins among the Yoruboid people groups.

The Saxwe people first became a substantive part of written history when they staged a revolt against the French colonial leadership in 1918 (Metinhoue, 2006). Known as the "Revolt of the Saxwe", this was a reaction to their increasing frustration with the impositions made by the colonial leadership, including an attempt by the French to recruit Saxwe young men into their army. The revolt was short-lived.

This history of being a Yoruboid people who descended into a Gbe-speaking region and adapted their speech accordingly has resulted in a Gbe language which differs in some interesting ways, both phonologically and syntactically, from other languages in the Gbe continuum.

In the remainder of this chapter, I provide the necessary background for the study of tone in Saxwe. Section 1.2 describes previous research done on Saxwe. In section 1.3, I discuss the methodology used in this study. Section 1.4 contains an overview of Saxwe phonology. In section 1.5, I describe morphophonological processes in Saxwe that touch on the study of tone. Section 1.6 looks at vowel underspecification in Saxwe. Section 1.7 clarifies the conventions of tonal transcription used in this study. In section 1.8, I give a very brief overview of Saxwe morphosyntax, concentrating on those structures that make it easy to read the example sentences given in this study. Finally, section 1.9 ends with a summary of this chapter and how it relates to the study of tone.

1.2 Previous research done on Saxwe

The first descriptive work on Saxwe, a phonetic outline, was done by Tchitchi (1984). Subsequently, a more in-depth phonological analysis of Saxwe was done by Tossa (1984). Following this, Capo included Saxwe among the languages he looked at when comparing the phonologies of the various languages in the Gbe continuum (Capo, 1984, 1991).

In addition to these studies, there exists a short lexicon including a brief orthography statement which was distributed among literacy supervisors in the Saxwe area (CENALA, 1995). A series of three literacy booklets and a book on arithmetic were also published as a part of the Beninese government's program to promote literacy in Saxwe.

Saxwe data can be found in a comparative word list published by a government research body (CNL du Bénin, 1983). Data can also be found in a compilation of local language translations of technical terminology, published by the Beninese government's Centre National de Linguistique Appliquée (CENALA, 1984).

A survey of the Saxwe-speaking region was carried out by SIL International (Johnson & SIL International, 2011). This survey included language comprehension testing among peoples of neighboring language communities.

More recent work includes a manuscript on general topics in Saxwe phonology by Beavon-Ham and Ham (2013), a study of the nasal consonant phonemes by Ham (2012), and a preliminary analysis of the interaction between consonant quality and tone by Beavon-Ham (2012).

1.3 Methodology of data gathering

The recordings referred to in the examples given in this study were collected over an initial period of two months (March and April) in 2015, and then a follow-up period of two weeks in May of 2017. Background research leading up to this collection of recordings was done over the course of four years from 2011 to 2015 during intermittent periods of residence in the town of Adrome, on the immediate outskirts of Houeyogbe.

My consultants (with their approximate ages) included the following: Saturnin Amoussou (mid 50's) from the village of Ahouloume, Jean Kpinso (late 60's) from the village of Adrome, Pierrette Goudjinou (late 20's) from the village of Tohou, Jean de Dieu Amoussou (mid 20's) from the village of Doutou. Other individuals who helped verify data included Patrice Videgnon (mid 20's) from the village of Lobogo and Godefroy Sossou (early 30's) from the village of Zoungbonou.

My approximately 5,000 recordings (of varying sizes ranging mostly from individual words to sentences) that are archived in conjuction with the publication of this study were obtained primarily from André Taïve (early 40s) from the village of Adrome. Taïve is a tailor with considerable experience in public oral translation and in radio recording. Chapter 7, which discusses the phonetic implementation of tone, gives details on the other speakers whose data contributed to the findings in that chapter as well as the techniques used for obtaining those data.

As much as possible, I have tried to reference a recording with each example given so that interested readers may have access to the primary data, found at: https://drive.google.com/open?id=1m1ayvexqtOGCHS9eFiypts9vz-NOu0dr.

Beyond these recordings and the elicited data obtained from consultants, my corpus of data included a lexical database of approximately 3600 entries using the program Fieldworks Language Explorer (SIL International, 2011). From this database, I first established a list of 300 monomorphemic nouns and 215 monomorphemic verbs. I then worked with Pierrette Goudjinou and André Taïve to categorize these nouns and verbs into groups of similar-sounding tone patterns, using whistling as a tool for helping in the distinction between minor differences. Following this, I recorded the transcriptions of these forms and did oral recordings of these words. Then I put these nouns and verbs into a variety of paradigms, doing oral recordings of all the paradigms with Taïve. I then followed the same process with other parts of speech. I continued with recordings of language paradigms with units of all levels, monomorphemic and polymorphemic, with utterances ranging from words to phrases to texts.

All recordings were done on a Marantz PMD 660 solid state recorder using an external Shure SM10A headworn, unidirectional dynamic microphone. The recordings were done in a cement-walled room, with efforts made to use fabric to dampen echos. The room was within earshot of a road and occasional street sounds may be heard on the recordings.

Finally, pitch traces and pitch measurements that appear in this study were done using the program Praat (Boersma & Weenink, 2015).

1.4 Overview of the phonology of Saxwe

This discussion of Saxwe phonology is drawn in large part from Beavon-Ham and Ham (2013), as well as from Tossa (1984). It begins with a look at syllable structure (section 1.4.1), followed by a vowel inventory (section 1.4.2) and a consonant inventory (section 1.4.3). Next, I examine in section 1.4.4 the status of nasal consonants in Saxwe, an issue that is relevant to consonant-tone interactions. Following this is a description of other allophonic contrasts in section 1.4.5, followed by a brief mention of the process of vowel elision in section 1.4.6.

1.4.1 Syllable structure

A discussion of the phoneme inventory of Saxwe must begin with a look at the structure of syllables. All syllables in Saxwe are open. In monomorphemic words there are three types of syllables: CV, V and CCV. Polymorphemic forms may have a fourth type of syllable, which is CCCV.

The CV syllable structure is by far the most common type of syllable. As Tossa demonstrates in his phonology of Saxwe, CV syllables are abundant and are an open class (1984).

The V syllable structure, however, is a closed class and is found only as a grammatical morpheme or as the initial vowel in a V.C(C)V noun. The V syllable only appears word-initially; when suffixes of the shape /-V/ are affixed to a word, a process of resyllabification makes these suffixes the nucleus of a C(C)(C)V syllable. This morphophonological process is described in section 1.5.1.

To my knowledge, the entire inventory of V syllables that function as grammatical morphemes are listed in (1).

(1)	[ṑ][1]	2SG
	[é]	3SG
	[ɔ̃̀]	negation marker (NEG)
	[ò]	anterior marker (ANT)
	[á]	subjunctive marker (SBJV)
	[á]	marks same subject non-initial clause chains in a future or habitual TAM framework (SS)

Most frequently, V syllables occur as the initial vowel (either /a/, /ɛ/, or /o/) in a V.C(C)V noun as in (2).

(2)	[ābɔ́]	arm	sxw-L0051-VCV nouns-arm-un.wav
	[ɛ̄ɖɛ́]	tongue	sxw-L0219-VCV nouns-tongue-un.wav
	[ōsú]	husband, male	sxw-L0226-VCV nouns-husband, male-un.wav

As with other Kwa languages that no longer have a functioning class system, it is hypothesized that these initial vowels in Gbe historically had a role as class marker prefixes and are now a vestige of that system (Good, 2012; Williamson, 1989).

The question has also been raised whether these initial vowels might be a derivational prefix, deriving a noun from a verb (Lefebvre & Brousseau, 2002, p. 193). This question comes from pairings where verbs and nouns are clearly semantically related, the difference being the presence of the initial vowel (*e.g.* [kú] 'die' and [ōkú] 'death'). However, the addition of a word-initial vowel to a verb in order to derive a noun is not a productive process from a synchronic perspective.

The initial vowel does, however, have interesting phonological properties; it has a predilection for undergoing deletion in processes such as noun compounding and in fast speech. Sometimes it is merely the segmental features of the vowel that are lost, and sometimes the loss includes the segmental features together with the tone-bearing unit. This is explored further in sections 4.2 and 4.4.

Long vowels exist in Saxwe in two clearly defined contexts: (1) in words with ideophonic properties, and (2) at a morphological boundary when a pronominal

[1] Note that the symbol (˜) over the [o] indicates a mid-falling tone.

first or third singular suffix is attached to the verb. The former context may involve more pronounced lengthening and is discussed in section 4.9, and the latter involves less pronounced lengthening and is discussed in section 4.6. An example of each is given below.

(3)	[xwíí]	quiet, quietly	sxw-L0038-Ideophones-un.wav
	[é kô:]	he laughed at me	sxw-L0044-verb plus pronoun-un.wav

Leaving now the topic of V syllables, I turn to CCV syllables. The monomorphemic C_1C_2V syllable structure exists in Saxwe, but the identity of C_2 in these structures is limited to the sonorants /l/ (and its allophone [ɾ]), /j/, and occasionally /w/.[2]

(4)	[āglȁ̃]	jaw	sxw-L0158-VCV nouns-jaw-un.wav
	[ōtɾɛ̃̏]	bachelor	sxw-L0155-VCV nouns-bachelor-un.wav
	[ōfjó]	dry season	sxw-L0105-VCV nouns-dry season-un.wav
	[ābwĩ]	vaccine, syringe	sxw-L0247-VCV nouns-shot, syringe-un.wav

1.4.2 Vowels

Saxwe has a seven-vowel system that includes vowel nasalization. In total, it has seven oral vowels and five nasalized vowels, shown in Table 1. In morphophonological processes, the vowels /a/ and /ã/ are grouped with [back] vowels (section 1.5.1). Although the feature [round] may appear redundant in this table, we see in section 4.6 that this feature is active in morphophonological processes.

[2] All CwV sequences are probably derived historically from the affixation of a word-formation suffix that was a completely unspecified vowel (/-V/) to a word that had a rounded vowel word-finally before affixation. Height harmony would have been part of the affixation process, followed by strengthening of the stem vowel to [w]—both of which are phonological processes that are attested synchronically when the 3SG suffix is affixed to a verb. As evidence of this claim of historical derivation, I have found that all CwV sequences in my database end in a front vowel.

Table 1 - Saxwe vowel phoneme inventory

<table>
<tr><td rowspan="3"></td><td colspan="2"></td><td colspan="4">[back]</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">[nasal]</td><td rowspan="2"></td><td rowspan="2">[nasal]</td><td colspan="2">[round]</td></tr>
<tr><td></td><td>[nasal]</td></tr>
<tr><td>[high]</td><td>i</td><td>ĩ</td><td></td><td></td><td>u</td><td>ũ</td></tr>
<tr><td>[ATR]</td><td>e</td><td></td><td></td><td></td><td>o</td><td></td></tr>
<tr><td></td><td>ɛ</td><td>ɛ̃</td><td></td><td></td><td>ɔ</td><td>ɔ̃</td></tr>
<tr><td>[low]</td><td colspan="2"></td><td>a</td><td>ã</td><td></td><td></td></tr>
</table>

An example of each of these vowels is found in (5).

(5)	[ōfí]	place, location	sxw-L0082-VCV nouns-place-un.wav
	[ōtĩ́]	tree	sxw-L0166-VCV nouns-tree-un.wav
	[ōté]	grinding stone	sxw-L0172-VCV nouns-grinding stone-un.wav
	[ōxɛ̃̀]	bird	sxw-L0262-VCV nouns-bird-un.wav
	[ōfɛ̃́]	error	sxw-L0163-VCV nouns-error-un.wav
	[ōtú]	gun	sxw-L0136-VCV nouns-gun-un.wav
	[ōfṹ]	fur	sxw-L0222-VCV nouns-fur-un.wav
	[ōtó]	ear	sxw-L0233-VCV nouns-ear-un.wav
	[ōtɔ́]	father	sxw-L0230-VCV nouns-father-un.wav
	[ōtɔ̃̀]	shrew	sxw-L0256-VCV nouns-shrew-un.wav
	[ōxá]	broom	sxw-L0085-VCV nouns-broom-un.wav
	[ōtã́]	saliva	sxw-L0140-VCV nouns-saliva-un.wav

1.4.3 Consonants

There are twenty-one consonant phonemes in Saxwe. Table 2 describes these phonemes in terms of their distinctive features. Note that in this table, allophones are indicated in phonetic brackets below the listing of the phoneme.

Table 2 - Saxwe consonant phoneme inventory (allophones in brackets)

<table>
<tr><td colspan="3" rowspan="3"></td><td colspan="2">[labial]</td><td colspan="4"></td><td colspan="4">[back]</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">[cont]</td><td rowspan="2"></td><td rowspan="2">[cont]</td><td rowspan="2">[api]</td><td rowspan="2">[del. release]</td><td rowspan="2"></td><td rowspan="2">[cont]</td><td colspan="2">[labial]</td></tr>
<tr><td></td><td>[cont]</td></tr>
<tr><td></td><td rowspan="2"></td><td rowspan="3"></td><td>(p)</td><td>f</td><td>t</td><td>s</td><td></td><td>tʃ</td><td>k</td><td>x</td><td>kp</td><td>xw</td></tr>
<tr><td rowspan="3">[vce]</td><td>b
[m]</td><td>v</td><td>d</td><td>z</td><td>ɖ
[n]</td><td>dʒ</td><td>g</td><td>ɦ</td><td>gb</td><td>ɦw</td></tr>
<tr><td rowspan="2">[son]</td><td colspan="2">w
[w̃]</td><td colspan="4">j
[ɲ]</td></tr>
<tr><td>[lat]</td><td colspan="2"></td><td colspan="4">l
[ɾ]</td></tr>
</table>

Leaving aside the issue of allophones in complementary distribution (discussed in sections 1.4.4 and 1.4.5), there are several remarks to be made about this chart of consonant phonemes in Saxwe. First, I note that the phonemes are arranged in rows such that the first row is comprised of voiceless obstruents, the second row is made up of voiced obstruents (including the sounds /b/ and /ɖ/ which are unusual in having nasal allophones), and the remaining rows group the sonorants. These three groupings, as well as the sub-category which includes just the sounds /b/ and /ɖ/, are relevant to tonal behavior; this is discussed in depth in chapter 3.

The sound [p] is found in Saxwe, but only in borrowed words and in ideophones. For this reason, its status as a phoneme of the language is marginal. Tossa (1984) does not include this sound in his phoneme chart of Saxwe and here I mark it in parentheses to indicate its marginal status.

The sound [ɣ] (not found in Table 2) is found in a handful of Saxwe words as pronounced by some older speakers, appearing in only 5 words out of my 3600-word database. Younger speakers do not have this sound and substitute /j/ or /w/ for it. I have chosen to leave it out of the inventory of consonant phonemes, as it no longer appears to play a role in the phonological system of Saxwe.

In Table 2, /ɦ/ functions as the voiced counterpart to /x/ and /ɦw/ as the voiced counterpart to /xw/. Bole-Richard discusses the difficulty of properly identifying the place of articulation for the cognate sound of /ɦ/ in Mina; his claim is that this sound is simultaneously velar and glottal (1983: p. 59). Lefebvre and Brousseau label the cognate sound in Fon as the velar /ɣ/ (2002: p. 16). Capo (1994), however, claims that the phoneme /ɣ/ does not exist in Fon or in the Phla-Pherá dialects (of which Saxwe is one), although it does exist in neighboring dialects.

While there are individual tokens in Saxwe where the phoneme /ɦ/ can sound like a velar /ɣ/, for the most part this phoneme is pronounced as a glottal sound, but with more friction "noise" than one might expect from a voiced glottal fricative. Given this reality, Capo's assertion, and the fact that some older speakers have a sound /ɣ/ distinct from /ɦ/ for a few lexical items, I feel it is correct to label this sound as /ɦ/. Perhaps Bole-Richard's (1983) hypothesis of simultaneous stricture at the velum and in the glottal region is an accurate assessment of the exact means of articulation of this sound in Saxwe as well. This is a potential area for further phonetics research.

The sounds /xw/ and /ɦw/ operate each as a single phoneme in Saxwe. Bole-Richard (1983) states that the phoneme /xw/ in Saxwe (and Aja, Fon, and Gun) has /ɸ/ as the corresponding cognate sound in Ewe, and the phoneme /ɦw/ in Saxwe (and Aja, Fon, and Gun) has /ß/ as the corresponding cognate sound in Ewe. Data from the reduplication process in Saxwe (described in section 1.5.2) show clearly that /xw/ and /ɦw/ are treated as a single phoneme in that although the reduplication prefix only permits a single consonant of the verb onset to be copied, /xw/ and /ɦw/ both appear in the reduplication prefix, just as /gb/ and /kp/ both appear in this prefix.

The following are examples of each of the consonants in the phoneme inventory.

(6)	[āfɔ̃]	foot	sxw-L0267-VCV nouns-leg-un.wav
	[ōtɔ́]	father	sxw-L0230-VCV nouns-father-un.wav
	[ōsɔ́]	horse	sxw-L0231-VCV nouns-horse-un.wav
	[ōtʃɔ́]	dead person, cadaver	sxw-L0218-VCV nouns-cadaver-un.wav
	[ōkɔ̃]	neck	sxw-L0150-VCV nouns-neck-un.wav
	[ōxɔ̃]	room, building	sxw-L0252-VCV nouns-room-un.wav
	[ōkpɔ̃]	panther	sxw-L0151-VCV nouns-panther-un.wav
	[āxwá]	shout, commotion	sxw-L0303-VCV nouns-shout.wav
	[ābɔ́]	arm	sxw-L0051-VCV nouns-arm-un.wav
	[āvɔ̀]	cloth	sxw-L0202-VCV nouns-cloth-un.wav
	[ōdà]	bow	sxw-L0197-VCV nouns-crossbow-un.wav
	[āzɔ̀]	smoke, haze	sxw-L0114-VCV nouns-smoke, haze-un.wav
	[ōɖā̃]	hair	sxw-L0174-VCV nouns-hair-un.wav
	[ōdʒɔ̀^{R}][3]	flea, louse	sxw-L0075-VCV nouns-flea, louse-un.wav
	[āgɔ̀]	underside, area under	sxw-L0297-VCV nouns-underside-un.wav
	[ōɦò^{R}]	money	sxw-L0270-VCV nouns-money-un.wav
	[ōgbɔ̀^{R}]	goat	sxw-L0065-VCV nouns-goat-un.wav
	[āɦwà]	locust bean pod	sxw-L0191-VCV nouns-locust bean pod-un.wav
	[ōwɔ́]	corn flour	sxw-L0167-VCV nouns-corn flour-un.wav
	[ōjɔ́]	call, hail	sxw-L0170-VCV nouns-call-un.wav
	[ālɔ̃]	hand	sxw-L0245-VCV nouns-hand-un.wav

1.4.4 The status of nasal consonants in Saxwe

The phonemic status of the nasal sounds [m], [n], [ɲ] and [w̃] is an issue that has long been a source of discussion in Gbe languages.[4] In Saxwe, these sounds appear in complementary environments: [m], [n], [ɲ] and [w̃] precede nasalized vowels and [b], [ɖ], [j] and [w] precede oral vowels.[5] Nasalized vowels, however, are not restricted to an environment in which they follow nasal consonants.

A brief comment is needed regarded the phonetic articulations of the sounds typically noted orthographically in the Kwa languages as **ɖ** and **d**. What is marked as **ɖ** is not a true retroflex as is found in languages in India. Rather, the sound **ɖ** in Ewe is characterized by Ladefoged (1964, p. 20) as an apical post-alveolar stop which is articulated with the tip of the tongue against the alveolar ridge. In contrast with this, the sound **d** is described as a laminal denti-alveolar stop

[3] The superscript ^{R} indicates a slight upglide in pitch utterance-finally. This is more noticeable for some speakers than for others and is described in sections 3.6.4 and 3.7.5 and demonstrated in F_0 measurements in sections 7.5.3 and 7.5.4.

[4] For some Gbe languages, the sound [ŋ] can be added to this list with its complementary sound [ɣ] preceding oral vowels.

[5] Before the nasalized vowel [ũ], the sound [w̃] can be almost imperceptible. Before the nasalized vowel [ɔ̃] the nasal counterpart to [w] can sound more like [ŋ^{w}]. Before the high vowel [i], the nasal counterpart of [j] can sound more like [j̃].

and is articulated with the blade of the tongue against the teeth and alveolar ridge (Ladefoged, 1964, pp. 19–20). The description of these sounds in Ewe matches my own informal observations of the articulations of these sounds in Saxwe.

A complicating factor in the issue of Gbe phonology is that the sounds [b] and [ɖ], unlike other voiced obstruents, do not have paired voiceless counterparts. This has been attributed to the fact that these sounds are historically derived from pre-Gbe implosive sounds ***ɓ** and ***ɗ** (Stewart, 1989, pp. 240–241).

One important question, then, that arises in trying to analyze the phonology of many Kwa languages is which of the following hold true: (1) /b/ and /ɖ/ are the underlying consonants (Bole-Richard, 1983, 1984; Capo, 1991; Gbéto, 1997; Lefebvre & Brousseau, 2002; LeSaout, 1973; Tossa, 1984); (2) /m/ and /n/ are the underlying consonants (Ham, 2012; Yaï, 1969), or (3) all of /b/, /ɖ/, /m/, and /n/ have phonemic status (Bentinck, 1975; Stewart, 1989).

In defense of the underlying /b/ and /ɖ/ theory, we see that there is fairly clear evidence for a process of nasal assimilation in the [w]-[w̃] alternation, so by analogy one would assume nasal assimiliation to be the relevant process by which the phonemes /b/ and /ɖ/ would be realized as the allophones [m] and [n]. Also, the sounds [b] and [ɖ] sometimes behave as depressors in the tone system of languages, which would argue for their belonging to the category of voiced obstruents (Bole-Richard, 1983, pp. 110–111).

On the other hand, positing a language without phonemic nasal consonants is typologically unusual. Moreover, there is no single feature or natural class that would unite the "nasalizable" sounds /b/, /ɖ/, /j/, and /w/ from a synchronic point of view, so the rule that would derive [m], [n], [ɲ], and [w̃] from these phonemes looks fairly arbitrary.[6]

Despite these difficulties, the analysis I adopt here, as represented in Table 2, is that /b/ and /ɖ/ are the underlying phonemes. This issue of the status of nasal consonants is tied to the study of tone in Saxwe. Take, for example, the complementary sounds [b] and [m]. As is seen in chapter 3, among verbs that begin with the sounds [b] or [m], all of them display tone patterns that are found in verbs that begin with sonorants (*i.e.* non-depressors). However, among nouns that have the consonant sounds [b] or [m], some (in cases of both [b] and [m]) display tone patterns that are typically found among nouns that have depressor consonants, and some display tone patterns that are typically found among nouns that contain sonorants, with the numbers being roughly equal on either side of this division.

The fact that a noun that has the consonant sound [m] would ever display a tone pattern typically found among nouns that have depressor consonants suggests

[6] Based on the historical development of the sounds, Stewart (1989) argues that the feature [lenis] (based largely on historic realities) would unite these sounds and distinguish [b] and [ɖ] from the voiced obstruents which do not participate in this nasal assimilation process.

that in Saxwe phonology, this sound is either currently an allophone of /b/ or it was an allophone of /b/ historically.

The fact that nouns show more complexity in this regard is not unrelated to Smith's (2011) observation that nouns generally show more phonological contrasts than do other parts of speech, including verbs. In this case, we could say that nouns in Saxwe tend to preserve historically relevant tonal contrasts longer than do verbs. This is true not only when we look at historic trends of consonant-tone interaction, but also when we look at the large number of tonal patterns that exist for nouns as compared to the fewer number of tonal patterns that exist for verbs—a fact discussed in section 3.10.

1.4.5 Other phonological rules

In Saxwe, the consonant [l] obtains the feature [nasal] by assimilation when it appears as the second consonant in a consonant cluster preceding a nasalized vowel and following the phonetic sounds [m] and [w̃] (underlying phonemes /b/ and /w/).

(7)	/ōblɛ̃̀/	[ōml̃ɛ̃̀]	fishhook	sxw-L0022-VCV nouns-fishhook-un.wav
	/wlã̿/	[w̃l̃ã̀]	write	sxw-L0105-verbs-write-un.wav

The flap [ɾ] is an allophone of /l/ and occurs following coronal consonants.

(8)	/jlã̿/	[ɲɾã̀]	be bad	sxw-L0022-verbs-bad (be), ugly (be)-un.wav
	/tlɔ́/	[tɾɔ́]	turn, turn sth	sxw-L0149-verbs-turn sth-un.wav
	/klã́/	[klã́]	separate from	sxw-L0154-verbs-separate from so-un.wav
	/blī/	[blì]	roll	sxw-L0275-verbs-roll-un.wav

Finally, there is a neutralization of the contrast between /x/ and /ɦ/ preceding nasalized vowels, such that only the voiced /ɦ/ appears before nasalized vowels. Similarly, there is a neutralization of the contrast between /xw/ and /ɦw/ preceding nasalized vowels, such that only the voiced /ɦw/ appears before nasalized vowels.[7]

[7] The single exception that I am aware of is the marker [xɛ̃́], which is used in identification clauses for proximal objects and means 'this is' or 'here is'. I believe this morpheme could be derived historically from an amalgam of the demonstrative [xé] 'this' and the marker [mɛ̃̿] which is used in identification clauses for distal objects and means 'that is' or 'there is'.

(9)	/xú/	[xú]	dry, be dry	sxw-L0155-verbs-dry (be)-un.wav
	/ɦù/	[ɦù]	kill	sxw-L0074-verbs-kill-un.wav
	/ɦũ̀/	[ɦũ̀]	open	sxw-L0080-verbs-open-un.wav
	*/xũ/			
	/ōxwē/	[ōxwē]	year	sxw-L0250-VCV nouns-year-un.wav
	/ōɦwè/	[ōɦwè]	fish	sxw-L0021-VCV nouns-fish-un.wav
	/ɦwɛ̃̌/	[ɦwɛ̃̀^{R}]	mature, grow	sxw-L0245-verbs-mature-un.wav
	*/xwɛ̃/			

Furthermore, there is a neutralization of the contrast between /x/ and /xw/ preceding rounded vowels, with only /x/ appearing before rounded vowels. Similarly, there is a neutralization of the contrast between /ɦ/ and /ɦw/ preceding rounded vowels, with only /ɦ/ appearing before rounded vowels.[8]

(10)	/xō/	[xò]	hit, beat	sxw-L0026-verbs-hit, beat-un.wav
	/xú/	[xú]	dry, be dry	sxw-L0155-verbs-dry (be)-un.wav
	*/xwo/			
	*/xwu/			
	/ɦù/	[ɦù]	kill	sxw-L0074-verbs-kill-un.wav
	/ōɦó/	[ōɦò^{R}]	money	sxw-L0270-VCV nouns-money-un.wav
	*/ɦwo/			
	*/xwo/			

Taken together with the neutralization of contrast between /x/ and /ɦ/ preceding nasalized vowels, this means that only /ɦ/ can precede a nasalized rounded vowel /ũ/ or /ɔ̃/—/x/, /xw/ and /ɦw/ do not appear in this environment.

1.4.6 Vowel elision

In section 1.4.1, it is noted that the initial vowel of monomorphemic V.C(C)V nouns is either /a/, /ɛ/ or /o/.[9] These initial vowels may historically have had a role either as noun class prefixes, or as derivational prefixes (deriving nouns from verbs). Synchronically, however, these initial vowels are not involved in any productive derivational process, nor are there any indications in the language that noun classes have a role in the grammar.

A role that the initial vowels do seem to fill is that of ensuring that nouns satisfy the constraint of being minimally bisyllabic; there is a constraint in Saxwe

[8] There is one exception to this, which is the exclamation [xwɔ̀], used to express amazement and, in some cases, disapproval.

[9] The prefix /o/ in Saxwe often corresponds to the prefix /e/ in cognate words in neighboring languages such as Gen and Aja.

that with the exception of pronouns and borrowed nouns, all nouns must be minimally bisyllabic in their lexical form.

That being said, in normal to fast speech, the segmental features of the initial vowels /o/ and /ɛ/ on the noun may be elided following the verb. This happens without deletion of the tone-bearing unit and only when the initial vowel has an underlying M tone. The initial vowel /a/ is not usually elided in this context, and when the noun begins with initial /a/, it is sometimes the final vowel of the preceding verb that is elided instead.[10] Since verbs usually have the form C(C)V, this elision is a means of continuing the preferred C(C)V pattern throughout the utterance. Noun-initial vowel elision is most frequent for common nouns such as [ōnṹ] 'thing', [ōxó] 'word, utterance', and [ōgbè] 'speech, voice, language', which are used in phrasal verb utterances.[11]

(11)	/ɖ̠ū ōɖ̠ṹ/	→	[ɖ̠ū nṹ]	eat	lit. eat thing
	/lɔ̄ ōxó/	→	[lɔ̄ xó]	speak	lit. tell a word
	/dò ōgbè/	→	[dò gbè]	greet	lit. put a speech
	/ɖ̠ó ōɖ̠jú/	→	[ɖ̠ó ɖ̠jú]	be dirty	lit. have dirt / mess
	/ɖ̠ū ōgá/	→	[ɖ̠ū gà^{R}]	become the leader	lit. eat leader
	/dò āxwá/	→	[dàxwá]	cry out	lit. put shout
	/dò āxwá/	→	*[dò xwá]	cry out	lit. put shout
	/dʒɛ̄ ādɔ̄̀/	→	[dʒādɔ̄̀]	become ill	lit. fall illness
	/dʒɛ̄ ādɔ̄̀/	→	*[dʒɛ̄ dɔ̄̀]	become ill	lit. fall illness

The more infrequent or unusual the noun, the less likely its prefix vowel will be elided. A brief examination of several of the texts in my corpus indicates also that a noun that has discourse-level pragmatic focus on it is not as likely to have its prefix vowel elided. This is a topic that could be pursued for further study.

1.5 Morphophonological processes

Saxwe has several interesting morphophonological processes that will be referred to in this study of tone. This discussion of morphophonological processes draws from Beavon-Ham and Ham (2013). In section 1.5.1, I look at the behavior of the first and third person singular object suffixes. In section 1.5.2, I discuss the reduplication

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[10] It is not within the purview of this study to give a detailed account of vowel elision. One of the cases I am aware of where the prefix vowel /a/ is elided is in /ɖ̠ī āsā/, a phrasal verb meaning 'go for a stroll', which is pronounced often as [ɖ̠ī sā̃].

[11] Interestingly, the initial [ɛ] of the word [ɛ̄mɛ̄̃] 'person' is not permitted to be elided:

/kā̃ ɛ̄bɛ̄̃/	→	*[kā̃ mɛ̄̃]	look for someone	lit. look for person
/kpɔ̄́ ɛ̄bɛ̄̃/	→	*[kpɔ̄́ mɛ̂̄]	find someone	lit. see person

process that is involved in deriving nominal and adjectival forms from monomorphemic verbs.

1.5.1 First and third person singular object suffix

When the verb is followed by the 1SG or 3SG object, the form used for this object is a pronominal suffix composed of a single vowel which assimilates to the features of the final vowel of the verb stem. Following this process of assimilation, the stem vowel undergoes strengthening. The details of this process are discussed at length in section 4.6. Here, I simply show the phenomenon.

The following data in (12) illustrate this process with the 1SG pronominal suffix, a vowel which is specified only for the feature [back]. In these examples, the form [é] is the 3SG pronoun. The underlying verb is given first.

(12) Verb followed by 1SG pronominal suffix (V [back])

a.	/s**í**/ → [é s**jû:**]	he respected me	sxw-L0030-verb plus pronoun-un.wav
b.	/w**ĩ́**/→ [é w̃**j̃ũ̂:**]	he awakened me	sxw-L0032-verb plus pronoun-un.wav
c.	/kp**é**/ → [é kp**jô:**]	he met me	sxw-L0034-verb plus pronoun-un.wav
d.	/gb**ɛ́**/ → [é gb**jɔ̂:**]	he refused me	sxw-L0036-verb plus pronoun-un.wav
e.	/ɦ**ɛ̃̀**/→ [é ɦ**jɔ̃̀:**]	he supported me	sxw-L0038-verb plus pronoun-un.wav
f.	/b**ú**/ → [é b**û:**]	he lost me	sxw-L0040-verb plus pronoun-un.wav
g.	/z**ũ̀**/→ [é z**ũ̀:**]	he insulted me	sxw-L0042-verb plus pronoun-un.wav
h.	/k**ó**/ → [é k**ô:**]	he laughed at me	sxw-L0044-verb plus pronoun-un.wav
i.	/s**ɔ́**/ → [é s**ɔ̂:**]	he took me	sxw-L0046-verb plus pronoun-un.wav
j.	/kp**ɔ̃́**/ → [é kp**ɔ̃̂:**]	he saw me	sxw-L0048-verb plus pronoun-un.wav
k.	/t**á**/ → [é t**â:**]	he drew me	sxw-L0052-verb plus pronoun-un.wav
l.	/f**ã́**/ → [é f**ã̂:**]	he embraced me	sxw-L0054-verb plus pronoun-un.wav

A similar process of assimilation following by strengthening occurs when the verb is followed by the 3SG pronominal suffix, a vowel which is unspecified for any feature.

(13) Verb followed by 3SG pronominal suffix (unspecified V)

a.	/tʃ**í**/ → [é tʃ**î:**]	he turned it off	sxw-L0001-verb plus pronoun-un.wav
b.	/w**ĩ́**/→ [é w̃**ĩ̂:**]	he awakened it	sxw-L0003-verb plus pronoun-un.wav
c.	/fl**é**/ → [é fl**ê:**]	he husked it	sxw-L0005-verb plus pronoun-un.wav
d.	/b**ɛ́**/ → [é b**ɛ̂:**]	he gathered it	sxw-L0007-verb plus pronoun-un.wav
e.	/tɾ**ɛ̃́**/→ [é tɾ**ɛ̃̂:**]	he ripped it	sxw-L0009-verb plus pronoun-un.wav
f.	/b**ú**/ → [é b**wî:**]	he lost it	sxw-L0013-verb plus pronoun-un.wav
g.	/t**ũ̄**/→ [é t**wĩ̂:**]	he untied it	sxw-L0015-verb plus pronoun-un.wav
h.	/t**ó**/ → [é t**wê:**]	he pounded it	sxw-L0018-verb plus pronoun-un.wav
i.	/s**ɔ́**/ → [é s**wɛ̂:**]	he took it	sxw-L0020-verb plus pronoun-un.wav
j.	/kp**ɔ̃́**/ → [é kp**wɛ̃̂:**]	he saw it	sxw-L0022-verb plus pronoun-un.wav
k.	/t**á**/ → [é t**jɛ̂:**]	he drew it	sxw-L0024-verb plus pronoun-un.wav
l.	/kp**ã́**/ → [é kp**jɛ̃̂:**]	he carried him on the back	sxw-L0026-verb plus pronoun-un.wav

1.5.2 Reduplication processes involved in derivation

Saxwe verbs undergo a process of reduplication to create either an action nominalization or an adjectival form (both syntactic forms having a single phonetic realization). The following are examples of these reduplicated forms. In these examples, [ōnṹ] means 'thing'.

(14)	a.	/lī/	[ōnṹ **lí**lí]	'grinding sth' or 'sth ground' sxw-L0007-verb reduplication-un.wav
	b.	/ɖā/	[ōnṹ **ɖí**ɖá]	'cooking sth' or 'sth cooked' sxw-L0003-verb reduplication-un.wav
	c.	/gɔ̀/	[ōnṹ **gì**gɔ̀]	'healing sth' or 'sth healed' sxw-L0011-verb reduplication-un.wav
	d.	/kã̄/	[ōnṹ **kí**kã́]	'searching for sth' or 'sth searched for' sxw-L0015-verb reduplication-un.wav
	e.	/gblé/	[ōnṹ **gbí**gblé]	'ruining sth' or 'sth ruined' sxw-L0039-verb reduplication-un.wav
	f.	/ɖū/	[ōnṹ **ɖú**ɖú]	'eating sth' or 'sth eaten, food'

This process, including the tone of these forms, is discussed in detail in section 4.4.3. Briefly here, we can see that the reduplication template is a CV prefix, and that only the initial consonant of the verb stem is copied to this prefix, as seen in (14)e [ōnṹ gbígblé]. The prefix vowel is high; specifically, [i] unless the verb stem contains the back vowel [u], in which case the the prefix vowel is [u].

For some speakers, nasal harmony is part of this reduplication process. This is not true of the speaker whose data is found in (14). However, for speakers for whom nasal harmony is a normal part of this process, the verb /kã̄/ in (14)d would give [ōnṹ **kĩ́**kã́].

1.6 Vowel underspecification in Saxwe

Both in the reduplication process described in section 1.5.2 and in borrowed words, epenthetic vowels are high—most commonly /i/, but in some cases /u/. In borrowed words, /i/ is typically added to the end of a word in order to permit resyllabification of a closed syllable so that only open syllables are pronounced. This is seen in [tʃɔ́tʃì], borrowed from the English word 'church', and in [tʃɛ̃́dʒì], borrowed from English 'change'. However, borrowed words that end in closed syllables with labial sounds, such as the French 'robe', generally get an epenthetic /u/, as in [ɦlɔ́bù].

These facts could lead to a suspicion that /i/ is the radically underspecified vowel in the Saxwe system. If we look at surrounding languages, we see that for Gen, a neighboring Gbe language, Abaglo and Archangeli (1989) argue that /e/ is the radically underspecified vowel. Pulleyblank (1988) presents a case for /i/ being the radically underspecified vowel in Yoruba, a language that is spoken in a geographic region close to the Saxwe people.

In Saxwe, however, there is stronger evidence for the vowel /ɛ/ being the radically underspecified vowel. This analysis is reflected in the table of the Saxwe vowel inventory, copied here for ease of reference.

Table 3 - Saxwe vowel inventory (repeated)

			[back]			
		[nasal]		[nasal]	[round]	
						[nasal]
[high]	i	ĩ			u	ũ
[ATR]	e				o	
	ɛ	ɛ̃			ɔ	ɔ̃
[low]			a	ã		

In the Gbe languages, V.C(C)V nouns have a restricted set of vowels that may appear in initial position. In neighboring languages such as Gen and Aja, there are two options: /a/ or /e/. Saxwe adds a third option, /ɛ/, to its inventory of /a/ and /o/ (the latter which is the Saxwe cognate of the initial vowel /e/ found in other Gbe languages).

In addition to the group of words that are pronounced by all Saxwe speakers with the initial vowel /ɛ/, there are a number of words which are pronounced with the initial vowel /a/ by some speakers of Saxwe, but with the initial vowel /ɛ/ by other Saxwe speakers—a situation which could indicate that /ɛ/ is gaining in prominence in the language.

There are also a number of lexical items that are obviously cognate in Saxwe, Gen and Aja, but which differ in the appearance of [ɛ] in the Saxwe surface form—usually in place of [e] in Gen and Aja. The following Gen data are taken from Bole-Richard (1983). The Aja and Saxwe data are taken from my field notes.

(15)	**Saxwe**	**Aja**	**Gen**	
	[sɔ́ kɛ̂]	[sɔ́ kè]		forgive
	[ōxɛ̃]/[ōxɛ́]	[xévĩ́]	[xèví]	bird
	[gɛ̀kɛ́]	[kèkè]		bicycle
	[ɖíɖɛ́]	[ɖèɖì]		ant
	[tɛ́]	[té]	[té]	sting (v.)
	[ōdʒɛ̀]	[èdʒè]	[èdʒè]	salt
	[ɛ̄ɖɛ́]	[àɖè]	[àɖě]	tongue
	[ɛ̄gbɛ̀]	[àgbè]	[àgbè]	life
	[ɛ̄kpɛ̂́]	[èkpê]	[èkpé]	rock
	[ōzɛ̄̀^{R}]	[zévì]	[èzě]	pot
	[ɛ̄sɛ́]	[èsè]		spirit
	[ɛ̄kpɛ́]	[àkpè]		thanks
	[ɛ̄vɛ̀^{R}]	[èvè]		Nile monitor
	[ōjɛ̀]	[èɣì]	[èjè]	spider

If /e/ is the radically underspecified vowel in Aja as it is in Gen, then examples in (15) where /ɛ/ in Saxwe is substituted for /e/ in Aja or Gen are merely cases of differing surface realizations for a vowel which in the underlying form has no pre-assigned features.

1.7 Conventions of transcription used in this study

In this study, the following notations are employed for marking details of tone: the acute symbol (´) indicates high tone, the macron symbol (¯) indicates mid tone, the grave symbol (`) indicate low tone, the circumflex symbol (ˆ) indicates a high-low falling tone, the symbol (˜) indicates a mid falling tone, the symbol (ˇ) indicates a low-high rising tone, the downward arrow (↓) indicates downstep, the degree symbol (°) following a low tone indicates that there is no utterance-final downglide and therefore marks a non-falling low, and finally the superscript letter R

(R) indicates a final slight upglide.[12] These conventions are also summarized in the abbreviations on page xiii.

In the underlying representations in this study, I will be marking underlying tonal forms, not underlying phonemic forms. Therefore I will no longer be marking the underlying forms /b/, /ḍ/, and /j/ for the surface forms [m], [n], and [ɲ]. There are several reasons for this. First, it improves clarity and helps the reader to focus on underlying tonal distinctions rather than phonemic distinctions. Second, it is shown in this study that this allophonic difference does not have a conditioning influence on tone in Saxwe, and therefore it is not clear how the derivation of allophones is ordered with respect to the derivation of allotones. Since it is not in the purview of this study to examine that question in depth, I prefer to go with what is the simplest notation.

1.8 Overview of Saxwe syntax

In this section, I outline the basics of Saxwe syntax, primarily to give the reader a framework for reading the examples given in this study. I first outline Saxwe constituent order typology in section 1.8.1 before turning to a general overview of the tense-aspect-modality (TAM) system in section 1.8.2.

1.8.1 Constituent order typology

Saxwe, like other Gbe languages, is an SVO language. The ordering in a transitive clause is Agent-Verb-Patient, and the ordering in an intransitive clause is Subject-Verb. The following is an overview of Saxwe constituent patterns categorized under head-initial or head-final patterns as generally labeled by typologists.

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[12] Words that end with a low tone and that have a final slight upglide (marked as R) can, for some tokens coming from my primary data source, sound very much like words that end with a low tone and are simply non-falling (marked as °); there is some variation among Saxwe speakers as to how pronounced they make the final upglide. This is explored in the instrumental study discussed in sections 7.5.3 and 7.5.4.

Table 4 - Constituent order patterns in Saxwe

Parameter	**Correlation with head-initial patterns**	**Correlation with head-final patterns**
main clause	VO	
adposition	prepositions	postpositions
genitive construction	N—modifier—suffix (-tɔ̃)	
associative construction		modifier—associative (wé)—N
head noun and modifier (adjective, numeral, relative clause)	N—modifier	
normal relationship of TAM markers to verb	TAM marker—V	
imperfective construction	preverbal tonal element AND post-argument marker	
negation	preverbal marker AND clause-final tonal element	
YNQ		sentence-final tonal element
question words	sentence-initial	

Aboh (2004) examines extensively the topic of clause structure in Gbe languages, drawing on data from Gun, Fon, Gen, and Ewe. The Saxwe data are very much in keeping with the overall distributions of head-initial and head-final surface patterns found among those languages. The most significant innovation in Saxwe is the post-argument imperfective marker [nɔ̃̄] which follows not only the verb, but also the object in the clause, but which also has a preverbal tonal element associated with it. This is discussed in sections 1.8.2 and 5.1.

As with other Gbe languages (Aboh, 2010b), Saxwe noun phrases have the following ordering of elements: Noun – Adjective – Numeral – Relative clause – Demonstrative – Discourse specificity marker – Plural.

In Saxwe, the discourse specificity marker (terminology adopted from (Aboh, 2010b)) has the form [lá]. Unlike the determiner "the" in English, the marker [lá] does not denote identifiability or objective referentiality of an object, but rather marks discourse referentiality (Payne, 2012). A noun that is *not* marked with this discourse specificity marker [lá], can be indefinite in certain utterances. Alternatively, given the context of the sentence, it can also be definite in the sense of being identifiable or it can be understood as a mass noun (Aboh, 2010b). In this study, I will typically translate a Saxwe bare noun using the English indefinite article unless the context seems to require otherwise. In my glosses, the marker [lá] will be labeled as a determiner.

The following are examples of the structures discussed thus far.[13]

[13] The following abbreviations are used in these examples: 2-second person, 3-third person,

(16) Noun and determiner
[ōkpɔ̄ lá]
leopard DET
the leopard (in question) sxw-L0009-noun phrases-un.wav

(17) SVO clause structure
[ōló ɖú ꜜnṹ]
crocodile eat thing
A crocodile ate. sxw-L0352-clause frames-un.wav

(18) Prepositional phrase
[jē zɔ̃̀ lè bwɛ́]
3PL move at here
They passed through here. sxw-L0010-prepositions-un.wav

(19) Postpositional phrase
[jē lē ōɦũ̀ mɛ̃̄]
3PL be.at car in
They are in the car. sxw-L0010-postpositions-un.wav

(20) Genitive construction
[gɛ̀kɛ́ kòfí-tɔ̃̂]
bicycle Kofi-GEN
Kofi's bicycle

(21) Associative construction
[ɛ̄mɛ̃̄ wé óɖâ]
person AM hair
a person's hair sxw-L0010-associative construction-un.wav

(22) Noun and modifier
[jē kpɔ̃́ óꜜnṹ zɛ́tɛ́ jé]
3PL see thing all PL
They saw all the things. sxw-L0030-NP boundary tests-un.wav

(23) Preverbal TAM marking
[ōló nɔ̃́ và^{R}]
crocodile HAB come
Crocodiles habitually come. sxw-L0089-auxiliaries-un.wav

AM-associative marker, DET-determiner, FOC-focus, GEN-genitive suffix, HAB-habitual, IPFV-imperfective, PL-plural, Q-question, SG-singular, YNQ-yes-no question. The tones marked in this section are surface tones.

(24) Imperfective aspect
[é ↓sɔ̃́ nɔ̃̂]
3SG IPFV-leave IPFV
He is leaving. sxw-L0109-auxiliaries-un.wav

(25) Negation
[jē ɔ̀n vâ]
3SG NEG come-NEG
They didn't come. sxw-L0395-auxiliaries-un.wav

(26) Yes-no question marker
[ōdȁ ɲɔ̃̂ː]
snake be.good-YNQ
Are snakes good? sxw-L0033-YNquestions-un.wav

(27) Question words
[bɔ̌ lɛ́ ó ↓sɔ̃́]
where FOC:Q 2SG leave
Where are you from? (lit. Where did you leave?) sxw-L0001-questions-un.wav

1.8.2 Tense, aspect and modality

Saxwe has a verbal system that mostly makes use of the categories of aspect and modality with only one reference to tense. This is not surprising; Ameka and Kropp Dakubu (2008) note that among Kwa languages, a general finding is that aspect and modality are by far the more important facets of the grammar of the verb, with the contrast between perfective and imperfective being of particular importance.

Saxwe tense, aspect and modality (TAM) markers are generally phonologically independent auxiliaries. There are elements of TAM marking that are simply tonal and do not include a segmental element. The majority of the TAM markers appear in the clause before the verb. However, some—such as the imperfective and completive markers—appear after the verb.

There is a morphologically unmarked verb form in Kwa languages that has been given multiple labels: the "perfective" (Aboh, 2004; Aboh & Essegbey, 2010; Winford & Migge, 2007), the "aorist" (Ameka 2008), and the "factative" (Welmers, 1973). Welmers describes the Yoruba "factative" by saying that "the construction expresses the most obvious fact about the verb in question, which in the case of active verbs is that the action was observed or took place, but for stative verbs is that the situation obtains at present" (p. 346-7).

In Saxwe, as in these other Kwa languages, morphologically unmarked action verbs are assumed to have taken place in the past, as in (28).

(28)

[é	ɖ̰é	ògbǎ	lé	ótà	bò	kpɔ̃́	gòdò°]
3SG	remove	hat	at	head	CONJ	look	area.behind

He removed his hat from his head and looked back.
sxw-T0047-texts-un.wav

Stative verbs, when used in the context of a discussion in the present, are assumed to describe states that hold true in the present, as in (29). When used in the context of utterances referring to past events, the stative verb is assumed to describe a past state, as in (30).

(29)

[kōfí	lé	↓bwɛ́]
Kofi	be.at	here

Kofi is here. sxw-L0001-other clauses-un.WAV

(30)

[é	lé	ó↓mɔ̃́	tɔ́ɦɔ̃̀-tɔ̃̀	lá	dʒí]
3SG	be.at	path	Tohon-GEN	DET	on

He was on the path to Tohon. sxw-T0101-texts-un.wav

Therefore, the interpretation of the unmarked verb in Saxwe has to do with both the lexical properties of the verb and the temporal framework of the discourse.

The following is a brief overview of the Saxwe auxiliary TAM markers, focusing on TAM marking that is seen in examples in this study. I include negation in this overview because the negation of future events is tied to TAM marking. This topic is examined in depth in chapter 5.

(31) Saxwe markers of tense, aspect and modality
(preverbal unless otherwise noted)

Tense	Future (FUT)	[nã̄]
Aspect	Imperfective (IPFV)	preverbal /M/ *with* post-argument [nɔ̃̄]
	Progressive (PROG)[14]	[ló] *with* IPFV marking
	Habitual (HAB)[15]	[nɔ̃̄]
	Anterior (ANT)[16]	[ò]
	Repetitive (REPET)	[mɔ̃̀]
	Completive (COMPL)[17]	clause-final [vɔ̀]
Modality	Subjunctive (SBJV)	[á]
	Prospective (PROSP)[18]	[kà] *with* /H/ *with* IPFV marking
	Imperative (IMP)	/L/
	Jussive (JUSS)	[nĩ́]
	Prohibitive (PROH)	[kâ]
	Outcome (OUTC)[19]	[dó]
Negation	Default negation	[ɔ̃̀] *with* clause-final /L/
	Future negation	[ɔ̃̀] *with* /H/ *with* IPFV marking

As is the case in the Gbe languages Gun and Fon, Saxwe has a single tense marker: the future [nã̄] (Aboh & Essegbey, 2010; Lefebvre & Brousseau, 2002; Winford & Migge, 2007).

Imperfectivity is a very important aspectual distinction made in the Saxwe verbal system. Imperfective marking is obligatory when marking the progressive, the prospective, and negative future events.[20] The resulting combinations are interesting as they can involve the juxtaposition of multiple floating tones. The way

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[14] The progressive [ló] is used to emphasize the ongoing nature of an event.

[15] This aspect marker is grammaticalized from the verb [nɔ̃̄] 'rest, remain'.

[16] This form resembles the perfect. However Givón (1984) states that the perfect has four facets: anteriority, counter-sequentiality, lingering relevance, and perfectivity. The Saxwe anterior has the first three characteristics, but not the fourth; it may co-occur with the imperfective.

[17] This aspect marker is probably grammaticalized from the verb [vɔ̀] 'finish'.

[18] The prospective is used to express events that are about to happen, as well as events that the subject wishes will happen.

[19] The modality which is labeled here as outcome projection is often used in subordinate clauses marking purpose or result, as well as in counterfactual conditional clauses.

[20] The progressive and the habitual are mutually exclusive. The progressive must obligatorily co-occur with the imperfective, while the habitual may optionally co-occur with the imperfective.

these various elements are ordered in these cases and how they are realized tonally is discussed in chapter 5.

This very brief overview of the Saxwe TAM system is intended to set the stage for sections in this study that touch on syntax. This concludes the discussion of background information having to do with the Saxwe language and speakers of this language. I turn now to a brief summary of the points which come out of this chapter which I consider most salient to the rest of the study.

1.9 Conclusions

In section 1.1, we see that historical accounts of the Saxwe people theorize that they are descendants of a Yoruboid-speaking population who immigrated into the Gbe-speaking region and adapted their speech to that of Gbe speakers. This has led to the evolution of a Gbe language that displays some idiosyncratic structures not seen in many of the other Gbe languages.[21] With regard to tone, we will see in this study that Saxwe has an underlying three-way tonal contrast, as does Yoruba, but much of the historical assignment of tone is influenced by consonant-tone interaction—a phenomenon which heavily influences the tonal systems of all the Gbe languages.

The overview of Saxwe phonology in section 1.4 highlights the absence of phonemic nasalized consonants in Saxwe. This is important because we see that in the category of nouns, some of the anomalous cases in the historic assignment of tone in Saxwe involve words that contain /b/ or its allophone [m], or /ɖ/ or its allophone [n].

The morphophonological processes described in section 1.5 include the suffixation of a pronominal form to a verb and the derivation of nominal or adjectival forms from a verb using a process of reduplication. These processes are revisited, with a focus on describing associated tonal phenomena, in sections 4.4.3 and 4.6.

The brief overview of Saxwe morphosyntax in section 1.8 should facilitate interpretation of the example sentences given in this study. It also provides a preview of some of the issues which are discussed in chapter 5, including the way in which grammatical floating tones interact with the rest of the elements on the tonal tier.

I now turn to the theoretical frameworks which inform this analysis of Saxwe tone.

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[21] For instance, in Saxwe, the conjunction [bō] used in coordinate clauses is located after the subject of the second clause and before verbal auxiliaries. This is where the coordinating conjunction is found in Yoruba. To my knowledge, in all other documented Gbe variants, the coordinating conjunction precedes the subject of the second clause.

2 Theoretical background

A tonal language is defined by Hyman (2001b) as a language "in which an indication of pitch enters into the lexical realization of at least some morphemes" (p. 1368). As a researcher in the field of tone, one is presented with a dizzying array of potential theoretical approaches and models to make use of. This is due in part to the complexity of tone itself. Hyman (2011b) states that tone is both qualitatively and quantitatively different from segmental features, length and stress, and "extraordinarily versatile, a lot of things at once" (p. 518). In part because of this, there is a lack of consensus on many tone-related questions, such as the feature geometry of tone, the particulars of how tone interacts with prosodic structure, or whether and how tone is related to the laryngeal node.

In this chapter I make clear which theoretical models will be used to describe and analyze Saxwe tone. The ultimate justification of these choices will be found in the degree to which the models chosen are able to produce an analysis that is insightful, comprehensive, and simple (to the degree to which this is possible). This study aims to provide both data and analyses that will be easily digested and re-interpreted in an ever-changing theoretical climate.

This chapter also includes a discussion of how tone has been analyzed in other Gbe languages, as a reference point for analyzing Saxwe tone.

This chapter is organized as follows. Section 2.1 examines tonal underspecification and the possibilities for underlying contrasts when underspecification is taken into account. In section 2.2, I look at the question of whether and how tone can be organized into features. Section 2.3 addresses the phenomena of automatic and non-automatic downstep, including explanations given for these phenomena. In section 2.4, I outline the basics of lexical phonology, including the differences between lexical and postlexical processes, especially as related to tone. Section 2.5 discusses how the prosodic hierarchy can interact with tone, either by limiting the domain of a tonal process or through the introduction of boundary tones. In section 2.6, I look at tone that is related to syntax. Section 2.7 prepares the ground for the overview of Gbe tone by raising the question of consonant-tone interaction and how this interaction has been explained. Section 2.8 gives a brief survey of the study of tone in Gbe languages to date. Finally, section 2.9 summarizes the major elements of this chapter that will inform the rest of the study.

2.1 Tonal underspecification

Underspecification, the concept that features can be underspecified at the underlying level and filled in by default rules (Kiparsky, 1982), has been fruitfully applied to the study of tone. Hyman (2011a) provides an overview of the contrasts that are possible when the theory of underspecification is applied to systems of two and three heights using privative tonal units /H/ (high), /M/ (mid) and /L/ (low). These possibilities are laid out in (32), where /Ø/ stands for a TBU that is unspecified for tonal attribution or features.

(32)	**Two tone heights**	**Three tone heights**
	/H, L/	/H, M, L/
	/H, Ø/	/H, Ø, L/
	/L, Ø/	/H, M, Ø/
	/H, L, Ø/	/Ø, M, L/
		/H, M, L, Ø/

The decision regarding whether to consider that a language's tonal system includes TBUs unspecified for tone is based on several criteria discussed in Hyman (2001a) and Hyman (2011a). Surface tones may be underlyingly unspecified if they are generally inactive phonologically. This can be manifested in several ways. For example:

1. Unspecified tones should not be manipulated in phonological rules such as rules of tone spread, tone shift or tone dissimilation.
2. Morphological rules should not assign a tone which is underlyingly unspecified.
3. Surface tones which are underlyingly unspecified should not appear in tonal contours.
4. A tone which is underlyingly unspecified should not be present as a floating tone.
5. Generally, only tones that are specified underlyingly would have constraints on their position within a prosodic unit.

There are also differences among tonal systems regarding the timing of the moment when a toneless TBU has default tone assigned to it. Pulleyblank (1986) gives three possibilities: default tone may be applied lexically (*i.e.* Luganda (Hyman and Katamba 1993)), postlexically (*i.e.* Tiv (Pulleyblank, 1986)), or at the level of phonetic implementation (*i.e.* Chichewa (Myers, 1996)).

In this study I show that Saxwe has a three-way tonal contrast: /H, M, L/. Both H and L are clearly phonologically active. They both spread rightward onto an adjacent M vowel (section 3.2), and are involved in H-L and L-H surface contours (sections 3.5, 3.7.5, and 3.7.8). In addition, there exist both lexical and grammatical floating Hs (sections 3.7.3, 3.7.7, and 5.4), as well as grammatical floating Ls (sections 5.2 and 5.6).

Underlying M is not phonologically active to the same degree that H and L are. In a certain sense, M could be considered inert or unstable; if there is any preceding H or L, this H or L will spread onto the M TBU (section 3.2). This might be considered good reason to posit that surface [M] is the default tonal height assigned to an underlyingly unspecified TBU were it not for the fact that M is stable as a floating tone and participates in various tonal processes, affecting the outcome of the phonological derivation. Floating M tones exist for a number of reasons. There are historic processes of vowel deletion or word formation that have resulted in floating Ms (sections 3.7.4 and 5.1). There are also synchronic processes of vowel deletion that produce floating Ms (section 4.2). In addition, the phonology of borrowed nouns involves floating Ms (section 4.5).

This floating M is the most significant reason that a /H, Ø, L/ claim is untenable for Saxwe. Chapter 6 summarizes and analyzes in detail the relationship between /H/, /M/, and /L/ and demonstrates why this is the best analysis for characterizing the contrasting levels of tone in Saxwe.

The challenge of defining a three-way contrast where the middle surface height is relatively inert compared to the other two surface heights is not unique to Saxwe. In Yoruba, underlying /rí igbá/ or [rí] + [īgbá] 'see calabash' becomes [rígbá] (Pulleyblank, 1986, p. 109). When the initial vowel [i] is deleted, there is no trace of the [M] to be found in the surface form [rígbá]. This, among other findings, is offered by Pulleyblank (1986) as evidence in favor of the theory that Yoruba has a three-way /H, Ø, L/ contrast.

However, other findings—including the observation that a floating L seems to trigger downstep on a following M tone (Ajiboye, Déchaine, Gick, & Pulleyblank, 2011), and the presence of a [M-H] surface contour (Akinlabi, 1985)—are cited in Pulleyblank (2004) as evidence that the third tone in Yoruba should be interepreted as underlying /M/ rather than /Ø/.

2.2 Tonal features and the Two-Feature model

It is widely held that privative tones such as H, M, and L are actually composed of features, although there is no final consensus about what these features are. The following is an overview of the predominant model that has been proposed to describe tonal features. Other feature models—those that attempt to include some aspect of consonant-tone interaction—are described in section 2.7.

The predominant model is that of Yip (1980, 1989) and Clements (1981), sometimes referred to as the Two-Feature Model. In this model, the TBU dominates a prosodic level that describes register, described as either [+ upper] or [-upper]. Each of [+upper] and [-upper] is in turn subdivided into [+raised] and [-raised] (the latter terminology introduced by Pulleyblank (1986)). This results in four hierarchically related tone levels, shown in (33).

(33)

[+upper]	[+raised]
	[-raised]
[-upper]	[+raised]
	[-raised]

Privative tones are then assigned positions with repect to this hierarchy. Different sets of labels have been given to these four levels: {high, mid, lower mid, and low} (Hyman, 2011a), and {super-high, high, mid, and low} (Clements, Michaud, & Patin, 2010; Odden, 2010). What the differing interpretations have in common is the notion of four absolute levels of pitch.

(34)

		Hyman (2011a)	Clements et. al. (2010) Odden (2010)
[+upper]	[+raised]	H	SH
	[-raised]	M_1	H
[-upper]	[+raised]	M_2	M
	[-raised]	L	L

In a three-tone system, there could theoretically be two possible ways to characterize the M tone. As seen in (34), M could be either [+upper] [-raised], or [-upper] [+raised]. This may depend on whether M is seen as having more in common with H or L (Hyman, 2010). Because these two feature combinations options exist for M, a researcher who employs underspecification in his or her analysis of a three-tone system is required to first choose which features are specified underlyingly, and then elaborate feature fill-in rules to ultimately generate the appropriate combination chosen for M, either [+upper] [-raised] or [-upper] [+raised]. Pulleyblank (1986), using the Two-Feature Model for tone, assigns the underlying features shown in (35) to Yoruba levels H, M and L. Default rules supply the features [-upper] and [+raised].

(35)

	Underlying	**After application of default rules**
H	[+upper]	[+upper, +raised]
M	Ø	[-upper, +raised]
L	[-raised]	[-upper, -raised]

A claim made by this model is that it defines natural classes of tone. It has, however, proven difficult to find in the body of African tone language literature clear evidence that these natural classes do in fact exist, and because of this there are some who question the value of a universal feature model for tone (Clements et al., 2010; Hyman, 2010). For example, Clements et al. (2010) state that "the Two-

Feature Model appears to receive little if any support from African languages" and that "confirming cases are vanishingly few, and the best-known of them (Ewe) can be given alternative analyses not requiring tone features" (p. 14).

It is important to note that although the Two-Feature model gives the label 'register' to the feature [+/-upper], it does not use the term in the way that is used by those (Hyman, 1993; Inkelas, 1989; Snider, 1999) whose aim is to account for the steady lowering of the 'ceiling' of H tone seen in automatic and non-automatic downstep (see section 2.6). Yip (2002) makes this clear in her statement that "for Yip, the interpretation of L register is absolute, whereas for Hyman it is relative" (p.154). This model is therefore not intended to account in a structural way for downstep in the phonological component and would therefore rely on widely used notions of floating tone (or in this case, perhaps floating features) to account for downstep.

There remains the ongoing question of whether a universal feature model of tone is useful. Hyman (2010) emphasizes the unusual complexity of tonal behavior as compared to the behavior of segments or other suprasegmental properties such as length or stress. He argues that tone has greater diversity and autonomy than segments and that "there seems to be little advantage to treating tones other than the way that most tonologists treat them: as privative elements that are related to each other through their relative and scalar phonetic properties" (p. 74).

In a similar vein, Clements et al. (2010) conclude that "the primitive unit in tonal analysis may be the simple tone level, as is assumed in much description work" (p. 20). The authors further state however, that while they do not see the benefit of universal tone features, they acknowledge that there may be language-specific tone features.

In chapters 3 through 5 of this study, Saxwe tonal processes are described using the privative units H, M, and L. Then in chapter 6, I explore how the Saxwe tonal system can be profitably and insightfully described using the Two-Feature model.

I move now to two common processes that affect the surface realization of tones: automatic and non-automatic downstep.

2.3 Automatic and non-automatic downstep

Many of the descriptions of automatic and non-automatic downstep come from African languages. Before discussing and defining automatic and non-automatic downstep, I mention first some related phenomenon, the first of which is declination. Connell and Ladd (1990) define declination as "a gradual modification (over the course of a phrase or utterance) of the phonetic backdrop against which the phonologically specified F_0 targets are scaled" (p. 2). Declination is a phonetic effect that has been observed in both tonal and non-tonal languages. The gradual lowering of declination can be distinguished from final lowering, which is a more abrupt lowering at a phrase or utterance end (Connell & Ladd, 1990; Herman, 1996; Laniran, 1992).

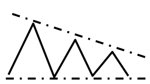
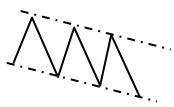
Distinct from both of these purely phonetic lowering phenomena are automatic and non-automatic downstep, terms first used by Stewart (1965). Automatic downstep is the lowering of the 'ceiling' of H tone in a phrase or utterance following a surface L. This leads to a downward stair-stepping pattern of pitch levels, or 'terracing' as it is sometimes referred to (Clements, 1979). Non-automatic downstep is described by Stewart as the lowering of H tone following an underlying L not present at the surface level. Stewart labels both of these phenomena as downstep because of the fact that both are triggered by L tone—one being at the surface level and the other being underlying. There are other labels given to these phenomena; some researchers use 'downdrift' for automatic downstep and 'downstep' for non-automatic downstep (Connell, 2011).

It is fairly common for a language to have automatic downstep but not non-automatic downstep, but it is rare for non-automatic downstep to occur in a language that does not also have automatic downstep (Connell, 2011).

The pitch level resulting from non-automatic downstep has often been compared to that of a M tone. Snider (1998) demonstrates in an instrumental study of the three-tone language Bimoba that in the context of a single instance of downstep in that language, automatic and non-automatic downstep involve the same F_0 difference. In addition, a single instance of downstep is equivalent in F_0 difference to the pitch interval of H to M.

There are other languages, however, for which the pitch difference of non-automatic downstep has been attested to be the same as that of H to L. These have been labeled as 'total downstep languages' and include Ebrie (Stewart, 1993) and Kikuyu (Clements & Ford, 1980).

There is a question whether the 'terracing' effect in downstep only affects Hs, or whether it affects Ls as well. That is, whether downstepping affects only the 'ceiling', as in (36)a, or whether it affects both the 'ceiling' and the 'basement', as in (36)b.

(36) a.  b. 

This may be a language-specific issue and may be dependent on how many iterations of downstep are considered. Instrumental studies in Bimoba (Snider, 1998) show that in that language, in the context of two instances of downstep, the F_0 decline of L exceeds the lowering that might be expected from general declination. On the other hand, a study of Yoruba (Laniran & Clements, 2003) shows that the data from lengthy sentences show no greater decline of Ls which alternate with Hs than is observed for sentences that contain all Ls.

In the vast majority of cases, L (rather than M) is named as a trigger for the downstep of H. There are indications, however, that M can also be the trigger. In Yala-Ikom (Armstrong, 1968), both a floating M and a floating L are shown to trigger downstep of H. So in [òré↓ré] 'eating' (compare to [òróōré] in Yala-Ogoja), downstep is due to a floating M following loss of a vowel. This can be compared to [èsí ɛ́↓má] 'these trees', from /èsí ɛ̀má/. In both cases—whether it is the floating M or the floating L which is the trigger—the H is downstepped by the same pitch interval.

It is not only H tones that are downstepped, although downstepping of M or L is rare. In Yala-Ikom (Armstrong, 1968) a preceding L will downstep a M. A L is downstepped in Bamileke Dschang (Hyman & Tadadjeu, 1976) and in Nawdm (Nicole, 1980). However, there are no languages documented to have downstepping of L without also having downstepping of H (Connell, 2011).

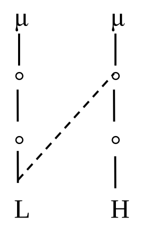
Downstep has been explained in several ways, either at the phonological level or at the level of phonetic implementation. One explanation has been that a floating L tone triggers downstep in the phonetic implementation (Pierrehumbert & Beckman, 1988; Pulleyblank, 1986). Some criticize this explanation of downstep because it has the application of phonetic implementation rules becoming phonologically significant (Snider, 1999).

Several theories of feature geometry respond to this criticism by allowing downstep to be dealt with in the phonology. One way this is done is by having a feature model that represents downstep by referring to the notion of tonal register interpreted in a relative way (*i.e.* successive occurrences of low register lower the 'ceiling' of H tone in an iterative fashion). For example in Hyman (1993), the representation of tone is as follows.

(37) TBU: μ
|
Tonal root node (TRN): °
|
Tonal node (TN): °

Downstep is represented by having L attached to the Tonal Register Node of a TBU that also has H attached to the Tonal Node (Hyman, 1993; Inkelas, 1989). The structure in (38) shows automatic downstep; in non-automatic downstep, the L would not be linked to a TBU.

(38)



There are other ways of explaining downstep. It has been shown that in some languages, non-automatic downstep may be attributed to an underlying sequence of two H tones. In KiShambaa, Odden (1982) attests that the difference between [ngó$^{\downarrow}$tó] 'sheep' and [nyóká] 'snake' is that the former has two underlying H tones while the latter has only one underlying H which is spread to the following syllable, as shown in (39).

(39)

Saxwe has both automatic and non-automatic downstep of H. Automatic downstep is triggered by a surface L. Non-automatic downstep is triggered by a floating M. Chapter 6 discusses the fact that in both cases, it is the feature [-upper] that is the trigger for the downstep. Chapter 7 examines the phonetic detail of automatic and non-automatic downstep.

2.4 Lexical phonology applied to tone

In this study, I make use of the theory of lexical phonology, a theory which is usefully applied to the study of tone because of the fact that tonal rules seem to be ordered with relation to where they fit in the interplay between phonology and morphology on the one hand, and phonology and syntax on the other.

The theory of lexical phonology (Kiparsky, 1982; Mohanan, 1986; Pulleyblank, 1986) organizes phonological processes into two sets—lexical processes and postlexical processes. Underived lexical entities are first subject to lexical rules (roughly word-level). There may be several cycles of lexical rules, following which the output from the lexical rules is subject to postlexical rules (beyond word-level), which typically apply only once.[22] Following the totality of these phonological processes, language is subject to phonetic implementation.

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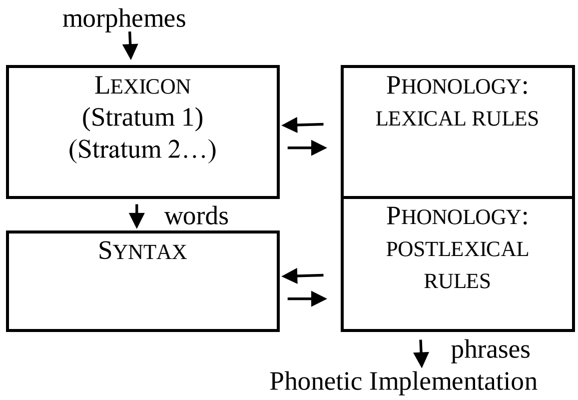
[22] Note, however, that in Ikalanga (Hyman & Mathangwane, 1998), the same postlexical tonal process may apply cumulatively by domain; a H spread process may apply multiple times if it is shown to be a common factor in multiple rules applicable to different prosodic domains.

Simply stated, what comes out of the lexical stage are words, including those that may have undergone processes such as compounding or derivation. These words enter the postlexical stage and become part of syntactic phrases. At this stage, the phonological rules that apply are postlexical rules. This is diagrammed in (40).

(40) Lexical phonology: simplified flowchart adapted from Pulleyblank (1986)



Lexical phonology is well-applied to the study of tone; Pulleyblank (1986) gives an early application of lexical phonology to the study of tone. For any given language, we can divide that language's relevant tonal processes into lexical and postlexical processes. Lexical rules may refer to word-internal structure, may not apply across words, may be cyclic, and may have lexical exceptions (Pulleyblank, 1986). Lexical tonal processes can appear to lack phonetic motivation (Snider, 1999). In some cases, it seems that lexical tonal processes may sometimes refer to the internal structure of the clitic group (taken as the phonological word in some cases) (Hyman, 1990).[23]

Postlexical rules, on the other hand, may not refer to word-internal structure, may apply across words, and cannot have lexical exceptions (Pulleyblank, 2004). Tone processes related to phrasal boundaries are necessarily postlexical. Postlexical tonal processes can refer to several prosodic units, including the phonological phrase, the intonational phrase, and the utterance. This brings up the topic of the prosodic hierarchy, which is addressed in section 2.5.

The output from the phonology is subject to rules of phonetic implementation, which are generally understood to produce effects of a gradient or scalar nature which do not either mask or represent underlying phonemic contrasts.

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[23] There are occasional mismatches between syntactic words and phonological words. The combination of noun followed by associative marker has been analyzed as the phonological word in Dschang (Hyman, 1985).

2.5 The prosodic hierarchy and tone

Related to the issue of postlexical rules is the notion of the prosodic hierarchy (Nespor & Vogel, 1986; Selkirk, 1984). The prosodic hierarchy is composed of several hierarchically-arranged levels. From top down, these are:

1) the Utterance (U)
2) the Intonational Phrase (IP)
3) the Phonological Phrase (PhP)
4) the Clitic Group (CG)
5) the Phonological Word (PW).

Selkirk (1984) proposes that these levels of prosodic hierarchy cannot appear recursively in a nested fashion. That is, a PhP must only contain PWs or CGs, but cannot contain PhPs. This is known as the Strict Layer Hypothesis (Selkirk, 1984).

There are several hypotheses as to how the prosodic structure is constructed in relation to the syntactic structure, with particular consideration often given to how the PhP is constructed. One possibility is that edges of PhPs are established with reference to the right or left edge of either the head or the maximal projection of the syntactic phrase, using X-bar terminology ((Selkirk, 1986), building on Chen (1987)).

For example, in the Anlo dialect of Ewe, PhPs are constructed by creating a new boundary at the left edge of every maximal projection of the syntactic phrase (Clements, 1978; Selkirk, 1986). Within these PhPs, a rule is applied which raises a mid tone located between two high tones to extra-high.

Branchingness of the syntactic phrase is also considered to be a factor in the construction of PhPs in some languages. One example of this is Kinyambo, which constructs phonological phrases with reference to the right edges of maximal projections—but only those maximal projections that branch (Bickmore, 1990). Within the delimitations of phonological structures that meet this description, a rule of H deletion is consistently applied.

Selkirk and Lee (2015) includes a number of modifications on the Nespor and Vogel (1986) and Selkirk (1986) notions of the prosodic hierarchy. For one thing, the U and CG levels are not considered necessary. Moreover, the authors recognize recursivity to be a possibility—a possibility not recognized in the Strict Layer Hypothesis.

In a more recent hypothesis about the way in which prosodic structure is constructed, Selkirk (2011) proposes Match theory. In this optimality-theoretic approach, there is a Match constraint which constructs PWs, PhPs, and IPs by matching the boundaries of these prosodic structures to the boundaries of syntactic words, phrases and clauses. This Match constraint can be ranked lower than other prosodic structure markedness constraints (such as a Headedness constraint, a Layeredness constraint, a Non-recursivity constraint, and an Exhaustivity constraint) when this becomes necessary in describing a specific language.

Just as the syntactic phrase can be non-isomorphic with the PhP, so too the grammatical word can be non-isomorphic with the PW. Hyman (2008) notes that the grammatical word can be larger than the PW (in which case the PW is foot-like), and it can also be smaller than the PW (in which case the PW can behave like a CG).

For example, Myers (1995) describes the PW in Shona as being a structure which includes what he terms a "full word" (a word of any category excluding function words) together with a string of procliticized function words. Thus in Shona, PW boundaries are created at the right edge of "full words". These PWs are the domain in which operate a rule of stress, a rule of epenthesis, and Meeussen's Rule.

Some examples given by Myers are shown in (41) and (42). The brackets and subscript labeling of PWs are my addition.

(41)	[babá]$_{PW}$	[vá-babá]$_{PW}$	[vángu]$_{PW}$
	father	of-father	my
	father of my father (Myers 1995:85)		

(42)	[ívo]$_{PW}$	[ndí-babá]$_{PW}$	[vángu]$_{PW}$
	he	COP-father	my
	he is my father (Myers 1995:85)		

Note in these examples that a single PW encompasses both a function word and the following noun even though the noun (the NP complement of the preposition, for example) may belong to a different branch of the syntactic tree than the function word (the head of the prepositional phrase, for example).

Based on Hyman's (2008) discussion of the Shona data, the following are two possible structures that could be considered to represent the sequences [vá-babá] 'of father' or [ndí-babá] 'COP-father'.

(43) Possible structures for [ndí-babá], based on Hyman (2008) and Myers (1995)

In structure (a), we see recursivity of the PW prosodic level, while structure (b) employs the term CG for what Myers labels as the PW. In both cases there is a recognition that the morphemes involved carry word status at some level in the lexical phonology, but are also integrated into a larger prosodic unit during the lexical stage of the phonology. The tone rules that operate within the PW or CG are lexical processes, although they may operate within the final stratum of lexical processes.

This recursivity in the prosodic structure at the level of the PW is an important element of Saxwe phonology and can account for certain observed tonal phenomena that cannot be dealt with by referencing prosodic structure at the higher level of the PhP. I show in section 4.1 that in Saxwe, two types of structures display this type of recursivity: compounds and nouns derived through reduplication.

So far the noted interaction between prosody and tone has been related to the fact that the operation of certain tone rules—such as a rule of tone deletion or tone raising—can be restricted to being applicable only within boundaries of particular prosodic constituents. However, another form of interaction is that boundary tones can be assigned or attributed to a location where there is a specific prosodic boundary. Such boundary tones are not uncommon in African languages.

In Kinande, a Bantu language, Hyman (1990) describes three different boundary tones: a $H_{\%}$ boundary tone that appears on the right edge of the PhP, a $L_{\%}$ IP boundary tone that appears on the right edge of a completed assertion or a citation form, and a $H_{\%}$ IP boundary tone that appears on the right edge of a question or a form given with list intonation.[24] In the appropriate context, the $H_{\%}$ phrasal boundary tone may appear on the surface together with a $L_{\%}$ or $H_{\%}$ intonational boundary tone.

Assertions and questions are common sources for right edge intonational effects, with higher pitch levels often being associated with questions and lower pitch levels with assertions. This has been observed for Hausa (Inkelas & Leben, 1990; Leben, Inkelas, & Cobler, 1989) and Chichewa (Myers, 1996), as well as Kinande (Hyman, 1990).

Snider (1999) predicts that "phonological phrases in many if not all Niger-Congo languages have Lo boundary tones assigned to their left and right edges" (p. 46). Snider finds partial support for this in the downglide of L tones utterance-finally.

Saxwe is among the Niger-Congo languages that has a $L_{\%}$ boundary tone. In Saxwe, a $L_{\%}$ boundary tone exists to right edge of the IP. However, there are circumstances that may prevent this $L_{\%}$ IP boundary from being realized at the surface level. This is discussed in section 3.5.

The relationship between tone and intonation is a complicated one, and Yip (2002) remarks that "the line between final tonal particles and what we usually call intonation is extremely fuzzy" (p. 114). For some languages, it seems more

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[24] Hyman uses the symbol % for PhP boundary tones and // for intonational phrase boundary tones. I have used the symbol % for both in keeping with current notational trends.

appropriate to address pitch-related boundary effects in the phonetic implementation rather than in the phonology (Myers, 1996; Pierrehumbert & Beckman, 1988). The literature on intonation includes much discussion on how to represent intonation in tonal languages (Cruttenden, 1986; Hirst & de Cristo, 1998; Ladd, 1996; Pierrehumbert, 1980).

2.6 Syntactically-informed tone

Turning to the issue of tone and syntax, we see that there can be a relationship between tone and syntax that is not necessarily or entirely mediated by prosody. Tone can be the sole manifestation of a syntactic marker, in which case it is commonly referred to as grammatical tone. It is also possible that a tonal phenomenon may reference a particular morphosyntactic structure rather than relying solely on references to prosodic structure (Odden, 1990).

For example, Yoruba (Pulleyblank, 1986) has a H boundary tone on the right edge of a subject NP under certain TAM conditions. Thus underlying /bàtà/ 'the shoe' and /já/ 'be cut' are realized as [bàtǎ já] 'the shoe got cut'.

Yip (2002) includes a good overview of the ways that tone interacts with morphology and syntax. Particular tonal rules may apply to particular morphological constructions (such as reduplication). Examples of various morphological and syntactic meanings carried by tone include: the associative construction, focus constructions, complement structures, case, definiteness, referentiality, and all types of tense, aspect, and modality. For example, in the Kwa language Gun, a sentence-final low tone marks a yes-no question (Aboh, 2010a).

In many cases like the Gun low tone of negation, a tone may carry a certain kind of syntactic meaning and be a morpheme in its own right even though it has no associated segmental information; this is what I refer to in this study as grammatical tone. I distinguish this from structurally-driven tone which I consider to be tone conditioned by prosodic structure (referencing any of the levels in the prosodic hierarchy).

The fact that syntax has a bearing on tone (whether directly or indirectly through prosodic mediation) has consequences for the person studying tonal languages. According to Snider (2014), when justifying an analysis of underlying contrasts of tonal patterns, the researcher must strictly control for morphosyntactic factors (in addition to many other factors). This excludes, for example, including both verbs and nouns in a single paradigm that is intended to demonstrate underlying contrast of tonal patterns. Boundary tone interference, prosodic mediation of tonal processes, or other morphosyntactically-driven tone phenomena may mean that such a contrast is not truly a contrast in analogous environments. Bearing this in mind, underlying contrasts in this study will be illustrated in paradigms that strictly control for morphosyntactic factors.

2.7 Consonant-tone interaction

Beginning with some of the earliest studies of Ewe, Gbe languages have been cited in the literature as having consonantal interaction with tone. In this study of Saxwe tone, we see that most of the consonant-tone correlations observed are based on a historic phonological relationship between consonants and tones. Synchronically, however, L has become independent of consonant quality at the phonological level. The lowered tone height that developed because of the lowering effect of depressor consonants is now fully phonologized as phonemic L tone. As evidence of this phonologization, we now see that L may occur in a variety of environments—not simply in a context where it follows a depressor consonant. Just as L is no longer phonologically tied to the presence of a depressor, depressors are no longer categorically followed by L. These facts are discussed in chapter 3.

Because of the historic links between consonant and tone in Saxwe, it is useful to summarize some of the relationships that have been described between consonant quality and tone.

It has long been recognized that depressor consonants—most frequently voiced obstruents—can have a lowering effect on tone. An example of the lowering effect of depressor consonants can be seen in Suma (Adamawa) verbs in the present tense where verbs have either a H or LH pattern depending on whether they begin with a depressor or a non-depressor (Bradshaw, 1995). Bradshaw's paradigm is given in (44).

(44)	**Initial depressor**		**Initial non-depressor**	
	bǒm	'be blind'	ɓúk	'applaud'
	dǐk	'be sonorous'	ɗáŋ	'mount'
	gǎy	'reprimand'	éé	'leave behind'
	gbǎk	'borrow'	fɔ́ɗí	'stir briskly'
	vǎy	'bet'	kírí	'look for'
	zàfí	'sneeze'	nɔ́y	'boil'
	bùsí	'be bland'	rɛ́m	'be able to'
	dìkílí	'tickle'	yárí	'unravel'
	gɔ̀ɓí	'twist'	ndáŋgí	'boom'
	zìkíɗí	'delay'	níkírí	'exaggerate'

The categories of sound that are treated as depressors can vary among languages. For example, Zina Kotoko, a Chadic language, includes glottal stops in the group of what can act as depressors, lowering H to M (Odden, 2007). In addition, the environment that conditions a M to L lowering rule includes voiced obstruents, glottal stops and implosives. Tsua, a Khoisan language, includes among its depressors voiced obstruents, aspirated obstruents, and the glottal fricative /h/ (Mathes, 2015). Tang (2008) and Bradshaw (1999) both include surveys of consonant-tone interaction which show that, in addition to voiced obstruents, the voiceless glottal fricative is one of the most frequent additions to the list of depressor consonants, with sonorants and implosives also occasionally having an affinity for lower tone.

A purely phonetic correlation between voiced obstruents and lowering of pitch, as well as between voiceless obstruents and raising of pitch exists even in languages where there is no phonological relationship between consonants and tone. In one study, Hombert (1977) shows that in Yoruba, a 3-tone language where tone is not affected by consonant quality at the phonological level, there is a lowering effect for voiceless obstruents and a raising effect for voiced obstruents. This effect in Yoruba wears off, however, by the end of the realization of the vowel—somewhere between 40 and 60 msec into the vowel in most cases.

Halle and Stevens (1971) relate the lowering and raising effects of voiced and voiceless obstruents to slack and stiff vocal cords, respectively. The lowering and raising of the larynx in voiced and voiceless obstruent production may also play a role in lowering and raising phonetic pitch (Ewan, 1976).

In order to capture the relationship between consonant type and tone, Halle and Stevens (1971) propose the features [+/- slack, +/- stiff], creating a three-way tonal contrast such that [+slack, -stiff] identifies voiced obstruents with low tone and [-slack , +stiff] identifies voiceless obstruents with high tone.

Duanmu (1990) incorporates the features [stiff] and [slack] into a featural representation where a Voicing/Register node projects from the Laryngeal node. (He borrows Yip's (1989) notion of register, identifying register with voicing). It is below this Voicing/Register node that we find the features [stiff] and [slack]. In this model, the features [above] and [below] replace the traditional use of H and L.

(45)

Laryngeal

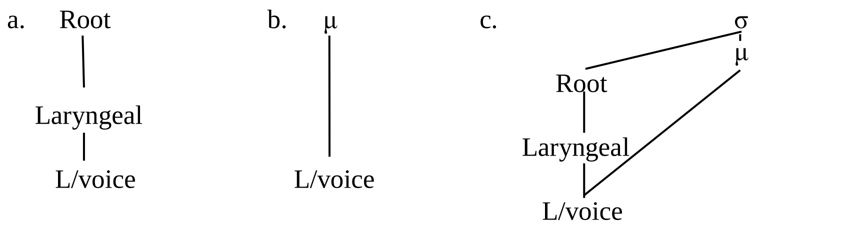
Voicing/Register   Pitch

[stiff] [slack]   [above] [below]

The problem with the complete identification of [slack] with low tone or lower register is that it is a model that can't be universalized. There are languages for which consonant-tone interaction is not a reality—many of which have more than two tone levels. Moreover, there are languages like Siswati in which voiced consonants play a role in one process in the phonology—creating rising tones—while appearing irrelevant in another process—shifting H to the antepenult (Odden, 2010).

Bradshaw (1999) addresses this difficulty in her Multiplanar account, where a single feature [L/voice] can be associated either to the Laryngeal node as in (46)a, or to the mora, as in (46)b, or to both.

(46)



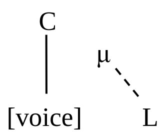
This means that L can be both segmental and autosegmental; it is crossplanar in nature. Interestingly, in Bradshaw's proposal, L is the only tone that has this crossplanar nature. This lopsidedness could be considered a weakness of Bradshaw's proposal, which would suffer if it were shown conclusively that H tone and voiceless obstruents have a parallel consonant-tone interaction.

Note that Bradshaw's model also allows bidirectional spreading of [L/voice]. A consonant may acquire voicing from the following L, just as a mora may acquire L from the preceding consonant.

One wonders about the universality of the Multiplanar mode considering the many languages where voicing of consonants and tone are completely independent of each other. The strong claims made by the Multiplanar model have yet to be shown to be widely valid.

As an alternative to trying to explain consonant-tone interactions through feature hierarchy interrelatedness, one can maintain the suprasegmental nature of L and have the feature [voice] or [+slack] trigger the insertion of L on a following mora by means of a phonological rule. The latter approach is proposed for Suma (Bradshaw, 1995) and Ikalanga (Hyman & Mathangwane, 1998) and is shown in (47) as a rule of L tone insertion.

(47)



Pearce (2009) describes a possible life cycle for consonant-tone interaction over time. First, a language may begin with an underlying voicing contrast but no related underlying tonal contrast. Then there is a development of pitch cues to enhance the voicing contrast. In the next stage of the cycle, both voicing contrast and tonal contrast exist in a redundantly contrastive situation. This may lead to two possible outcomes. Either voicing can lose its contrastiveness and exist only as byproduct of tone—a situation which Pearce argues is presently true for the Chadic language Kera—or voicing and tone develop independently of each other.

In Saxwe, one can find evidence that underlying voicing and tone are currently phonologically independent despite the fact that they may once have been in a redundantly contrastive situation. Section 3.9 discusses how the rule of L tone insertion shown in (47) represents a process that was relevant at one stage in the historical development of Saxwe and could still be considered to be categorically applicable if one looked only at the data from verbs. However, this rule is no longer tenable as a synchronic rule in Saxwe phonology.

2.8 Tonal analysis of Gbe languages

The Gbe languages share many lexical forms, and many of these are likely to have similar underlying tones. Moreover, there is an overlap of tonal processes in the various Gbe languages. For this reason, any student of tone in a Gbe language is well-served by studying previous analyses of tone in Gbe languages. The following is an overview of these tone studies.

2.8.1 Ewe

The most well-researched tone system among Gbe languages is that of Ewe. Studies of Ewe cover several different dialectical variants. Westermann (1930) (cited in Stahlke (1971)), is the first description of the fact that Ewe has three phonetic tone heights—H, M and L—as well as rising and falling pitch. Westermann describes an allophonic relationship between L and M when comparing nouns in isolation with those same nouns in complex forms. He interprets L as underlying in these alternations.

In the first in-depth analysis of Ewe tone, Ansre (1961) describes the Peki dialect and demonstrates that Ewe has consonant-tone interaction. Ansre also describes Ewe as having three phonetic tone heights: H, M and L. He sees the basic underlying tonal contrast as being H *vs.* non-H, and argues for M and L being complementary allotones of non-H, although he does not choose either M or L as being underlying. The realization of M *vs.* L is based on several factors, including (1) the consonant quality preceding the TBU, (2) whether the syllable is in isolation, in a complex form, or in final position, and (3) the following tone.

For isolation forms of nouns, Ansre gives data to show that monomorphemic (V).C(C)V-shaped nouns in isolation have three surface tonal patterns following voiceless obstruents and sonorants (non-depressors) and two surface tonal patterns following voiced obstruents (depressors). The following are data from Ansre (1961) pp. 24, 26, 27, 60, 62, and 63.[25] Note that Ansre himself

[25] Ansre indicates contour tones by placing the second tone over a full stop character, such as in [kē.́] 'root'. He gives no indication of vowel length being phonemic. According to his explanation of vowel length, vowels that are semi-long are always contour tones and those that are long are found in words that have ideophonic qualities. In Stahlke's (1971) copies of Ansre's data, he writes contour tones over two vowels, as in [kēé] 'root'. Although long

does not speak of 'tonal patterns'. Instead, he analyzes some nouns as having a high tone suffix.

(48)

	Voiceless obstruent or sonorant onset			
	CV-shaped noun		VCV-shaped noun	
[H]	[tú]	gun	[àkpé]	thanks
	[ké]	sand	[àfí]	ashes
	[ló]	crocodile	[ānyí][26]	bee
	[nú]	thing	[ālá]	raffia
[L]	[klò]	knee	[àfì]	mouse
	[tò]	buffalo		
	[mò]	face	[àwù]	clothes
	[nyà]	word	[àmì]	oil
[MH]	[pɛ̄ɛ́]	chisel	[àkpāá]	fish
	[tōó]	mortar	[àtɔ̄ɔ́]	nest
	[nūú]	mouth	[āmāá]	greens
	[yāá]	air		
	Voiced obstruent onset			
	CV-shaped noun		VCV-shaped noun	
[L]	[bè]	thatch	[àdzò]	riddle
	[dà]	snake	[àzì]	egg
[LH]	[gbɔ̀ɔ́]	goat	[àvùú]	dog
	[dèé]	palm nut	[àzìí]	peanuts
	[gòó]	gourd		

In this summary table, the tone of the 'prefix' [a-] is not included in the labeling of tonal patterns. The tone of the prefix [a-] is non-H and is discussed at length in this section. For the moment, I note that although the term 'prefix' is used by both Ansre and Stahlke (1971) to describe the initial vowel of these nouns, it is not clearly shown to what degree this vowel would function synchronically in Ewe as a true inflectional prefix despite its presumed historic role as a noun class prefix.

According to Ansre, surface L which is seen following non-depressors in isolation forms such as [mò] 'face' and [àwù] 'clothes' is exceptional and occurs only because these words are in their isolation form. His observation is that in non-isolation environments following non-depressors, the non-H tone is realized as a

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vowels do not appear to be phonemically contrastive in Peki, Stahlke (p. 205) argues that they are in Kpando, giving the following forms as evidence of words that have contrastive length while being linked to a single tone: [āyíí] 'skin', [fyáá] 'axe', [fúú] 'fur', [táá] 'pond, [nɛ́ɛ́] 'palm nut', [kéé] 'sand'. In accordance with the tradition for work in Ewe, I mark contour tones on two vowels.

[26] For the data sets in this section, I employ the original conventions of the authors by writing **ny** for [ɲ] and **y** for [j], and not marking nasality on vowels that follow a nasal consonant.

"characteristic mid allotone" (p. 28). He gives the following data which are put in a frame which includes the definite article [lá] to show that the non-H tone following a non-depressor is realized in non-isolation environments as M.

(49)	CV-shaped noun		VCV-shaped noun	
	[tē lá]	the yam	[àsī lá]	the market
	[lā̃ lá]	the animal	[āwū lá]	the dress
	[mō lá]	the face	[āŋē lá]	the rubber

There is evidence from Ansre's data to indicate that the single [LH] rising contour seen after depressors in (48) may in fact be a neutralization of two different underlying tonal patterns (Stahlke, 1971). Consider the following data from Ansre (p. 60) where the possessive forms [nyèé] 'my' and [éɸé] 'his' precede nouns that have depressor consonants. Note that all of the nouns in (50) have the same [LH] surface pattern in isolation.

(50) **Isolation form**

nyèé + gbɔ̃̀ɔ̃́	my + goat	→	[nyè gbɔ̃́]	[L] [H]
éɸé + dèé	his + palmnut	→	[éɸé dé]	[H] [H] [H]
nyèé + gòó	my + gourd	→	[nyèé gòó]	[LH] [LH]
éɸé + dòó	his + hole	→	[éɸé dòó]	[H] [H] [LH]

Stahlke (1971) re-examines Ewe using Ansre's data in light of the derivational rules of Smith (1968) and compares these with his own data from the Kpando dialect. Stahlke and Smith both take /M/ to be the underlying non-H tone, thus assuming that nouns have either underlying /H/ or /M/ and that surface L is derived from /M/ by a series of rules that will be examined shortly.

Stahlke draws several important conclusions about underlying tones in Ewe nouns. First, he argues that forms like [gbɔ̃̀ɔ̃́] 'goat' and [gòó] 'gourd' in (50) have different underlying tones—/H/ for the former and /MH/ for the latter. These forms have the same rising contour in isolation, but are realized in different ways when they appear as the final element in a complex noun (where noun-initials vowels are deleted word-medially). We can see this difference in the following data from Stahlke (1971, pp. 175, 207).

(51) **Isolation form**

/gā/ + /gōó/	[gà] 'metal' + [gòó] 'gourd'	→	[gàgòó] 'oil drum'
/ādē/ + /āvú/	[àdè] 'hunt' + [àvùú] 'dog'	→	[àdèvú] 'hunting dog'

The following would be the underlying forms for the compounds in (51).

(52) a. ade vu b. ga go

M H M MH

In order to explain surface rising contours in the isolation form of a noun that has underlying H, such as in [àvùú] 'dog', Stahlke introduces two rules. First, there is a rule of M prefix lowering. This rule lowers M prefixes to L preceding any obstruent—voiced or voiceless. (This accounts for the initial L on forms such as [àkpé] 'thanks' and [àdzò] 'riddle', but not on [ānyí] 'bee'.)[27]

Following application of the rule of M prefix lowering, there is a rule of L tone insertion. This rule inserts L (and a vowel to function as the TBU for this L) in the environment that includes both of the following: (1) a preceding sequence of L plus a depressor consonant, and (2) a following H.[28]

Stahlke sees this same rule of L tone insertion applying in cases of the imperative, where the underlying H verb /vá/ becomes [vàá] (p. 212). He asserts that there is a separate L tone grammatical prefix that is inserted for the imperative. It is this L tone that creates the conditioning environment for the rule of L tone insertion to apply.

This brings us to the form for 'goat', [gbɔ̃̀ɔ̃́] in Ewe. There is evidence (such as in the paradigm in (50)) that this is underlyingly /gbɔ̃́/. One might wonder where would be the L tone that would trigger L tone insertion following the depressor in this case. Stahlke argues that a L is present here as well, but as a floating noun prefix. According to Stahlke, *all* nouns in Ewe have a prefix. Where there is no segmental element to that prefix, the prefix is simply a floating M (which is lowered to L preceding an obstruent). He provides evidence for this proposal from several angles.

First, he gives the following examples where a H verb followed by a H noun is realized with a falling [HL] contour. The following is taken from Stahlke (1971, p. 167) and is representative of both the Peki and the Kpando dialects.

(53) **Underlying form**

kpɔ́ + `tó	see + ear	→	[kpɔ́ɔ̀ tó]
kpɔ́ + àtí	see + tree	→	[kpɔ́ àtí]

As we can see in (53), the same verb does not have a HL contour when followed by a noun that has a [a-] prefix. Stahlke argues that when the noun prefix

[27] In light of this rule, sonorants should be seen as having a phonological categorization distinct from the category of obstruents—both voiced and voiceless.

[28] Note that this rule of L tone insertion does not apply in the case of the compound [àdèvú] 'hunting dog'.

does not have a segmental dimension, the floating M prefix (lowered by the rule of M prefix lowering) becomes associated to the vowel of the verb.

The presence of the floating noun prefix is also indicated by the tonal difference in reduplicated forms of the verb which have either nominal or adjectival roles. These are illustrated below from Ansre (1961, p. 39) and Stahlke claims they are the same in the Kpando dialect.

(54)	**Underlying form**		**Nominal derivation**		**Adjectival derivation**	
	/bú/	to lose	[bùbú]	loss	[búbú]	lost
	/bū/	to respect	[bùbù]	respect	[būbūú]	respected
	/vó/	to rot	[vòvó]	rottenness	[vóvó]	rotten
	/vō/	to be free	[vòvò]	freedom	[vōvōó]	free
	/tú/	to shut	[tùtú]	shutting	[tútú]	closed
	/tū/	to grind	[tùtù]	grinding	[tūtūú]	ground

Stahlke (1971) describes this paradigm by saying that the reduplication prefix does not have any pre-assigned tone. In cases where the reduplicated form serves as a noun, the floating tone that is the noun prefix in these examples becomes linked to the vowel of the reduplication prefix. Otherwise, the tone of the prefix is presumably obtained through copying or spread from the verb root, although this is not explicitly stated by Stahlke.[29]

Note also in (54) that the adjectival forms derived from verbs in Ewe have what is labeled in the Ewe literature as a 'high suffix'. This high suffix causes a final M to be realized as a MH contour.

We return then to the question of the rising tone on [gbɔ̏ɔ̋] 'goat', derived from underlying /gbɔ̋/. The premise is that all nouns have a floating M prefix. The rule of M prefix lowering causes this prefix to be lowered to L. At this point, the conditions are met for Stahlke's rule of L tone insertion, yielding the surface form [gbɔ̏ɔ̋].

Now we can re-examine the tonal patterns of nouns in Ewe (Peki dialect) from (48) in light of Stahlke's ideas regarding underlying forms.

[29] Note that the adjectival forms all end in H or rising tones. Ansre and Stahlke mention the existence of what they label as a 'H tone participial suffix'.

(55) **Voiceless obstruent or sonorant onset**

	CV-shaped noun		VCV-shaped noun	
/(M.)H/	[tú]	gun	[àkpé]	thanks
	[ló]	crocodile	[ānyí]	bee
/(M.)M/	[klò]	knee	[àfì]	mouse
	[mò]	face	[àwù]	clothes
/(M.)MH/	[pɛ̄ɛ́]	chisel	[àkpāá]	fish
	[yāá]	air	[āmāá]	greens

Voiced obstruent onset

	CV-shaped noun		VCV-shaped noun	
/(M.)H/	[gbɔ̀ɔ́]	goat	[àvùú]	dog
/(M.)M/	[bè]	thatch	[àdzò]	riddle
/(M.)MH/	[gòó]	gourd	[àdèé]	saliva

Here we see that there are only three underlying tonal patterns. There remains the question of how to explain many of the instances of L. Given the assumption that all L phonetic tones are derived from /M/, Smith (1968) endeavors to create rules that account for every instance of L. These rules are simplified in some cases by Stahlke (1971). First, there is the previously discussed rule of M prefix lowering which lowers the M prefix before an obstruent, accounting for the initial L on the forms [àkpé] 'thanks' and [àdzò] 'riddle', in contrast with the initial M on [ānyí] 'bee'.

There is also a rule that /M/ in nouns becomes L following a depressor.[30] This rule applies only to nouns, not to verbs or forms from other grammatical categories. This accounts for L following the depressors in [bè] 'thatch' and [gòó] 'gourd'. This also accounts for the forms in (56)a and (56)b from Stahlke (1971, p. 140).

(56)	a.	/¯dā lá/	[dà lá]	the snake
	b.	/¯hā lá/	[hà lá]	the pig
	c.	/¯kpō lá/	[kpō lá]	the stick
	d.	/¯nyī lá/	[nyī lá]	the cow

The fact that this lowering rule applies only to nouns is evident from examples such as [wó dā nyī lá] 'they threw the cow', derived from /wó dā ¯nyī lá/ (Stahlke, 1971, p. 141). In this utterance, the verb /dā/ 'throw' does not have its M lowered even though this M follows a depressor.

In the Peki dialect of Ewe (Ansre, 1961; N. Smith, 1968), there is also a rule that /M/ becomes L in final position. This explains surface forms such as [mò]

[30] This is the second rule that refers specifically to the category of depressors. The other is the rule of L tone insertion which inserts L before H; here, /M/ becomes L.

'face', as well as the final L in an utterance such as [wó wù nyì] 'they killed a cow', derived from /wó wū ¯nyī/ (Stahlke, 1971, p. 141). Stahlke claims that this rule does not apply to final noun stems in the Kpando dialect.[31]

Finally, there is a bidirectional rule of L spread that iteratively spreads L to an adjacent M TBU. This accounts for forms such as /¯dā wū ālɛ̃́/ 'a snake killed a sheep', which is realized as [dà wù àlɛ̃́] following the depressor-motivated lowering of /¯dā/ 'snake' to [dà] (Stahlke, 1971, p. 215).

Given these rules, one can understand the paradigms in (57), taken from Stahlke (p. 141).

(57)	**underlying**	**prefix lowering**	**depressor effect**	**L spread**
a.	/wó wū ¯dzātá lá/ 'they killed the lion'	wó wū ˋdzātá lá	wó wū ˋdzàtá lá	[wó wù dzàtá lá]
b.	/wó wū ¯sɔ́ lá/ 'they killed the horse'	wó wū ˋsɔ́ lá	wó wū ˋsɔ́ lá	[wó wù sɔ́ lá]
c.	/wó wū ¯nyī lá/ 'they killed the cow'	wó wū ¯nyī lá	wó wū ¯nyī lá	[wó wū nyī lá]
d.	/wó dā ¯zē lá/ 'they threw the pot'	wó dā ˋzē lá	wó dā ˋzè lá	[wó dà zè lá]
e.	/wó dā ¯sɔ́ lá/ 'they threw the horse'	wó dā ˋsɔ́ lá	wó dā ˋsɔ́ lá	[wó dà sɔ́ lá]
f.	/wó dā ¯nyī lá/ 'they threw the cow'	wó dā ¯nyī lá	wó dā ¯nyī lá	[wó dā nyī lá]

In the Kpando dialect, L spread is affected by the presence of a voiceless obstruent—specifically one found in a noun. This is shown in data from Stahlke (pp. 147, 163, 178, 179).[32]

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[31] The example of [wó wù nyì], comes from a data set that appears in Stahlke (1971, p. 141). Although this utterance is not explicitly stated as representing the Peki dialect, given his claim that nouns do not undergo final lowering in Kpando, it is presumed that these data are from the Peki dialect.

[32] I skip the depressor effect rule in these derivations for reasons of fitting the derivations on one line and because the final realization is the same whether it is listed or not.

(58)	**underlying**	**prefix lowering**	**L spread**
a.	/mē fī ¯kpō lá/ 'I stole the stick'	mē fī `kpō lá	[mè fì kpō lá]
b.	/mē bū ¯fyā lá/ 'I repected the chief'	mē bū `fyā lá	[mè bù fyā lá]
c.	/āmē fī āzī lá/ 'a person stole the egg'	āmē fī àzī lá	[àmè fì àzì lá]
d.	/āfī fī āzī lá/ 'a mouse stole the egg'	àfī fī àzī lá	[àfī fì àzì lá]
e.	/āmē wū āfī lá/ 'a person killed the mouse'	āmē wū àfī lá	[àmè wù àfī lá]

The last tonal process to highlight, one that is only valid in the Kpando dialect, is a process of H spread that exists at the boundary between verb and noun. This rule spreads final H from a verb to the prefix vowel of the noun. Some examples of this are /kpɔ́ āyíí/ 'see beans', which is realized as [kpɔ́ áyíí], and /kpɔ́ ādɔ̄/ 'see squirrel', which is realized as [kpɔ́ ádɔ̀]. Interestingly, this H spread does not happen before a voiceless obstruent, so /kpɔ́ àtí/ 'see tree' is realized as [kpɔ́ àtí] (Stahlke, 1971, p. 167).

Before moving to a discussion of an alternate analysis of Ewe, it is worth mentioning that although Stahlke maintains that Ewe has an underlying /H, M/ contrast, there is a role for grammatical L in his analysis—marking the imperative and marking yes-no questions utterance-finally—that is not well-accounted for in his analysis.

There are (at least) two ways to approach the Ewe data. One can explain these data by positing a small number of underlying tonal patterns and proposing multiple phonological rules that account for the variety in surface forms. This is the strategy employed by Stahlke and Smith. One can also propose a greater number of underlying patterns, thereby requiring fewer derivational rules. Bradshaw (1999) opts for the latter strategy, proposing the following as the underlying forms of Ewe nouns (p. 127). Note that this analysis assumes the existence of a four-way underlying tonal contrast: /H, M, L, Ø/.

(59)

		CV-shaped noun	VCV-shaped noun
		Voiceless obstruent onset	
	high	` CV́	` VCV́
	non-high	` CV̄	` VCV̄
	contour	` CV̄V́	` VCV̄V́
		Sonorant onset	
	high	CV́	VCV́
	non-high	CV	VCV
	contour	CVV́	VCVV́
		Voiced obstruent onset	
	non-high	` CV	` VCV
	contour	` CVV́	` VCVV́

According to Bradshaw's analysis, all that is required in addition to these underlying forms is a bidirectional iterative rule of L spread and a default fill-in of M following the rule of L spread. In exchange for Stahlke's three underlying tonal patterns, Bradshaw has sixteen distinct underlying tonal patterns. In exchange for the increased complexity involved in having sixteen underlying patterns, Bradshaw avoids the necessity of having rules that refer specifically to morphological structures such as the noun prefix (as in the M prefix lowering rule) or syntactic structures such as the noun (as in the depressor-motivated lowering rule). This analysis also prevents having a rule that seems to imply that sonorants may belong to a natural class distinct from voiced and voiceless obstruents (as in the M prefix lowering rule).

Another result of Bradshaw's analysis is that it avoids attributing to voiceless obstruents any role in blocking L spread. Rather, it is the presence of /M/ which prevents L from spreading in the underlying forms of nouns that have voiceless obstruents.

Note that among nouns that have voiced obstruents, there is no 'high' category of tonal patterns as there is for nouns that have either voiceless obstruent or sonorant onsets. This means that there is no way to explain why some nouns that have [LH] contours in their isolation forms are realized H when in compound or possessive constructions, and others are realized [LH] in these same constructions. The relevant data are repeated here.

(60) **Isolation form** (Ansre 1961, 60)

nyèé + gbɔ̀ɔ́	my + goat	→	[nyè **gbɔ́**]
éɸé + dèé	his + palmnut	→	[éɸé **dé**]
nyèé + gòó	my + gourd	→	[nyèé **gòó**]
éɸé + dòó	his + hole	→	[éɸé **dòó**]

(61) **Isolation form** (Stahlke 1971, 175, 207)
[gà] 'metal' + [gòó] 'gourd' → [gà**gòó**] 'oil drum'
[àdè] 'hunt' + [àvù́ú] 'dog' → [àdè**vú**] 'hunting dog'

This may be a weakness in Bradshaw's analysis. One also wonders whether, in multiplying numbers of underlying tones and underlying tonal patterns, the explanatory power gained makes up for this increased complexity.

Clements (1972, 1978) also addresses Ewe, but deals with the Anlo dialect. Clements, like Smith and Stahlke, posits Ewe as having a two-way underlying tonal contrast: /H, M/. However, from these underlying tones, the Anlo dialect has four surface levels—including raised H (hereafter $^{\uparrow}$H), H, M and L. Clements (1978) describes a rule raising /M/ to $^{\uparrow}$H in certain syntactic domains. A frequently cited example of this is /ātyí mɛ̄gbé/ 'behind a tree', which is realized as [àtyí̋ mɛ̋gbé].

Clements demonstrates that this type of raising occurs within the domain of of prosodic consituents that are mapped from syntactic structures that contain no left branches. Selkirk (1986) restates this using X-bar theory by saying that phonological phrases are mapped in Ewe by creating a phrasal boundary at the left edge of every syntactic maximal projection.

Besides its relevance to theories of phonology-syntax interactions, Clements' work is also theoretically interesting as it has been used to support the idea of mid tone being in a natural class with raised high. This idea is an assertion made by the Two-Feature Model of tone (see section 2.2). Clements himself, however, does not consider the Anlo data to be adequately convincing evidence for this assertion (Clements et al., 2010).

Before closing this section on Ewe tone, I note one other interesting tonal phenomenon found in Ameka (1999), which is that complex nominal constructions sometimes have a H tone suffixed to the end of the construction. An example Ameka (p. 75) gives is found in (62).

(62)

[é-nyé	ŋútsu	gbɔ́	ŋútsǔ]
3SG-be	man	vicinity	man-high.tone.suffix

He is an effeminate/emasculated man. (lit. He is a man near man.)

Here, the H suffix is responsible for the final [LH] rise on [ŋútsǔ] 'man'. Additionally, Ameka states that the H suffix has a function, particularly in the northern dialects of Ewe, in marking syntactic nominal compounds (p. 96).

Other Gbe languages have been the topic of tone studies as well, and I briefly turn to some of the observations made in those studies before summarizing some of the phenomena common to all of these languages.

2.8.2 Gen

Although Bole-Richard's (1983) study of Gen is not primarily a tone study, he does include tone in his study. He analyzes Gen as having an underlying /H, L/ system. The following is an overview of the underlying forms and the surface realizations of these forms in monomorphemic nouns in Gen according to Bole-Richard (1983, pp. 107, 109). Note that C(C)V-shaped nouns do not exist in Gen.

(63)	**Voiceless obstruent or sonorant onset**	
/L.H/	[ètɔ́]	father
	[àlɔ́]	cheek
/L.L/	[ètɔ̀]	stream
	[àlɔ̀]	hand
	Voiced obstruent onset	
/L.H/	[ègǎ]	chief
/L.L/	[ègà]	metal

In Gen, all of the initial vowels on nouns are realized L. Another observation to be made is that in monomorphemic nouns, an underlying /H/ following a voiced obstruent is realized as a [LH] contour.

Bole-Richard also mentions six exceptional forms that have a rising contour following a voiceless obstruent or sonorant. These are [ètǎ] 'head', [àtǎ] 'chief', [ètǒ] 'mortar', [ènǔ] 'mouth', [àyǐ] 'beans', and [àyǎ] 'wind'.

Bole-Richard documents an interesting pattern that has to do with the phonemes /b/ and /ɖ/ and what he analyzes as their allophones [m] and [n]. Following [b] and [ɖ], a surface [LH] contour is the realization of underlying /H/. Following [m] and [n], surface [H] is generally the realization (except in the exceptional case of [ènǔ] 'mouth'). He gives the following as examples of this pattern (p. 110).[33]

(64)	**[b] and [ɖ]**		**[m] and [n]**	
	[àbǎ]	mat	[èmá]	fermented flour
	[àbɔ̌]	arm	[èmɔ́]	path
	[èbǔ]	other	[èmú]	mosquito
	[èɖǐ]	sweepings	[èní]	namesake
	[àɖɔ̌]	rejoinder	[ànɔ́]	breast
	[àɖǔ]	tooth	[ènú]	thing

Thus in Gen, the tonal process that takes as its input an underlying /H/ in a noun and yields [LH] following a depressor is consistently distinguishing between

[33] The transcriptions given by Bole-Richard do not mark nasalization on vowels that follow nasal consonants; nasalization is nonetheless assumed by Bole-Richard to be present (p. 48).

these allophones based on a surface-level distinction between [b] and [m] in the one case, and [ɖ] and [n] in the other. Stated otherwise, in Gen, surface [b] and [ɖ] pattern with depressors in their tonal patterns, but [m] and [n] do not, regardless of the underlying phonemic status of these latter sounds.

Bole-Richard discusses noun compounds at length. In noun compounds, the initial vowel of any noun is deleted word-medially along with its tone. He notes that in noun compounds, there is always a raising of pitch at the right edge of the compound (p. 253).

(65)	**Isolation form**	**At right edge of compound**
all consonants	CV̀	CV̌
depressors	CV̌	CV́
non-depressors	CV́	CV́

In addition, if the surface tone of any initial noun in a noun-noun compound is H (in the case of non-depressors) or LH (in the case of depressors), the tone of the final noun will be H regardless of its tone in isolation. This indicates that there is H spread within noun compounds in Gen.

2.8.3 Fon

In Fon as in Ewe, monomorphemic nouns can have a C(C)V or V.C(C)V shape. The following captures the tonal paradigms in Fon as seen in data taken from Brousseau (1993, pp. 8, 12, 13) and Lefebvre and Brousseau (2002, pp. 20, 26, 48).

(66)	**CV-shaped noun**		**VCV-shaped noun**	
	Voiceless obstruent onset			
/(L.)H/	[xú]	bone	[àsɔ̃́]	crab
/(L.)L/	[xɔ̀]	building	[àsì]	wife
	Voiced obstruent or sonorant onset			
/(L.)H/	[vǐ]	child	[àvǔ̃]	dog
	[lǒ]	crocodile	[àlǐ]	liver
/(L.)L/	[dã̀]	snake	[àzɔ̃̀]	disease
	sonorant data unavailable		[àwù]	clothes

Lefebvre and Brousseau (2002) describe Fon as having a two-way underlying /H, L/ tonal contrast. Disregarding the initial vowel (which is always L), nouns are either /H/ or /L/. Sonorants pattern with voiced obstruents in having a [LH] rise rather than a [H] surface realization on the C(C)V syllable of the noun.

Brousseau (1993) rejects the notion of there being a tonal 'prefix' or initial floating tone on nouns that have no initial vowel.[34] Instead, she explains this rising tone by positing that voiced obstruents and sonorants are themselves tone-bearing units (TBUs) and are associated to L tone. Thus in [vǐ] 'child', a L linked to the voiced obstruent spreads rightward to the following vowel which is already associated to H.

In certain contexts, the L linked to a voiced obstruent is prevented from linking to the following vowel and one gets a surface H rather than a rising LH following this obstruent. This happens in verbal reduplication. For example, the verb /gbá/ 'build' can be reduplicated to yield the adjectival form [gbìgbá] 'built'. Here, Brousseau argues that the L linked to the voiced obstruent spreads leftward to the prefix and therefore cannot also spread rightward.

The L linked to the voiced obstruent is also prevented from linking to the following vowel when the obstruent is preceded by a H. So, for example, the verb /gbá/ 'build' is realized [gbá] following a H tone in [é gbá xwé] 'he built a house' (Lefebvre & Brousseau, 2002, p. 24).

In Fon, there is a process of H spread in certain domains. These are described in (67), where the domains in which spread occurs are marked with brackets. The data here come from Lefebvre and Brousseau (2002, pp. 22, 23)

[34] This notion is rejected principally because Brousseau also observes a rising tone on the isolation forms of verbs that have voiced obstruent or sonorant onsets. She states that there cannot be a floating tone preceding both verbs and nouns.

(67)	**underlying**[35]		**surface form**	**domain of spread**
a.	/é sà àsɔ́n wè/ '(s)he sold two crabs'	→	[é sâ] [àsɔ́n wê]	Subj NP+Verb; Obj NP
b.	/é kò xɔ̀ àsɔ́n/ '(s)he bought some crab'	→	[é kó ꜜxɔ̂] [àsɔ́n]	Subj NP+Aux+Verb; Obj NP
c.	/àsá-mɛ̀/ 'groin' (lit. thigh-inside)	→	[àsá-mɛ̂]	N-Prep Compound
d.	/hwèví-sà-tɔ́/ 'fishmonger' (lit. fish-sell-AGENT)	→	[hwèví-sá-ꜜtɔ́]	N-Verb-Suffix Derivation
e.	/à só tè/ 'you mashed yams'	→	[à só tê]	Subj NP+Verb+Obj NP (monosyllabic)
f.	/é nɔ̀ sà tè/ '(s)he usually sells yams'	→	[é nɔ́ sá tê]	Subj NP+Aux+Verb+Obj NP (monosyllabic)

According to Lefebvre and Brousseau, H spread occurs iteratively in Fon (1) in any derived word, whether affixed or compounded; (2) within the object NP; (3) within a domain which includes the subject NP, any verbal auxiliaries, and the verb head of the VP; and (4) within a domain which includes the former *plus* a monosyllabic object NP. Spread continues until the end of the domain. If the last TBU in the domain is underlyingly L, a surface HL contour is created on this TBU. If a second H appears within the domain, this H is realized as a downstepped H.[36]

2.8.4 Maxi

The Gbe variety called Maxi has also been the topic of a tone study. Gbéto (1997) proposes that in Maxi, voiced obstruents and sonorants are TBUs and carry L tone. This L tone spreads to the following H vowel to produce a surface LH rise in isolation forms of nouns and verbs. This is the same proposal as that made for Fon by Brousseau (1993).

An interesting twist, however, is that following this spread of tone, there is devoicing of voiced obstruents. This can be seen in /àˋzé/ 'sorcery', which is realized [àsě] and in / ˋgbɛ́/ 'refuse', which is pronounced [kpɛ̌] (p. 125, 127). (The floating L

[35] I have copied the data as presented by Lefebvre and Brousseau. Nasalization of vowels is not marked when the vowel follows a nasal consonant. Otherwise, nasalization is marked by adding an orthographic **n** following the vowel.

[36] It is unclear why there is a downstepped HL contour on the verb in (67)b since there is no underlying H tone on the verb /xɔ̀/ 'buy'.

marked in these underlying forms is the L originating from the voiced obstruent.) Interestingly, though, this process of devoicing never applies to the sounds [b] or [ɖ]. For example, / ̀blú/ 'trouble, be troubled' is realized [blǔ] (p. 111).

This devoicing process can yield surface contrasts like the following given in Gbéto (p. 122).

(68)	**underlying**		**surface form**
a.	/xwà/ 'weed'	→	[xwà]
b.	/xwá/ 'empty (v.)'	→	[xwá]
c.	/ ̀ɦwá/ 'eat avidly'	→	[xwǎ]

This concludes the overview of tone analyses for some of the Gbe languages. I turn now to a summary of the common trends found in these tonal data in light of the theoretical framework discussed earlier in this chapter.

2.9 Summary

Saxwe displays many tonal phenomena that have interested researchers of African tone over the years. The various topics discussed in this chapter—including automatic and non-automatic downstep, tone effects related to prosodic structure, and syntactically conditioned tone—are all addressed in the course of this study of Saxwe tone. While the bulk of this study employs privative H, M and L to describe and discuss the data, in chapter 6, I look at how tone features might be employed to describe the Saxwe tonal system.

This study of Saxwe tone comes in the wake of many previous studies on tone of languages in the Gbe continuum. While there are many common trends to be found in the Gbe tone data, these may be dealt with in a variety of ways by the researchers who describe them. Some of this has to do with the relative complexity of the system being described. I highlight some of these common trends in the following paragraphs.

First, we see that in none of the Gbe languages surveyed here do we find surface [H] following a voiced obstruent in the isolation form of a monomorphemic noun. Instead, we always find a [LH] rise in this context.

In some cases, researchers have decided that this [LH] rise is derived from underlying /H/ through a tonal rule. In Ewe, Stahlke (1971) has a rule of L tone insertion (also inserting a V slot to bear the L) that inserts L before H in the appropriate environment. In Gen, Bole-Richard (1983) has a rule of allotonic variation that changes /H/ to [LH] in the same environment.

In the case of Fon, Brousseau (1993) claims that the [LH] rise is derived from underlying /H/ not only following voiced obstruents, but also following sonorants. In order to deal with this, she hypothesizes that voiced obstruents and sonorants have the status of being TBUs. As such, they bear L tone. She then has a rule that spreads this L to the following H vowel, thus producing the [LH] rise. Gbéto (1997) takes the same position for describing the [LH] rise in Maxi.

Bradshaw (1999) takes yet another approach to explaining the [LH] rise in Ewe. She posits an underlying sequence of two vowels in these forms—one toneless and one /H/. Using her Multiplanar model (discussed in section 2.7), she explains that the low pitch of the [LH] sequence is due to the multiple association of L both to the laryngeal node of the voiced obstruent as well as to the TBU of the adjacent toneless vowel.

The questions that are being answered in all of these cases are similar. Is L in this context underlying or phonologically derived? How directly is its presence understood to be triggered by the voiced obstruent—indirectly through a rule that refers to the voiced obstruent or more directly through lines of association that run directly from the voiced obstruent to L? These are questions that must be answered in the analysis of Saxwe tone as well.

Another trend in the Gbe data (noted in two of the four languages surveyed) is that there are certain constructions that seem to have H tone suffixes. In Ewe, these include derivations involving verbal reduplication as well as complex nominal constructions (Ameka 1999, Ansre 1961). In Gen, there are H tone suffixes on noun-noun compounds (Bole-Richard 1983). The question that can be raised here is whether this H tone is truly a suffix, or whether it marks a syntactic or prosodic boundary (discussed in section 2.5). If it marks a boundary, what exactly is the nature of that boundary? These questions will also be addressed in the analysis of Saxwe, although in Saxwe the tonal cognate of this H suffix is shown to operate much like a floating H in that it cannot link to a TBU.

A third common trend in the Gbe languages is a process of H spread. It is interesting that the process of H spread in Fon (Lefebvre & Brousseau, 2002) operates within a domain that includes the subject and the verb but not the object—unless this object is comprised solely of a monosyllabic noun (*i.e.* one that does not have an initial vowel), in which case H will spread to the monosyllabic object noun. In the Kpando dialect of Ewe, H is spread *only* from the verb to the initial vowel of the noun object (Stahlke, 1971, p. 167). In contrasting the two languages, we see very different, almost opposing, situations with regard to how the initial vowel participates in helping to delineate domains of H spread. We also see that H spread occurs within all derived words in Fon (Lefebvre & Brousseau, 2002). In Gen, H spread occurs in noun-noun compounds (Bole-Richard, 1983).[37] Here, there are similarities in processes of H spread.

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[37] H spread may occur in other types of derived words in Gen as well; Bole-Richard does not

These observations attest to the fact that H spread is a relevant process in several of the Gbe languages. However, its domains of operation can be defined in very different ways. In the analysis of Saxwe, it is shown that the domain of H spread in Saxwe is more broadly encompassing than in any of the Gbe languages surveyed in this section.

Turning to questions of underlying tonal contrasts, we see that the most common analysis for these Gbe langauges is one that proposes a two-way underlying contrast—either /H, M/ (Ewe) or /H, L/ (Gen, Fon). Bradshaw's (1999) analysis of Ewe as having a four-way /H, M, L, Ø/ underlying tonal contrast is unique in this regard. In the more common two-way contrast proposed for Ewe, we see that in some dialects, this contrast is realized as three tonal heights. In the Anlo dialect, however, it is realized as four tonal heights (Clements 1978).

This study demonstrates that Saxwe has three tonal heights and a three-way underlying contrast—/H, M, L/. This makes it atypical among the Gbe varieties. Rather, in this respect, Saxwe has more in common with Yoruba. As noted in section 1.1, this is not altogether surprising given the Saxwe peoples' putative history of being the product of a Yoruboid group that migrated into the Gbe-speaking territory. However, unlike the /H, Ø, L/ analysis of the Yoruba underlying contrasts, Saxwe is best analyzed as having a /H, M, L/ contrast. Reasons for this are discussed in chapter 3.

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provide data to ascertain this.

3 Monomorphemic tone patterns and common tonal processes

In this chapter, I present an analysis of monomorphemic nouns and verbs in Saxwe which includes an inventory of the underlying tone patterns as well as a description of the operations that are required to derive the surface forms of these words. The organization of this chapter is as follows. In section 3.1, I outline the three-way tonal contrast of the Saxwe tone system. Before proceeding to an analysis of the underlying tone patterns of nouns and verbs, I first cover in section 3.2 a process of tonal spread that is widely observed in Saxwe utterances. I then discuss automatic downstep of H in section 3.3 and non-automatic downstep of H in section 3.4. In section 3.5, I describe the default $L_{\%}$ boundary that is found at the right edge of most utterances.

With these background topics having been covered, I proceed in section 3.6 to the analysis of underlying tone in verbs. Then in section 3.7, I give an analysis of the underlying tone patterns for nouns. Section 3.8 discusses the fact that unlike with verbs, the tone patterns of certain nouns are not distributed consistently with respect to the type of consonant found in the noun. I then discuss the implications of this observation. Section 3.9 presents some thoughts with regard to the historical development of Saxwe tone. Finally, summaries and conclusions are provided in section 3.10.

3.1 A three-way system: /H, M, L/

In Saxwe, there are three tonal heights which are the realization of a three-way underlying tonal contrast: /H, M, L/. Utterance-final /M/ and /L/ are both realized with the final downglide that is frequently seen on utterance-final /L/ in many African languages. The reason for this is discussed in section 3.5.

In the following near minimal triplets, we see in the second syllable of these nouns examples of each of the three tonal heights.

(69)	/M.H/	[ābɔ́]	arm	sxw-L0051-VCV nouns-arm-un.wav
	/M.M/	[ābā]	forked branch	sxw-L0249-VCV nouns-forked branch-un.wav
	/M.L/	[ābɔ̀]	cooked beans	sxw-L0184-VCV nouns-cooked beans-un.wav

(70)	/M.H/	[ōɖá]	silence	sxw-L0221-VCV nouns-silence-un.wav
	/M.M/	[ōɖā]	hair	sxw-L0174-VCV nouns-hair-un.wav
	/M.L/	[ōɖɔ̀]	fishing net	sxw-L0203-VCV nouns-fishing net-un.wav

(71)	/M.H/	[ōmɔ̃́]	path	sxw-L0227-VCV nouns-path-un.wav
	/M.M/	[āmĩ̀]	oil	sxw-L0264-VCV nouns-oil-un.wav
	/M.L/	[ōmɔ̃̀]	machine	sxw-L0161-VCV nouns-machine-un.wav

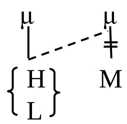
While there are only three underlying tones, these tones combine to form a fairly large number of surface tone patterns that can be realized on monomorphemic verbs or nouns. This is the topic of sections 3.6 and 3.7.

3.2 Tonal spread

In Saxwe, either H or L will spread onto a TBU that carries M, delinking the M. This spread is iterative within an intonational phrase (IP).

The rule of Tonal spread can be depicted as follows.

(72) Tonal spread (iterative):



The iterative spread of H is seen in (73) below.

(73) /ōló wɔ̃̄ ōxɛ̄/ → [ōló wɔ̃́ óxɛ̂]
crocodile forget bird
A crocodile forgot a bird. sxw-L0363-clause frames-un.wav

Ignoring for the moment the final fall at the end of the utterance in (73) which is explained in section 3.5, we see that H spreads from the second TBU in the utterance to the end of the utterance. This is because the remaining TBUs in the utterance carry M tone.

At any point where a spreading H encounters a L, H is no longer permitted to spread, as shown in (74).

(74) /ōló ɦwlɛ̃̀ ōxɛ̄/ → [ōló ɦwlɛ̃̀ òxɛ̀]
crocodile save bird
A crocodile saved a bird. sxw-L0375-clause frames-un.wav

In (74), H spread is blocked by the L linked to /ɦwlɛ̃̀/ 'save'. In (75), H spread is blocked by the L linked to the anterior marker /ò/ (see section 1.8.2 for an overview of TAM markers). Note that this example shows that it is L tone, not the presence of a depressor consonant, that blocks H spread.

(75) /ōló ò sē/ → [ōló ò sè]
crocodile ANT hear
The crocodile had heard. sxw-L0174-auxiliaries-un.wav

An underlying H is equally effective in blocking the spread of H. This is discussed in section 3.4, which describes non-automatic downstep in Saxwe.

The spread of L is analogous to the spread of H. In (76) we see an example of this L spread.

(76) /ōdȁ wɔ̄̄ ōxɛ̄/ → [ōdȁ wɔ̏ òxɛ̀]
snake forget bird
A snake forgot a bird. sxw-L0368-clause frames-un.wav

In (76), the L which initiates L spread is underlyingly associated with a syllable that has a depressor onset. However, underlying L may also spread in an utterance where there is no depressor consonant. This is true in (77), where the L from the anterior marker /ò/ spreads to the underlying M TBU of the following verb /sē/ 'hear'.

(77) /ōló ò sē/ → [ōló ò sè]
crocodile ANT hear
The crocodile had heard. sxw-L0174-auxiliaries-un.wav

The spread of L is blocked by underlying H.

(78) /ōdȁ wɔ̄̄ ōwí̋/ → [ōdȁ wɔ̏ òwí̋]
snake forget bee
A snake forgot a bee. sxw-L0399-clause frames-un.wav

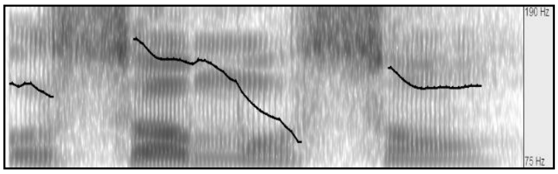
3.3 Automatic downstep of H

In Saxwe, in any H – L – H sequence where a surface L is followed by a surface H within an IP, the level of the second H is lowered in pitch frequency (F_0) in comparison with that of the preceding H (see section 2.3). Stated differently, automatic downstep of H is triggered by a L tone that is linked to a TBU in the output to the phonetic implementation. This is not restricted to a certain syntactic or morphological domain, but is instead relevant within the domain of the IP. However, whether there is statistically significant recursive downstep is a more complex question; in this section I provide a brief summary of the data and conclusions of the more extensive instrumental study which is discussed at length in chapter 7.

In keeping with common practice, automatic downstep in this study is assumed to be present but is not marked in surface forms; the ($^{\downarrow}$) symbol is reserved for marking non-automatic downstep, discussed in sections 3.4 and 7.3.

An example of the lowering of H triggered by surface L is shown in (79).

(79) /ōsɔ́ mɔ̏ sɔ̋/
[ōsɔ́ mɔ̏ sɔ̋] 'A horse left again'
horse REPET leave sxw-L0197-auxiliaries-un.wav

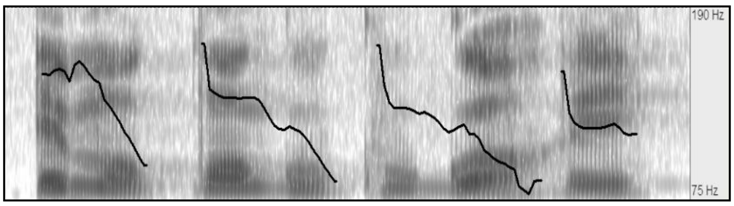


ō- **sɔ́** mɔ̏ **sɔ̋**

In (79), the F_0 level of the second H (on the syllable [sɔ̋]) is roughly equivalent to that of the initial M tone in this and other M - H - L - H sequences.[38]

There can be multiple iterations of automatic downstep of H within an IP. In (80), we see an example of this.

(80) /[M-] é mɔ̏ kpɔ̋ [M-] gùkú gɔ̀ xé/
[é mɔ̏ kpɔ̋ gùkú gɔ̀ xé]
3SG REPET see corn.porridge bottom this
He again saw the bottom [crust] of the corn porridge.
sxw-L0078-register tests-un.wav



é mɔ̏ **kpɔ̋** gù- **kú-** gɔ̀ **xé**

In (80), syllables with surface H are marked in bold. We see that there is a progressive lowering of the F_0 of each H with each reoccurrence of L followed by H.

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[38] This can be compared to a M - L - H sequence where the H is realized at a higher F_0 than the M.

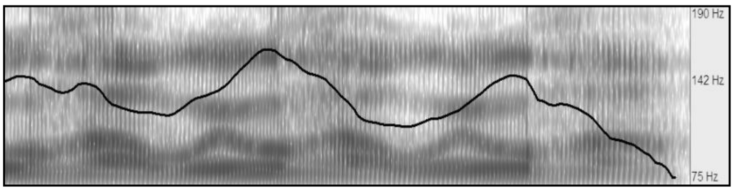
While at first glance, this may seem to be good evidence of iterative automatic downstep, the details are more complex.

In order to qualify as downstep, the degree of lowering must exceed that which could be attributable to declination. In addition, in order to claim that this downstep is iterative, it must exceed a single instance of stepping down. Section 7.3 gives the results of an instrumental study of four Saxwe speakers on the subject of iterative downstep of H. As a result of that study, I conclude that for all speakers, there is a single instance of lowering of the F_0 of H in a H - L - H sequence which is largely facilitated by the anticipatory raising of the first H. In addition, for some speakers of Saxwe, there is a further instance of stepping down of H which exceeds the lowering attributable to declination. However, this automatic downstep of H exists for a maximum of two iterations, after which the progressive lowering of the ceiling of H is no longer in excess of what can be attributed simply to declination.

The automatic lowering of H is not marked in any way in output forms in this study, but is assumed to be a reality even though unmarked. This assumption is justified in the case of the speaker André Taïve, whose data are depicted here in this section and who consistently produces two iterations of automatic downstep of H.

A related question to be answered is whether Ls are also automatically downstepped; that is, whether a L following a H is lowered in F_0 in comparison with a preceding L. In (81), it appears at first glance that the 'basement' of L is lowered just as the 'ceiling' of H is, creating a terracing effect (Clements, 1979).

(81)	/ōɦȁ	wé	ōɦȁ	wé	ōɦȁ/	→	[ōɦȁ wě óɦȁ wě óɦȁ]
	song	AM	song	AM	song		
	a song of a song of a song sxw-L0092-register tests-un.wav						



ō- **ɦȁ** wě ó- **ɦȁ** wě ó- **ɦȁ**

However, again we need to look more closely at the complexities of defining downstep. In order to qualify as downstep, the lowering of the F_0 of L must exceed any lowering that can be attributed to declination. Furthermore, in order to be iterative, the stepping down of L must occur more than once. Given this definition, I conclude in section 7.4 that there is no automatic downstep of L in Saxwe. Some speakers (like André Taïve, whose data are depicted here) have a single instance of lowering of the F_0 of L, facilitated by the fact that the first L in the utterance is slightly raised with respect to baseline levels of L. (The IP-final drop in F_0 in (81) is attributable to a $L_{\%}$ boundary which is discussed in section 3.5.) No speaker studied demonstrated more than a single instance of lowering of L beyond that attributable to declination, so we cannot conclude that there is iterative automatic downstep of L in Saxwe.

3.4 Non-automatic downstep of H

Section 3.2 describes the rule of Tonal spread, which states that H and L both spread rightward to a TBU that is linked to M tone. As a result of Tonal spread, M is delinked. The spread of H and L to this adjacent TBU is iterative within an IP and is not restricted by syntactic or morphological considerations.

When a spreading H encounters an underlying H, spreading is stopped and the result is that two Hs are now separated by floating M. In the phonetic implementation (discussed further in section 7.3), the second H is realized as a downstepped H. In my transcription of surface forms, I use the superscript down arrow (↓) to indicate this non-automatic downstep.

However, non-automatic downstep is not restricted to contexts where there has been Tonal spread. Any time that a floating M appears between two surface H tones, the output is realized as [H-↓H]. Stated differently, non-automatic downstep of H is triggered by a floating M tone in the output to the phonetic implementation. This is not restricted to a certain syntactic or morphological domain, but is instead relevant at any time that this sequence occurs within the IP. There are a number of floating M tones, both lexical and grammatical, that trigger downstep of H in Saxwe; these are discussed in sections 3.7.4, 4.3, 4.7, and 5.1.

In this section, I describe non-automatic downstep of H and provide a brief summary of the data and conclusions of the instrumental study which is discussed at length in chapter 7.

(82) /ōló wɔ̄̃ ōwĩ́/ → [ōló wɔ̃́ ó↓wĩ́]
crocodile forget bee
A crocodile forgot a bee. sxw-L0393-clause frames-un.wav

Structurally, this utterance is represented in (83).

(83) olo wɔ̃ owĩ
M H M H

If the conditions for the downstep of H occur in successive iterations, one can have iterative lowering of the register of H. At the stage of phonetic implementation, every new occurrence of H on the tonal tier may be marked by further lowering of the pitch F_0.

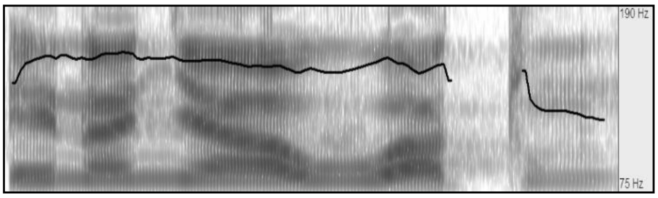
(84) / $^{\text{M-}}$ é nã̄ kpɔ̃́ ōtĩ́ ātṹ/ → [é nã́ ↓kpɔ̃́ ó↓tĩ́ á↓tṹ]
3SG FUT see tree five
He will see five trees. sxw-L0117-register tests-un.wav

Structurally, this would be represented as in (85) following H spread.[39]

(85)
e nã kpɔ̃ otĩ atũ
M- H M H M H M H

More than one M may be delinked before a spreading H reaches a second H within the IP. We can compare (86), where non-automatic downstep occurs once, with (87), where non-automatic downstep occurs three times. Each instance of a syllable with underlying H tone is marked in bold below the pitch trace.

(86) / $^{\text{M-}}$ é nã̄ ɲã̄ āwū ātṹ/
[é nã́ ɲã́ áwú á↓tṹ]
3SG FUT wash shirt five
He will wash five shirts. sxw-L0128-register tests-un.wav



é nã́ ɲã́ á- wú á- **↓tṹ**

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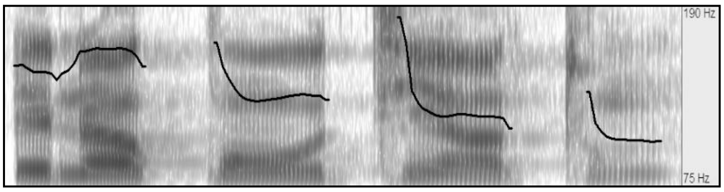
[39] The $^{\text{M-}}$ notation on the pronoun is the left floating M tone on nouns that do not have one of the initial vowels /a/, /ɛ/, or /o/. This is described in section 4.3.

(87)	/$^{M\text{-}}$ é	nã̄	kpɔ̃́	ōtĩ́	ātṹ/
	[é	nã́	↓kpɔ̃́	ó↓tĩ́	á↓tṹ]
	3SG	FUT	see	tree	five

He will see five trees. sxw-L0117-register tests-un.wav



é nã́ **↓kpɔ̃́** ó- **↓tĩ́** á- **↓tṹ**

There are three occurrences of downstep of H in (87). The F^0 of the last surface H overlaps with the phonetic space where L is often realized by the speaker of this utterance.

So far we have seen that each new occurrence of floating M between two Hs on the tonal tier at the surface level results in a lowering of the 'ceiling' with regard to the pitch at which H is realized. It is clearly the floating M which is the trigger for non-automatic downstep because in cases like (88) where there are successive surface Hs but no floating M, there is no downstep. This can be compared with (89), where there is downstep.

(88)	/ōló	sɔ̃́/	→	[ōló sɔ̃́]
	crocodile	leave		

A crocodile left. sxw-L0023-clause frames-un.wav

(89)	/ōló	nã̄	sɔ̃́/	→	[ōló ná ↓sɔ̃́]
	crocodile	FUT	leave		

A crocodile will leave. sxw-L0013-auxiliaries-un.wav

Floating M tones in Saxwe are not always a result of Tonal spread; they have multiple sources. The floating M that triggers non-automatic downstep may be floating because of the loss of a vocalic segment. For example, in Saxwe, there is an optional process of initial vowel elision at the boundary between verb and object in fast speech. This elision can occur when the object has a M initial vowel that is either /o/ or /ɛ/ (see sections 1.4.6 and 4.2).

When an initial vowel is elided, the M tone is not deleted, but remains as a floating tone. This floating M triggers non-automatic downstep of a following H (see (91) and (93)) just as if the initial vowel had not been elided.

(90) /āfí kpɔ̋ ōsú ɲwɛ̋/ → [āfí kpɔ̋ ó↓sú ɲwɛ̋]
Afi see husband good
Afi found a good husband. sxw-L0005-other clauses-un.wav

(91) /āfí kpɔ̋ ōsú ɲwɛ̋/ → [āfí kpɔ̋ ↓sú ɲwɛ̋]
Afi see husband good
Afi found a good husband. sxw-L0006-other clauses-un.wav

(92) / M- kōfí tű ōtấ/ → [kōfí tű ó↓tấ]
Kofi spit saliva
Kofi spit. sxw-L0003-other clauses-un.wav

(93) / M- kōfí tű ōtấ/ → [kōfí tű ↓tấ]
Kofi spit saliva
Kofi spit. sxw-L0004-other clauses-un.wav

We see then that automatic downstep and non-automatic downstep of H in Saxwe do not have the same trigger. Automatic downstep of H is triggered by a surface L between two Hs, while non-automatic downstep of H is triggered by a floating M between two Hs. Chapter 6 discusses what these two triggers have in common.

The details of the phonetic implementation of non-automatic downstep of H are addressed in section 7.3. Here, I summarize by saying that for some speakers, non-automatic downstep of H is iterative up to four steps of lowering (the maximum tested in my recordings), which results in the level of H descending below the speaker's baseline levels for the realization of L. For these speakers (including the one whose data are depicted in this chapter), automatic downstep of H and non-automatic downstep of H are not equivalent in terms of F_0 measurements.

Other speakers are limited to a maximum of two non-automatic downsteps of H. For these speakers, there is a closer correspondence between the two kinds of downsteps in terms of F_0 measurements.

I finish this section with the question of whether there is non-automatic downstep of L. The instrumental studies in section 7.4 show clearly that there is no lowering of L triggered by a floating M that is in excess of the lowering that can be attributable to declination. This means that M does not function in the phonetic implementation as a trigger for the downstepping of L. Section 6.2 discusses the reason why this is the case.

Before proceeding with a discussion of the underlying tonal patterns of verbs and nouns, I turn now to the right edge $L_{\%}$ IP boundary tone in Saxwe, as this boundary bears an influence on the surface realization of nouns and verbs in isolation.

3.5 Right edge $L_{\%}$ IP boundary tone

In Saxwe, there is a L boundary tone on the right edge of the IP, which I symbolize as $L_{\%}$. This $L_{\%}$ IP boundary tone is responsible for falling pitches on the right edge of the IP. The $L_{\%}$ boundary tone is associated to the final TBU of the IP in a postlexical operation described in (94). This rule is ordered first in the postlexical derivation.

(94) $L_{\%}$ association

$$\begin{array}{ll} \mu\ ]_{IP} & \\ \begin{Bmatrix} M \\ L \end{Bmatrix} & L_{\%} \end{array}$$

This rule of $L_{\%}$ association states that the $L_{\%}$ IP boundary tone will become associated to the final TBU of the IP if the final tone of the IP is a non-H tone (either M or L).[40] The rule of $L_{\%}$ association is sensitive to floating tones and PW tonal boundaries (see section 4.1) in addition to those tones that are associated to a TBU. In Saxwe, the tone which precedes the $L_{\%}$ boundary may be one of three tones: H, M, or L. Given this three-way choice, M must pattern either with H or with L. Here we see that it patterns with L. Section 6.2 discusses why this is the case.

We see a final falling tone in (95)a, where there is an underlying M preceding the $L_{\%}$ IP boundary, but not in (95)b, where a H precedes the $L_{\%}$ boundary.

(95)	a.	/ōsɔ́	sē/	A horse heard.
		[ōsɔ́	sê]	sxw-L0026-clause frames-un.wav
	b.	/ōsɔ́	sɔ̃́/	A horse left.
		[ōsɔ́	sɔ̃́]	sxw-L0029-clause frames-un.wav

The derivation of these forms looks as follows.

[40] There are parallels between this rule of $L_{\%}$ association and the role attributed to the L% boundary tone in the 'autosegmental-metrical' theory of intonational phonology applied to non-tonal languages. Ladd (1996) describes the boundary as follows: "The L% boundary tone can best be described as indicating the absence of final rise. After L phrase tone, it indicates a fall to the bottom of the speaking range, but after H phrase tone it indicates a level sustention of the previous tone" (p. 88).

(96) a.
osɔ sɔ̃ osɔ se Underlying forms
M H H L% M H M L%

b.
osɔ sɔ̃ osɔ se L% association
M H H L% M H M L%

c.
osɔ sɔ̃ osɔ se Tonal spread
M H H L% M H M L%

The right L% boundary tone fails to associate to the final TBU of an IP in three cases: (1) when there is a H linked to the final TBU of the IP, (2) when there is a lexical floating H at the right edge of the IP, or (3) when there is a prosodically-derived H_{ω} boundary at the right edge of the IP. Examples of failure of the L% boundary tone to associate due to a floating lexical H can be found in sections 3.7.3 and 3.7.7, and examples that are due to a H_{ω} boundary tone can be found in section 4.1.

Note in (96)c that a TBU that is linked to a right L% boundary tone is still susceptible to having H spread to it if there is a M linked to that TBU. The M tone makes the TBU a candidate for acquiring H through Tonal spread and the presence of an associated L% boundary does not impede this.

In many of the derivations of this study (particularly those which do not include lines of association), I do not mark the default L% boundary in underlying forms. Its presence is assumed unless noted otherwise (for example in section 5.8 where the alternative H% boundary is discussed). In cases where a final H is present, the L% boundary never becomes associated to a TBU and therefore never becomes realized at the surface level. In cases where L% association results in this boundary tone becoming associated to a TBU, that is consistently indicated in the derivation.

Having now covered the rule of Tonal spread, the processes of automatic and non-automatic downstep of H, as well as the right edge L% IP boundary, we can now begin the analysis of the underlying forms of monomorphemic verbs and nouns in Saxwe.

3.6 Monomorphemic verbs – underlying tones

I begin with the analysis of the underlying tones of verbs rather than nouns because verbs have simpler underlying tone patterns. In addition, verbs have consistent patterns of consonant-tone interaction—unlike words of other lexical categories. The following are the surface tonal patterns for verbs in isolation. The isolation form for verbs is the imperative in Saxwe. Included in this table are the percentage of verbs in my database which have this tone pattern.

The superscript [R] indicates a tendency toward a slight upglide in pitch—an upglide that does not approach the height of a [LH] contour or even a [LM] contour.[41] Some speakers produce more of an upglide than others.

The surface tones of monomorphemic verbs are seen in (97); recordings are at: https://drive.google.com/open?id=1Lsu0ipaXPX8yb7DGoF7dH57S73NoSpBQ.

(97) C(C)V-shaped verbs – surface tones

	Voiceless obstruents		
[H]	[sɔ́]	leave	62/291 (21%)
[L]	[sè]	hear	60/291 (21%)
	Sonorants, /ɖ/, and /b/		
[LH]	[jɔ̌]	call	38/291 (13%)
[L]	[lè]	exist	43/291 (15%)
	Voiced obstruents		
[L^R]	[và^R]	come	39/291 (13%)
[L]	[gbɔ̀]	return	49/291 (17%)

Here, we see surface tone patterns grouped according to whether the onset of the verb belongs to one of three groups: (1) voiceless obstruents, (2) voiced obstruents, or (3) a third category comprised of sonorants, /ɖ/, and /b/. In section 1.4.4, I explain that the phoneme /ɖ/ has a nasal allophone [n], and the phoneme /b/ has a nasal allophone [m].

For verbs, there is no ambiguity in the interaction of the sounds [b] and [m] or [ɖ] and [n] with tonal patterns. Verbs containing either [b] or [m], for example, pattern consistently with sonorants in having one of two surface realizations: [LH] or [L]. This is demonstrated in (98), which shows all of the verbs in my database which contain either the sound [b] or [m].

[41] This upglide is demonstrated on nouns by means of an instrumental study in sections 7.5.3 and 7.5.4.

(98) **C(C)V verbs with onsets [b] and [m]**

[LH]	[mɛ̃̌]	be clean	[mɔ̃̌]	be bald
	[mã̌]	divide	[bɛ̌]	begin
	[mɛ̃̌]	be fine to the touch	[bɛ̌]	pick up
	[mɔ̃̌]	cause to eat	[blǎ]	attach
	[mjɔ̃̌]	tighten	[bǐ]	be cooked
	[mɔ̃̌]	deny	[bjɔ̌]	ask for a thing
[L]	[mɛ̃̀]	grill	[bì]	burn
	[mɛ̃̀]	sting, bite	[blì]	roll
	[mĩ̀]	swallow	[bɔ̀]	meet
	[mũ̀]	fall over, be demolished	[bù]	think
	[bɛ̀]	hide	[bjà]	ripen, be ripe
	[bà]	draw up (water)		

The underlying tones of monomorphemic verbs are less complex than their surface forms would lead one to believe. The following are the underlying tone patterns of verbs in Saxwe.[42]

(99) C(C)V-shaped verbs – underlying patterns and surface tones

	Non-depressors – voiceless obstruents, sonorants, /ɖ/ and /b/	
/H/	[sɔ̃́]	leave
	[jɔ̌]	call
/M/	[sè]	hear
	[lè]	exist
	Depressors – voiced obstruents	
/LH/	[và^{R}]	come
/L/	[gbɔ̃̀]	return

Verbs can be divided into two subsets: those with non-depressor onsets and those with depressor onsets. In this table of underlying tone patterns, we see that there is no further subdivision of the subset of verbs with non-depressors when we address underlying rather than surface tone. Verbs containing voiceless obstruents, sonorants, /ɖ/, or /b/—all of which together make up the category of non-depressors—are all either /H/ or /M/.

A general statement that can be made is that for both subsets of onset type (the non-depressor subset and the depressor subset), there is an underlying pattern that includes /H/ and one that is non-high (either /M/ or /L/). Another point worth

[42] This analysis differs from that in Beavon-Ham (2012).

underlining is that for verbs, my database contains no exceptions to the patterns of consonant-tone interaction that we see here.

We still must explain the surface forms seen in (97). For instance, we must be able to explain why sonorants have a surface [LH] realization for /H/ tone, why the surface [L^{R}] pattern is described as the realization of underlying /LH/, and why the /M/ verbs are realized [L]. In the next sections, I examine each underlying tone pattern, beginning with the subset of non-depressors.

Before continuing, I briefly note that there is a grammatical tone which marks the imperative in Saxwe. In studies of Gbe languages, the imperative has been analyzed as a floating grammatical L which docks or fails to dock to the verb, depending on the consonant quality of the verb onset (Bradshaw, 1999; Stahlke, 1971). In Saxwe as well, there is evidence that the imperative is a floating grammatical L. This floating L interacts with the tones of verbs in a way that is consistent with floating grammatical tones in other environments, and its presence is largely responsible for the surface forms seen in (97).

3.6.1 The /H/ verb

I begin the explanation of these underlying patterns with a discussion of /H/ tone when it is lexically assigned to a verb that has a voiceless obstruent onset. The following shows the H tone verbs /sɔ̃́/ 'leave' and /kpɔ̃́/ 'see' in frames where they follow each of three underlying tone possibilities: H, M, and L. The verb /sɔ̃́/ is utterance-final in (100)a-f and the verb /kpɔ̃́/ is utterance-medial in (100)g-i.

(100) Tonal frames for the /H/ verb with a voiceless obstruent onset[43]

a.	/ōsɔ́ sɔ̃́/	[ōsɔ́ sɔ̃́]	A horse left.	sxw-L0029-clause frames-un.wav
b.	/ōxɛ̄ sɔ̃́/	[ōxɛ̄ sɔ̃́]	A bird left.	sxw-L0011-clause frames-un.wav
c.	/ōdã̀ sɔ̃́/	[ōdã̀ sɔ̃́]	A snake left.	sxw-L0053-clause frames-un.wav
d.	/ōsɔ́ nã̄ sɔ̃́/	[ōsɔ́ nã́ ↓sɔ̃́]	A horse will leave.	sxw-L0001-auxiliaries-un.wav
e.	/ōdã̀ nã̄ sɔ̃́/	[ōdã̀ nã̀ sɔ̃́]	A snake will leave.	sxw-L0031-auxiliaries-un.wav
f.	/sɔ̃́/	[sɔ̃́]	Leave.	sxw-L0141-verbs-leave-un.wav

[43] Underlying tones, not phonemes, are in focus in underlying representations. Therefore, /ɖ/ will not be marked for [n], /b/ will not be marked for [m], and /j/ will not be marked for [ɲ] here and elsewhere in the remainder of this study.

g.	/ōsɔ́ kpɔ̃́ ōwĩ́/	[ōsɔ́ kpɔ̃́ ó↓wĩ́]	A horse saw a bee.	sxw-L0383-clause frames-un.wav
h.	/ōkpɔ̄ kpɔ̃́ ōwĩ́/	[ōkpɔ̄ kpɔ̃́ ó↓wĩ́]	A leopard saw a bee.	sxw-L0384-clause frames-un.wav
i.	/ōdà̃ kpɔ̃́ ōwĩ́/	[ōdà̃ kpɔ̃́ ó↓wĩ́]	A snake saw a bee.	sxw-L0386-clause frames-un.wav

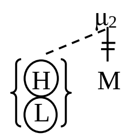
In each of these utterances in (100)a-f, right edge $L_{\%}$ association fails to occur because of the H of /sɔ̃́/ 'leave'. The TBU of the verb /sɔ̃́/ is realized H in every utterance where it occurs—it is not subject to L spread, nor to any process in the phonetic implementation that would alter this realization.

In (100)d, the surface structure has two occurrences of H which are separated by a floating M, and therefore the second occurrence is realized as a downstepped ↓H in the phonetic implementation. Following application of the rule of Tonal spread (see section 3.2), the utterance would look as follows.

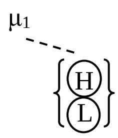
(101) osɔ nã sõ
M H M H

In the citation form [sɔ̃́], 'leave', the verb is the imperative form. Because of this, there is a floating L preceding the verb. In Saxwe, a floating H or L does not dock rightward onto a TBU that carries H or L tone. This is described in the rules of Grammatical tone docking A and B, which are shown here and also referred to in sections 5.2 and 5.4.

(102) Grammatical tone docking A



Grammatical tone docking B



These rules of Grammatical tone docking are two-part and ordered, with rule A ordered before rule B. These rules state that a floating grammatical H or L will only dock rightward onto a following TBU if that TBU has M tone. If this condition is met, the floating grammatical tone docks and delinks the M. If rightward docking is not possible (either because the following TBU has H or L tone or because there is no following TBU), the floating grammatical H or L will dock leftward to the preceding TBU.[44]

In the case of [sɔ̃́], 'leave', the floating L of the imperative is unable to dock to the TBU of the verb because there is a H associated to that TBU. As a result, the floating L remains floating.

In the utterances (100)g-i where the H verb /kpɔ̃́/ 'see' occurs utterance-medially, the realization of this verb is the same as the realization of the verb /sɔ̃́/ 'leave' in utterance-final utterances. Also, the initial vowel of the immediately following noun is realized H even though its underlying tone is M. This is due to Tonal spread. The following is the derivation of [ōsɔ́ kpɔ̃́ ó↓wĩ́] 'a horse saw a bee'.

(103)

osɔ kpɔ̃ owĩ M H H M H	Underlying forms
	L% association (NA)
osɔ kpɔ̃ owĩ M H H M H	Tonal spread

I turn now to the /H/ pattern when it is lexically assigned to a verb with a sonorant onset (including in this category the sounds /ɖ/ and /b/). Here in (104) we see a very close resemblance to the surface forms in (100) with two exceptions, both of which are circled.

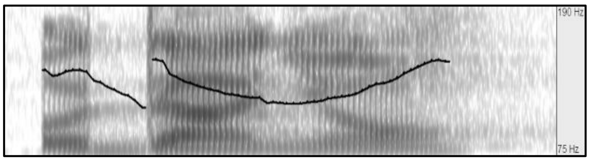
(104) Tonal frames for the /H/ verb with a sonorant onset

a.	/ōsɔ́ ɲɔ̃́/	[ōsɔ́ ɲɔ̃́]	A horse is good.	sxw-L0028-clause frames-un.wav
b.	/ōxɛ̄ ɲɔ̃́/	[ōxɛ̄ ɲɔ̃́]	A bird is good.	sxw-L0010-clause frames-un.wav
c.	/ōdà̃ ɲɔ̃́/	[ōdà̃ ɲɔ̃̌]	A snake is good.	sxw-L0052-clause frames-un.wav
d.	/ōsɔ́ nã̄ ɲɔ̃́/	[ōsɔ́ nã̄ ↓ɲɔ̃́]	A horse will be good.	sxw-L0003-auxiliaries-un.wav
e.	/ōdà̃ nã̄ ɲɔ̃́/	[ōdà̃ nà̃ ɲɔ̃́]	A snake will be good.	sxw-L0033-auxiliaries-un.wav
f.	/ɲɔ̃́/	[ɲɔ̃̌]	Be good.	sxw-L0207-verbs-good (be)-un.wav

There are surface rising pitches on the realizations of the verb 'be good' in (104)c and f. In (105), we see the pitch trace of (104)c.

[44] Floating grammatical M does not dock but only plays a role in triggering downstep or creating an environment for rule B of Contour simplification to apply. This is seen in section 5.1.

(105) /ōdã̏ ɲɔ̃́/ 'a snake is good' → [ōdã̏ ɲɔ̃̌]



Here, there is a rising pitch on the last syllable going from L to H. Here and in other sections of this study, we see that there is an operation in Saxwe that spreads L onto a H TBU in the environment where the intervening consonant is voiced at the surface level. This rule is shown below and also referred to in section 3.7.8.

(106) Partial L spread

$$\begin{Bmatrix}\text{voice}\\ \text{son}\end{Bmatrix}$$

C

μ

L H

Because voicing is normally assigned by default to sonorants and it is unclear at what point in the phonology that default assignment occurs with respect to tonal rules, this rule states that this spread happens in the environment of an intervening consonant which is either: (1) voiced at the underlying level (*i.e.* a voiced obstruent), or (2) a sonorant. This is a rule of partial spread because the H is not delinked; there is simply a surface [LH] rise on the second TBU.

This rule is ordered before the rule of Tonal spread. If this were not the case, one would expect to see the same sort of surface [LH] contour in (104)d [ōdã̏ nã̏ ɲɔ̃́] 'a snake will be good', derived from /ōdã̏ nã̄ ɲɔ̃́/. The two possibilities are shown below.

(107) Correct rule ordering: Partial L spread prior to Tonal spread

/ōdã̏ ɲɔ̃́/	/ōdã̏ nã̄ ɲɔ̃́/	Underlying forms
--	--	$L_{\%}$ association
ōdã̏ ɲɔ̃̌	--	Partial L spread
--	ōdã̏ nã̏ ɲɔ̃́	Tonal spread
[ōdã̏ ɲɔ̃̌]	[ōdã̏ nã̏ ɲɔ̃́]	Surface

(108) Incorrect rule ordering: Tonal spread prior to Partial L spread

/ōdã̀ ɲɔ̃́/	/ōdã̀ nã̄ ɲɔ̃́/	Underlying forms
--	--	$L_{\%}$ association
--	ōdã̀ nã̀ ɲɔ̃́	Tonal spread
ōdã̀ ɲɔ̃̌	ōdã̀ nã̀ ɲɔ̃̌	Partial L spread
[ōdã̀ ɲɔ̃̌]	*[ōdã̀ nã̀ ɲɔ̃̌]	Surface

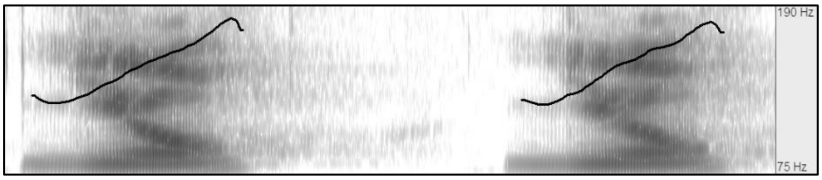
We can now look at the citation form [ɲɔ̃̌] 'be good' of (104)f. Here, the rising pitch is again due to the Partial L spread. In this case, it is the floating L of the imperative which spreads onto the following H TBU.

(109)	ɲɔ̃ | L H	Underlying form $L_{\%}$ association (NA) Grammatical tone docking (NA)
	ɲɔ̃ L H	Partial L spread Tonal spread (NA)

One may raise the question of whether Partial L spread is truly a valid phonological operation in the language, or whether the rising pitch observed on a form like [ɲɔ̃̌] is simply a phonetic phenomenon—a delay in the attainment of a target pitch such that the target F_0 is reached late within the syllable after an intonational boundary or after a surface L. The instrumental studies in section 7.2 show that there is for some speakers a phonetic peak delay in all-H utterances; the highest F_0 of an utterance of multiple H syllables is often produced on the second syllable rather than the first. One might question whether the Partial L spread here is also a phonetic effect, occurring within the duration of a single syllable.

There are several reasons for categorizing this rise as phonological rather than phonetic. First, the rising observed on this form—unlike the delay in peak attainment seen in section 7.2—involves a rise from a point low in the speaker's F_0 range (where L would be realized) to a point high in the speaker's range. Moreover, there is some indication of deliberate widening of these endpoints through a slight initial dip in F_0 and a slight final peak in F_0. This can be seen in the two repetitions of [ɲɔ̃̌] shown in (110).

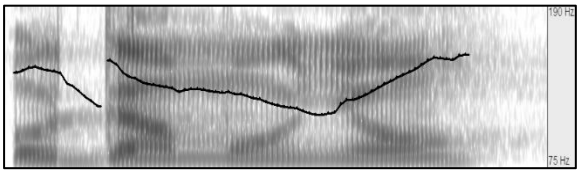
(110) /ɲɔ̃́/ 'be.good' → [ɲɔ̃̌]



ɲɔ̃̌ **ɲɔ̃̌**

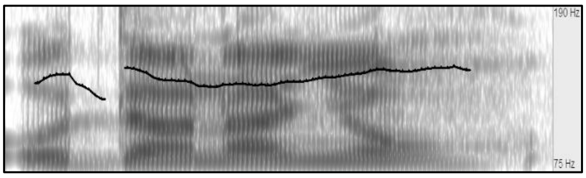
More convincing, however, is the argument that the surface rise can help distinguish between underlying lexical differences. We see this in the two utterances shown below where in the first case, the TBU preceding the H of /ɲɔ̃́/ has an underlying lexical L, and in the second case, the TBU preceding /ɲɔ̃́/ has an underlying lexical M (realized as surface L because of Tonal spread). Both are shown within the same graphing range of 75 to 190 Hz.

(111) /ōdã̀ mɔ̃̀ ɲɔ̃́/ 'a snake is again (REPET) good' → [ōdã̀ mɔ̃̀ ɲɔ̃̌]
sxw-L0229-auxiliaries-un.wav



ō- dã̀ mɔ̃̀ **ɲɔ̃̌**

(112) /ōdã̀ nã̄ ɲɔ̃́/ 'a snake will be (FUT) good' → [ōdã̀ nã̀ ɲɔ̃́]
sxw-L0033-auxiliaries-un.wav



ō- dã̀ nã̀ **ɲɔ̃́**

There is in (111) a widening of the F_0 endpoints that make up the extremes of the [LH] rise.[45] In comparison, the distinctions between surface M, L, and H in

[45] There seems to be anticipatory phonetic lowering of the F_0 of L in anticipation of the [LH] rise. Another type of anticipatory lowering of the L immediately preceding a H is described in section 7.4.

(112) involve relatively small F_0 differences. Partial L spread, with its [LH] output, appears to be a phonological recovery strategy for distinguishing between underlying M and L in the TBU preceding the H.

I turn now to an analysis of the second tonal option for verbs that have non-depressor onsets.

3.6.2 The /M/ verb

The following are utterances that show how a /M/ verb is realized when it follows TBUs that are H, M, or L. The following utterances contain the verb /sē/ 'hear'.

(113) Tonal frames for the /M/ verb with a voiceless obstruent onset

a.	/ōsɔ́ sē/	[ōsɔ́ sê]	A horse heard.	sxw-L0026-clause frames-un.wav
b.	/ōxɛ̄ sē/	[ōxɛ̄ sḕ]	A bird heard.	sxw-L0008-clause frames-un.wav
c.	/ōdã̀ sē/	[ōdã̀ sè]	A snake heard.	sxw-L0050-clause frames-un.wav
d.	/ōsɔ́ nã̄ sē/	[ōsɔ́ nã́ sê]	A horse will hear.	sxw-L0002-auxiliaries-un.wav
e.	/ōdã̀ nã̄ sē/	[ōdã̀ nã̀ sè]	A snake will hear.	sxw-L0032-auxiliaries-un.wav
f.	/sē/	[sè]	Hear.	sxw-L0020-verbs-hear-un.wav

Voiceless obstruents and sonorants are both part of the category of non-depressors. This is confirmed when we see the tonal behavior of the verbs /lē/ 'exist, be present, be at' and /wɔ̃̄/ 'forget' when placed in the same tonal environments as /sē/. In (114), there are utterances containing /lē/ in utterance-final position, and utterances containing the verb /wɔ̃̄/ in utterance-medial position.

(114) Tonal frames for the /M/ verb with a sonorant onset

a.	/ōsɔ́ lē/	[ōsɔ́ lê]	A horse is present.	sxw-L0025-clause frames-un.wav
b.	/ōxɛ̄ lē/	[ōxɛ̄ lḕ]	A bird is present.	sxw-L0007-clause frames-un.wav
c.	/ōdã̀ lē/	[ōdã̀ lè]	A snake is present.	sxw-L0049-clause frames-un.wav
d.	/ōsɔ́ nã̄ lē/	[ōsɔ́ nã́ lê]	A horse will be present.	sxw-L0004-auxiliaries-un.wav
e.	/ōdã̀ nã̄ lē/	[ōdã̀ nã̀ lè]	A snake will be present.	sxw-L0034-auxiliaries-un.wav
f.	/lē/	[lè]	Be present, exist.	sxw-L0005-verbs-be at, exist-un.wav

g.	/ōsɔ́ wɔ̄̄ ōwí̄/	[ōsɔ́̄ wɔ́̄ ó↓wí̄]	A horse forgot a bee.	sxw-L0395-clause frames-un.wav
h.	/ōkpɔ̄ wɔ̄̄ ōwí̄/	[ōkpɔ̄ wɔ̄̄ ōwí̄]	A leopard forgot a bee.	sxw-L0396-clause frames-un.wav
i.	/ōdà̄ wɔ̄̄ ōwí̄/	[ōdà̄ wɔ̀̄ òwí̄]	A snake forgot a bee.	sxw-L0399-clause frames-un.wav

In (114)g-i where the verb is utterance-medial, we see that if there is a H or L tone preceding the M TBU, the /M/ verb is realized either H or L because of Tonal spread. The floating M that results from Tonal spread triggers non-automatic downstep when it is located between two Hs, as in (114)g.

In utterances (114)a-e, the verb is utterance-final. The association of the right edge $L_{\%}$ intonational boundary to the final TBU (section 3.5) is responsible for the final fall or downglide on all of these forms. This association occurs whenever the $L_{\%}$ boundary is not immediately preceded by a H. Note that the pitch level in utterances (114)a-e begins at either H, M, or L levels (depending on the level of the TBU that precedes) and descends or trails downward from there. The derivation of (114)a would look as follows.

(115) osɔ le
M H M
Underlying forms

osɔ le
M H M $L_{\%}$
$L_{\%}$ association
Partial L spread (NA)

osɔ le
M H M $L_{\%}$
Tonal spread

At first glance, the least straightforward part about the /M/ pattern for monomorphemic verbs is its surface realization in isolation. In isolation, there is no consistent difference between the surface realization of a /M/ verb like (114)f /lē/ 'exist, be present', which is realized as [lè] and that of a /L/ verb like /gbɔ̀̄/ 'return', which is realized as [gbɔ̀̄] (section 3.6.3).[46] Both are produced as a surface L with downglide.

[46] Sometimes in the vowel duration of /M/ verbs such as /sē/ 'hear', there is a brief initial phonetically raised F_0 because of the raising effect of voiceless obstruents—a well-documented phenomenon (Hombert, Ohala, & Ewan, 1979). This does not last long into the duration of the vowel.

The reason toneless monosyllabic verbs such as [sè] and [lè] are realized as such in isolation has to do with the floating L of the imperative. According to rules A and B of Grammatical tone docking (102), a floating H or L can dock rightward if the following TBU is M. Here, the underlying M TBU of the verbs /sē/ 'hear' or /lē/ 'be, be present, exist' creates the right environment for the floating L to dock.

(116)

	se			Underlying form
L	M			
	se			$L_{\%}$ association
L	M	$L_{\%}$		
	se			Grammatical tone docking Partial L spread (NA) Tonal spread (NA)
L	M	$L_{\%}$		

The realization of this output from the phonology is a surface L with final downglide.[47]

3.6.3 The /L/ verb

Having discussed verbs that have onsets that are non-depressors, I move now to verbs that have a depressor onset. In the categorization of tone patterns of verbs repeated here in (117), we see that verbs with depressor onsets are either /LH/ or /L/, unlike verbs with non-depressor onsets, which are either H/ or /M/.

[47] The speaker whose data this analysis is largely built on has virtually no F_0 distinction between M and L baseline levels in longer all-M and all-L utterances (section 7.2). Therefore, were the L tone of the imperative not present, there still may not be a significant difference between the surface realization of the /M/ verb and the /L/ verb in the imperative form, especially given that the right $L_{\%}$ boundary is linked to both. However, there are other reasons to believe that the imperative L is present and able to link to the TBU of the verb here (sections 3.6.1 and 3.6.4). In addition, I have observed that speakers who do have a baseline F_0 difference between all-M and all-L utterances still realize the imperative /M/ and /L/ verbs at the same F_0 levels and are unable themselves to distinguish between verbs of the two categories in this environment.

(117) C(C)V-shaped verbs - patterns of consonant interaction

	Non-depressors—voiceless obstruents, sonorants, /ɖ/ and /b/	
/H/	[sɔ̋]	leave
	[jɔ̆]	call
/M/	[sè]	hear
	[lè]	exist
	Depressors—voiced obstruents	
/LH/	[và$^{R]}$	come
/L/	[gbɔ̏]	return

Taking first the /L/ verb, we can see how it fares in various tonal frames. The verbs used in these utterances are /gbɔ̏/ 'return' and /ɦwlɛ̏/ 'save'.

(118) Tonal frames for the /L/ verb

a.	/ōsɔ́ gbɔ̏/	[ōsɔ́ gbɔ̏]	A horse returned.	sxw-L0027-clause frames-un.wav
b.	/ōxɛ̄ gbɔ̏/	[ōxɛ̄ gbɔ̏]	A bird returned.	sxw-L0009-clause frames-un.wav
c.	/ōdȁ gbɔ̏/	[ōdȁ gbɔ̏]	A snake returned.	sxw-L0051-clause frames-un.wav
d.	/ōsɔ́ nā̄ gbɔ̏/	[ōsɔ́ nā́ gbɔ̏]	A horse will return.	sxw-L0006-auxiliaries-un.wav
e.	/ōdȁ nā̄ gbɔ̏/	[ōdȁ nȁ gbɔ̏]	A snake will return.	sxw-L0036-auxiliaries-un.wav
f.	/gbɔ̏/	[gbɔ̏]	Return.	sxw-L0014-verbs-return-un.wav
g.	/ōsɔ́ ɦwlɛ̏ ōwı̋/	[ōsɔ́ ɦwlɛ̏ òwı̋]	A horse saved a bee.	sxw-L0403-clause frames-un.wav
h.	/ōkpɔ̄ ɦwlɛ̏ ōwı̋/	[ōkpɔ̄ ɦwlɛ̏ òwı̋]	A leopard saved a bee.	sxw-L0404-clause frames-un.wav
i.	/ōdȁ ɦwlɛ̏ ōwı̋/	[ōdȁ ɦwlɛ̏ òwı̋]	A snake saved a bee.	sxw-L0406-clause frames-un.wav

The underlying /L/ verbs are realized L in all tonal environments. When utterance-final as in (118)a-f, this L has a final downglide because of the association of the right edge $L_{\%}$ boundary to the verb. When Tonal spread causes a M to be delinked as in (118), this M plays no role in triggering non-automatic downstep of L in the phonetic implementation. The reason for this is discussed in section 6.2.3.

While the tonal behavior of /L/ verbs is straightforward, /LH/ verbs are often less transparent in their surface forms. I turn now to this category of verb.

3.6.4 The /LH/ verb

The following are utterances that contain the /LH/ verbs /vǎ/ 'come' and /gbɛ̌/ 'refuse, reject'. In these transcriptions, the superscript ^{R} stands for a final slight upglide in pitch. This upglide is more pronounced in certain utterances than in others.

(119) Tonal frames for the /LH/ verb

a.	/ōsɔ́ vǎ/	[ōsɔ́ vá]	A horse came.	sxw-L0030-clause frames-un.wav
b.	/ōxɛ̄ vǎ/	[ōxɛ̄ và^{R}]	A bird came.	sxw-L0012-clause frames-un.wav
c.	/ōdȁ vǎ/	[ōdȁ và^{R}]	A snake came.	sxw-L0054-clause frames-un.wav
d.	/ōsɔ́ nā̃ vǎ/	[ōsɔ́ nã́ và^{R}]	A horse will come.	sxw-L0005-auxiliaries-un.wav
e.	/òdȁ nā̃ vǎ/	[ōdȁ nȁ và^{R}]	A snake will come.	sxw-L0035-auxiliaries-un.wav
f.	/vǎ/	[và^{R}]	Come.	sxw-L0208-verbs-come-un.wav
g.	/ōsɔ́ gbɛ̌ ōwĩ́/	[ōsɔ́ gbɛ́ ó↓wĩ́]	A horse rejected a bee.	sxw-L0389-clause frames-un.wav
h.	/ōkpɔ̄ gbɛ̌ ōwĩ́/	[ōkpɔ̄ gbɛ̀ ōwĩ́]	A leopard rejected a bee.	sxw-L0390-clause frames-un.wav
i.	/ōdȁ gbɛ̌ ōwĩ́/	[ōdȁ gbɛ̀ ōwĩ́]	A snake rejected a bee.	sxw-L0392-clause frames-un.wav

In Saxwe, underlying lexical /LH/ on a TBU does not remain intact at the surface level as LH in monomorphemic contexts. In these utterances in (119), we see that following a L or a M, the phonemic contour /LH/ is realized L—with some phonetically-implemented nuances to be discussed shortly. Following a H, it is realized H.

This requires a rule of Contour simplification. In fact, there are two rules of Contour simplification, which I label as rules A and B. The following are the rules of Contour simplification.

(120) Contour simplification A:

μ

H ~~L~~ H

(121) Contour simplification B:

μ

$\begin{Bmatrix} M \\ L \end{Bmatrix}$ L H

The rule of Contour simplification A states that in the environment of a preceding H, an underlying LH contour is simplified by deleting the L. The rule of Contour simplification B states that in the environment of a preceding non-H (a M or L), an underlying LH contour is simplified by delinking the H (thereby creating a floating H). In both cases, the contour is simplified in a manner so that the surface realization of the underlying LH contour will approximate (in broad terms) the surface pitch of the preceding TBU.

We can now return to the utterances in (119). I consider first the case of the phonemic /LH/ contour which is realized H following an underlying H. The following is the derivation of (119)a /ōsɔ́ vǎ/ 'a horse came'.

(122)

osɔ	va	Underlying forms
M H	L H	$L_{\%}$ association (NA)
osɔ	va	Contour simplification Partial L spread (NA)
M H	H	Tonal spread (NA)

The output of the phonetic implementation is [ōsɔ́ vá].

When the underlying /LH/ contour follows an underlying L or M TBU, it is the L part of the /LH/ contour of a verb such as /vǎ/ that is retained. However, it is realized with phonetically-implemented nuances which are due to the presence of the floating H. We can look at (119)b /ōxɛ̄ vǎ/ 'a bird came' as an example of the application of rule B of Contour simplification.

(123) oxɛ va Underlying forms

M L H L% association (NA)

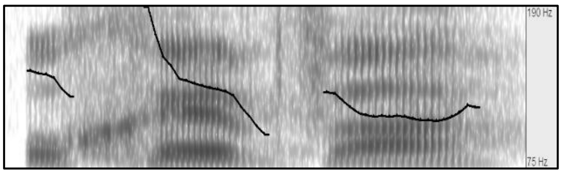
oxɛ va Contour simplification

M L H Partial L spread (NA)

Tonal spread (NA)

The output of the phonetic implementation in this case is [ōxɛ̄ và^R], in which the L–floating H is realized utterance-finally as having a slight upglide of pitch. This slight upglide is more pronounced for some speakers than for others, but it never rises in the way that a surface [LH] might. The upglide is seen on the final syllable in the pitch trace below.

(124) /ōxɛ̄ vǎ/ → [ōxɛ̄ và^R]



ō- xɛ̄ **và^R**

Besides triggering utterance-final upglide, the L–floating H sequence that is obtained as a result of Contour simplification may trigger other effects on surface realization. There can be an initial lowering of F_0 of this L within the duration of the TBU. This is described through instrumental tests summarized in sections 7.5.3 and 7.5.4. The F_0 of this TBU may be discernibly lower than the F_0 of a preceding L. This can be seen in (119)c /ōdȁ vǎ/ 'a snake came', shown in (125).

(125) odã va Underlying forms

M L L H L% association (NA)

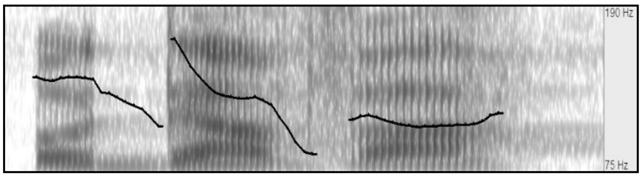
odã va Contour simplification

M L L H Partial L spread (NA)

Tonal spread (NA)

The output of the phonetic implementation is [ōdȁ và^R]. A pitch trace of this utterance is shown below.

(126) /ōdȁ vǎ/ → [ōdȁ và^{R}]



ō- dȁ **và^{R}**

In section 7.4, we see that in the phonetic implementation, Saxwe speakers demonstrate an anticipatory lowering of the L TBU immediately preceding an IP-final H. Here, it is as though this anticipatory lowering of the F_0 of L occurs despite the fact that the IP-final H that follows is a floating tone.

A final effect of the L–floating H sequence is that the floating H blocks L spread. This is seen in (119)h /ōkpō gbɛ̌ ōwĩ́/ 'a leopard rejected a bee', derived in (127).

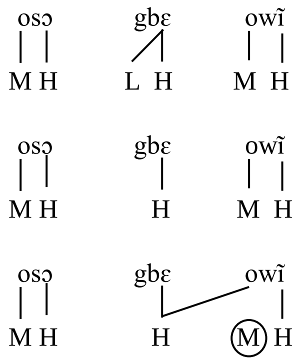
(127) okpɔ gbɛ owĩ Underlying forms
L$_{\%}$ association (NA)
M L H M H

okpɔ gbɛ owĩ Contour simplification
Partial L spread (NA)
M L H M H Tonal spread (NA)

The surface realization of this utterance is [ōkpō gbɛ̀ ōwĩ́]. The floating H that results from Contour simplification blocks the spread of L, so that when Tonal spread occurs, there is no spread of L and the following TBU is realized M.

Given that the L of an underlying /LH/ contour does not participate in Tonal spread (because of the floating H following it), we must examine whether the H of an underlying /LH/ contour ever participates in Tonal spread. The answer is indicated in (119)g /ōsɔ́ gbɛ̌ ōwĩ́/ 'a horse rejected a bee'. The derivation of this utterance is shown below.

(128)



Underlying forms
L% association (NA)

Contour simplification
Partial L spread (NA)

Tonal spread

This utterance is realized [ōsɔ́ gbɛ́ ó↓wĩ́]. Because the underlying /LH/ contour of the verb follows a H, it is simplified according to rule A of Contour simplification (120) by deleting the L. The H spreads onto the following M TBU and delinks it, so that the following H TBU is realized as a downstepped H.

If we compare (128) /ōsɔ́ gbɛ̌ ōwĩ́/ to (127) /ōkpɔ̄ gbɛ̌ ōwĩ́/, we see that the manner in which the underlying /LH/ contour is simplified—whether it is the L or H which remains linked to the vowel—determines whether there is to be H spread or not. Put in derivational terms, the rules of Contour simplification must be ordered before the rule of Tonal spread, as can be seen by comparing (129) to (130).

(129) Correct rule ordering: Contour simplification prior to Tonal spread

/ōsɔ́ gbɛ̌ ōwĩ́/	/ōkpɔ̄ gbɛ̌ ōwĩ́/	Underlying forms
--	--	L% association
ōsɔ́ gbɛ́ ōwĩ́	ōkpɔ̄ gbɛ̀ H ōwĩ́	Contour simplification
--	--	Partial L spread
ōsɔ́ gbɛ́ ó M wĩ́	--	Tonal spread
[ōsɔ́ gbɛ́ ó↓wĩ́]	[ōkpɔ̄ gbɛ̀ ōwĩ́]	Surface

(130) Incorrect rule ordering: Tonal spread prior to Contour simplification

/ōsɔ́ gbɛ̌ ōwĩ́/	/ōkpɔ̄ gbɛ̌ ōwĩ́/	Underlying forms
--	--	L% association
--	--	Partial L spread
ōsɔ́ gbɛ̌ ó M wĩ́	ōkpɔ̄ gbɛ̌ ó M wĩ́	Tonal spread
ōsɔ́ gbɛ́ ó M wĩ́	ōkpɔ̄ gbɛ̀ H ó M wĩ́	Contour simplification
[ōsɔ́ gbɛ́ ó↓wĩ́]	*[ōkpɔ̄ gbɛ̀ ó↓wĩ́]	Surface

If the rule of Tonal spread is ordered before the rules of Contour simplification, we get the incorrect surface form *[ōkpɔ̄ gbɛ̀ ó↓wĩ́] from /ōkpɔ̄ gbɛ̌ ōwĩ́/.

We can also examine how the rules of Contour simplification are ordered with respect to the rule of Partial L spread. In order to do this, we must look at an utterance that has two /LH/ verbs back to back.

(131) /ōɲĩ̄ vǎ gbɛ̌/ → [ōɲĩ̄ và gbɛ̌]
cow come refuse
A cow eventually refused. sxw-L0255-auxiliaries-un.wav

(132) Correct rule ordering: Contour simplification prior to Partial L spread

/ōɲĩ̄ vǎ gbɛ̌/	Underlying forms
--	L% association
ōɲĩ̄ và H gbɛ́	Contour simplification
ōɲĩ̄ và H gbɛ̌	Partial L spread
--	Tonal spread
[ōɲĩ̄ và gbɛ̌]	Surface

(133) Incorrect rule ordering: Partial L spread prior to Contour simplification

/ōɲĩ̄ vǎ gbɛ̌/	Underlying forms
--	L% association
--	Partial L spread
ōɲĩ̄ và H gbɛ́	Contour simplification
--	Tonal spread
*[ōɲĩ̄ và gbɛ́]	Surface

Only the rule ordering in (132) where Contour simplification occurs prior to Partial L spread yields the correct surface form with its [LH] contour. Interestingly, in the derivation in (132), it is evident that the simplification of both contours takes place simultaneously. In addition, we see that the floating H that is the result of Contour simplification does not interfere with the Partial L spread.

Before leaving the subject of the /LH/ verb, I return to the isolation form, which has a floating L of the imperative preceding it. Recall that the rules of Grammatical tone docking (102) state that a grammatical tone will only dock to the rightward TBU if this TBU is M. Thus the L of the imperative does not dock to the TBU of a /LH/ verb in its imperative form. However, the floating L does provide the correct environment for the rule of Contour simplification B to be applied, with the result that H is delinked. The final realization is a surface form [và^{R}] with a slight utterance-final upglide. The derivation is shown below.

(134)	va L L H	Underlying form L% association (NA)
	va L L H	Contour simplification Grammatical tone docking (NA) Partial L spread (NA) Tonal spread (NA)

This concludes the examination of each of the four underlying tones that may be lexically associated with monomorphemic verbs. Before turning to an examination of the underlying tone patterns associated with monomorphemic nouns, I first mention some thoughts regarding the historical development of verb tone.

3.6.5 Thoughts on the historical development of verb tone

If we look at the table of underlying lexical tone of verbs repeated below in (135), there appears to be a certain arbitrariness to the tone categories at first glance. One expects perhaps to see that in a tone system with a 3-way underlying tonal opposition, there would be three underlying tone patterns. Instead, verbs with depressor onsets are either /LH/ or /L/, and this is opposed to an option of either /H/ or /M/ for verbs with non-depressor onsets.

(135) C(C)V-shaped verbs – underlying patterns and surface tones

	Non-depressors—voiceless obstruents, sonorants, /ɖ/ and /b/	
/H/	[sɔ̃́]	leave
	[jɔ̌]	call
/M/	[sè]	hear
	[lè]	exist
	Depressors—voiced obstruents	
/LH/	[và$^{R]}$	come
/L/	[gbɔ̃̀]	return

I believe that this apparent arbitrariness is attributable to the historical development of tone in Saxwe. In section 1.1, I discuss the fact that the Saxwe people are theorized to be a people of Yoruboid origin who migrated into the Gbe-speaking region. The Gbe languages that have been the subject of tone analysis are frequently analyzed as having a two-way underlying tonal contrast which yields three (or four in the case of one dialect) surface heights because of consonant-tone interaction. Such an analysis has been claimed for Ewe (Ansre, 1961; Clements, 1978; Stahlke, 1971) and Gen (Bole-Richard, 1983), although it has also been shown that there are some anomalous forms which call into question this analysis (Bradshaw, 1999).

The Yoruboid languages, on the other hand, frequently have a three-way underlying tonal contrast (Wedekind, 1985). Yoruba itself is well-documented as having a three-way underlying tonal contrast (Akinlabi, 1985; Pulleyblank, 1986).

If Saxwe is indeed a result of language contact between a people of Yoruboid origins and a people of Gbe origins, then it is also likely a product of contact between a tone system of two-way underlying contrast and one of three-way underlying contrast.

Let us assume that in the Gbe system, there was at the time of language contact a two-way underlying system (reconstructed as /H, Ø/) that, because of consonant interaction, yielded three surface heights. The non-high tone in all Gbe languages is usually realized as L in a syllable whose onset is a depressor consonant.

As a result of the contact between such a two-tone language and a three-tone language that already had L in its inventory of underlying contrasts, the L acquired lexical status as a toneme in its own right, no longer merely the phonetic realization of a toneless TBU when following a depressor. There would therefore have been a tone change as shown in (136).

(136) *L insertion

```
   C
   |     μ
   |      ` .
[voice]     L
```

This would have yielded the following progression.

(137) Hypothesized historical progression of Saxwe tone – intermediate

	*2-tone system		*L insertion
Non-depressors	H	→	H
	Ø	→	Ø
Depressors	H	→	LH
	Ø	→	L

Finally, what was a default phonological rule of M insertion eventually became a lexical assignment of M. Such a tone change is shown below.

(138) *M insertion

$$\text{Ø} \rightarrow \text{M}$$

The entire progression would be as indicated in (139).

(139) Hypothesized historical progression of Saxwe tone – final

	*2-tone system		*L insertion		*Ø→M
Non-depressors	H	⟶	H	⟶	H
	Ø	⟶	Ø	⟶	M
Depressors	H	⟶	LH	⟶	LH
	Ø	⟶	L	⟶	L

The resulting four categories are the present-day four tone patterns assigned to verbs as seen in (135). If we consider only Saxwe verbs, we could imagine that these rules of L insertion and M insertion in (136) and (138) still have the status of being phonological rules in a synchronic system. If this were the case, the best way to categorize the underlying tones of verbs would be to analyze all verbs as being either /H/ or /Ø/.

However, the data coming from monomorphemic nouns—as well as data from other parts of speech—provide strong reasons for maintaining that Saxwe does indeed have a /H, M, L/ three-way underlying contrast. I turn now to this topic.

3.7 Monomorphemic nouns – underlying tone

Saxwe monomorphemic nouns have a V.C(C)V shape that includes an initial vowel. This initial vowel, discussed in section 1.4.6, is either /o/, /a/, or /ɛ/. While this initial vowel may historically have been a noun class prefix, it is no longer a functional prefix. A function the initial vowel does have is that of assuring that nouns are minimally bisyllabic in their lexical forms; there is a constraint in Saxwe that with the exception of pronouns and borrowed nouns, nouns must be bisyllabic in their lexical forms.

Initial vowels in Saxwe are usually associated with M tone. The exception to this is found in the [L.LH] tone pattern listed in (140), where the initial vowel is linked to L tone instead of M.

The following are the surface tone patterns for monomorphemic nouns. The full list of nouns and their recordings can be found at the following site: https://drive.google.com/open?id=1muj7g8mvBq33Fyq5c2-4XkEdiNPXs8xB.

(140) V.C(C)V-shaped nouns – surface tone patterns

	Voiceless obstruents, sonorants, some of /ɖ/ & /b/		**Followed by determiner /lá/**	**Frequency of the tonal pattern**
[M.H]	[ōsɔ́]	horse	[ōsɔ́ lá]	79/295 (27%)
	[ōló]	crocodile	[ōló lá]	
[M.M]	[ōxɛ̄̀]	bird	[ōxɛ̄ lá]	62/295 (21%)
	[ōɲĩ̄̀]	cow	[ōɲĩ̄ lá]	
[M.M°]	[ōsī°]	female, wife	[ōsī lá]	17/295 (6%)
	[ōnɔ̃̄°]	mother	[ōnɔ̃̄ lá]	
[M.HL]	[ōklâ]	soul	[ōklá ↓lá]	2/295 (1%)
.	**Voiced obstruents, but also at least one of everything else**			
[M.L^R]	[ōgbɔ̀^{R}]	goat	[ōgbɔ̀ lǎ]	47/295 (16%)
[M.L]	[ōdȁ]	snake	[ōdȁ là°]	63/295 (22%)
[M.L°]	[ōɦwè°]	fish	[ōɦwè là°]	13/295 (4%)
[L.LH]	[òdʒǔ]	rain	[òdʒǔ lá]	11/295 (4%)

There are a few things to be aware of in these representations given for the phonetic tone. First, the [M.M] pattern has a falling pitch at the end of the word, whereas the [M.M°] pattern does not.

Second, the [M.L^R] pattern has a slight upglide on the L, and the [M.L°] pattern has a non-falling L, although for individual tokens, these two surface patterns can sound similar. There can be an initial lowering of F_0 of L in the [M.L^R] pattern within the beginning of the duration of the TBU, and possibly within the duration of the onset consonant itself. This is described through instrumental tests summarized in sections 7.5.3 and 7.5.4. Note also that the determiner [lá] is realized differently when following words of each of these two patterns.

Looking at this overview, we can say that there are two subsets of tone patterns that may be assigned to monomorphemic nouns in Saxwe—subsets that can simplistically be called the depressor subset and the non-depressor subset. However, there are inconsistencies in the assignment of lexical tone with respect to consonant quality. Some nouns that contain non-depressors are exceptionally assigned tone patterns that normally belong to the depressor subset of noun tone patterns. These are seen below.

(141) **Exceptional words:** nouns with non-depressors that have tone patterns normally assigned to nouns of the depressor subset

[M.L^{R}]	[ōmı̃̀^{R}]	excrement
	[ānɔ̃̀^{R}]	breast
	[ɛ̄nɛ̃̀^{R}]	palm kernel
	[ōlı̃̀^{R}]	hoe
[M.L]	[ābɔ̀]	cooked beans
	[ōbà]	manioc dish
	[ōmɔ̃̀]	machine
	[ōɖɔ̀]	fishing net
[M.L°]	[ōmlɛ̃̀°]	fishhook
	[ōjɛ̀°]	spider
	[ōtà°]	head
[L.LH]	[òbǒ]	disabled person
	[àmɔ̃̌]	tofu (recently adopted word)

Just over half of these exceptional nouns include the sounds [b] or [m], and three of them include the sounds [ɖ] or [n]. In section 1.4.4, I discuss the fact that there has been a longstanding debate among Gbe researchers as to the status of these sounds, which are in complementary distribution—[m] and [n] occurring before nasalized vowels and [b] and [ɖ] occurring before non-nasalized vowels. I follow the fairly well-established precedent of analyzing /b/ and /ɖ/ as the underlying phonemes and [m] and [n] as their respective allophones (Bole-Richard, 1983; Capo, 1991; Lefebvre & Brousseau, 2002).

Among verbs, the sounds /b/ and its allophone [m], as well as /ɖ/ and its allophone /n/ all fall into the category of non-depressors, and behave accordingly in a predictable way with regard to tone patterns. However, for nouns, the pattern is not as consistent.

The data in (142) include all instances in my corpus of monomorphemic V.(C)CV noun containing either [b] or [m]. Here we see the inconsistency well displayed. Seven of the eight tone patterns are attested among this group. Neither the sound [b] nor the sound [m] is predictably assigned a tone pattern from one or the other of the two subsets of tone patterns—whether the depressor subset or the non-depressor subset.

(142) V.C(C)V nouns involving [b] and [m]

	Tone patterns of the non-depressor subset	
[M.H]	[ābɔ́]	arm
	[ōbjá]	harmattan
	[ōbó]	amulet
	[āmã́]	corn dish
	[āmṹ]	raw food
	[ɛ̄mwĩ́]	mosquito
	[ōmɔ̃́]	path
[M.M]	[ābā]	forked branch
	[ābī]	wound
	[ābwī]	syringe, injection
	[āmĩ̄]	oil
	[ɛ̄mɛ̃̄]	person
[M.M°]	[āmã̄°]	leaf
	[āmjɔ̃̄°]	left side
[M.HL]	---	
	Tone patterns of the depressor subset	
[M.L^{R}]	[ōmĩ̀^{R}]	excrement
[M.L]	[ābɔ̀]	cooked beans
	[ōbà]	manioc dish
	[ōmɔ̃̀]	machine
[M.L°]	[ōmlɛ̃̀°]	fishhook
[L.LH]	[òbǒ]	disabled person
	[àmɔ̃̌]	tofu (recent word)

We can therefore summarize the data presented thus far by saying that the top four patterns in (140) are tone patterns only observed in nouns that contain a non-depressor (excluding from consideration those nouns containing /b/ and /ɖ/), but the bottom four patterns are observed in nouns that contain a depressor as well as some nouns that contain non-depressors. Moreover, it is not clear from these data how /b/ and [m], /ɖ/ and [n] should be categorized—whether as depressors or as non-depressors. This said, we can proceed to an analysis of the underlying tonal patterns for nouns.

The following is an overview of the Saxwe underlying tonal patterns for monomorphemic nouns.

(143) V.C(C)V-shaped nouns – underlying patterns and surface tones

	Voiceless obstruents, sonorants, some of /ɖ/ and /b/		**Frequency of the tonal pattern**
/M.H/	[ōsɔ́]	horse	27%
	[ōló]	crocodile	
/M.M/	[ōxɛ̃̄]	bird	21%
	[ōɲĩ̄]	cow	
/M.M ^{H}/	[ōsī°]	female, wife	6%
	[ōnɔ̃̄°]	mother	
/M.H ^{M}/	[ōklâ]	soul	1%
	Voiced obstruents, but also at least one of everything else		
/M.LH/	[ōgbɔ̀^{R}]	goat	16%
	[ōlĩ̀^{R}]	hoe	
/M.L/	[ōdã̀]	snake	22%
	[ōmɔ̃̀]	machine	
/M.L ^{H}/	[ōɦwè°]	fish	4%
	[ōtà°]	head	
/L.H/	[òdʒǔ]	rain	4%
	[òbǒ]	disabled person	

In sections 3.7.1 through 3.7.8, I describe these tone patterns in detail.

3.7.1 The /M.H/ noun tone pattern

I begin with the tone patterns that are found lexically assigned to monomorphemic nouns with non-depressor consonants. In each of these four patterns, the initial vowel is M. These tonal patterns involve the tones H or M, but never L, as shown below.

(144) Tone patterns found exclusively on nouns with non-depressors, including some /b/ and some /ɖ/

/M.H/	[ōsɔ́]	horse	27%
	[ōló]	crocodile	
/M.M/	[ōxɛ̃̄]	bird	21%
	[ōɲĩ̄]	cow	
/M.M ^{H}/	[ōsī°]	female, wife	6%
	[ōnɔ̃̄°]	mother	
/M.H ^{M}/	[ōklâ]	soul	1%

The first tone pattern, /M.H/, is shown in various tonal frames in (145) using the nouns /ōsɔ́/ 'horse' and /ōwī́/ 'bee' as examples of words with this tone pattern.

(145) Tonal frames for /M.H/ noun tone pattern

a.	/ōsɔ́ sɔ̄́/	[ōsɔ́ sɔ̄́]	A horse left.	sxw-L0029-clause frames-un.wav
b.	/ōsɔ́ sē/	[ōsɔ́ sê]	A horse heard.	sxw-L0026-clause frames-un.wav
c.	/ōsɔ́ gbɔ̄̀/	[ōsɔ́ gbɔ̄̀]	A horse returned.	sxw-L0027-clause frames-un.wav
d.	/$^{M-}$ é kpɔ̄́ ōsɔ́/[48]	[é kpɔ̄́ ó↓sɔ́]	He saw a horse.	sxw-L0213-clause frames-un.wav
e.	/$^{M-}$ ō xɔ̄ ōsɔ́/	[ō xɔ̄ ōsɔ́]	You bought a horse.	sxw-L0214-clause frames-un.wav
f.	/ōsɔ́ ɦwlɛ̄̀ ōwī́/	[ōsɔ́ ɦwlɛ̄̀ òwī́]	A cow saved a bee.	sxw-L0403-clause frames-un.wav

Given the tonal rules and phenomena discussed in sections 3.2 through 3.5, the tonal behavior seen in (145) is fairly straightforward. Where there is no H or L preceding it, the initial vowel is realized M. The initial vowel acquires H tone through Tonal spread if there is a preceding H in the utterance, as in (145)d /$^{M-}$ é kpɔ̄́ ōsɔ́/ 'he saw a horse'. When this happens, the underlying H (as in that of /ōsɔ́/) is realized as a downstepped H in a case of non-automatic downstep triggered by a floating M between Hs. The surface form of (145)d is [é kpɔ̄́ ó↓sɔ́].

Alternatively, the initial vowel may acquire L tone through Tonal spread, as in (145)f /ōsɔ́ ɦwlɛ̄̀ ōwī́/ 'a cow saved a bee'. In this case, the underlying H (as in that of /ōwī́/) is realized as an automatically downstepped H. The surface realization of (145)f is [ōsɔ́ ɦwlɛ̄̀ òwī́].

The right edge $L_{\%}$ IP boundary is not able to associate to the right edge of an IP ending in /ōsɔ́/ or /ōwī́/ because of the H of this underlying tone pattern.

3.7.2 The /M.M/ noun tone pattern

The second tone pattern to be described is /M.M/. For this pattern, there is a single M linked to both the initial vowel and the TBU of the following syllable of the noun. An example of a word with this pattern is /ōxɛ̄/ 'bird', realized in isolation as [ōxɛ̄̀] with a falling M on the final TBU.[49]

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[48] The left floating M- on [$^{M-}$ é] is present on nouns which do not have one of the initial vowels /a/, /ɛ/, or /o/. It is descrbied in section 4.3.

[49] After using this word as a keyword for recordings of this tone pattern in a number of tonal

(146) Tonal frames for /M.M/ noun tone pattern

a.	/ōxɛ̄ sɔ̄́/	[ōxɛ̄ sɔ̄́]	A bird left.	sxw-L0011-clause frames-un.wav
b.	/ōxɛ̄ sē/	[ōxɛ̄ sḕ]	A bird heard.	sxw-L0008-clause frames-un.wav
c.	/ōxɛ̄ gbɔ̄̀/	[ōxɛ̄ gbɔ̄̀]	A bird returned.	sxw-L0009-clause frames-un.wav
d.	/$^{\text{M-}}$ é kpɔ̄́ ōxɛ̄/	[é kpɔ̄́ óxɛ̂]	He saw a bird.	sxw-L0207-clause frames-un.wav
e.	/$^{\text{M-}}$ ō xɔ̄ ōxɛ̄/	[ō xɔ̄ ōxɛ̄̂]	You bought a bird.	sxw-L0208-clause frames-un.wav
f.	/ōɲī̄ ɦwlɛ̄̀ ōxɛ̄/	[ōɲī̄ ɦwlɛ̀ òxɛ̀]	A cow saved a bird.	sxw-L0376-clause frames-un.wav

This /M.M/ tone pattern is realized at a M level if there is no preceding H or L in the IP. This is seen in (146)a, b, c, and e.[50] Otherwise, the noun (both initial vowel and following syllable) is realized either H or L because of Tonal spread, as seen in (146)d and f.

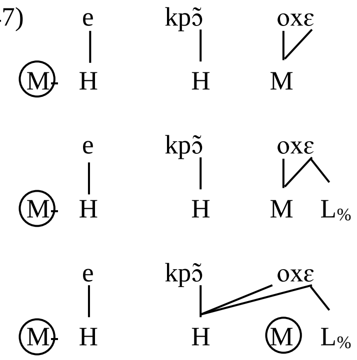
When an utterance ends with a noun of this tonal pattern, the right edge $L_{\%}$ boundary tone associates to the noun, causing the final pitch of the utterance to be falling—either from the H level, the M level, or the L level depending on whether Tonal spread occurs or not. This is seen in (146)d, e, and f. The following is the derivation of (146)d /$^{\text{M-}}$ é kpɔ̄́ ōxɛ̄/ 'he saw a bird'.[51]

frames, I discovered that some speakers assign it the /M.H/ tone pattern and pronounce it [M.H]. The reality is that there is interdialectical and interspeaker variation with regard to the lexical tone pattern assigned to certain nouns. I signal this variation for those words where I am aware of it.

[50] The baseline F_0 for an all-M utterance is quantified for four speakers in section 7.2.

[51] The $^{\text{M-}}$ notation on the pronoun is the left floating M tone on nouns that do not have one of the initial vowels /a/, /ɛ/, or /o/. This is described in section 4.3.

(147)



Underlying forms

L% association
Contour simplification (NA)
Partial L spread (NA)

Tonal spread

The surface realization of this is [é kpɔ̃́ óxɛ̂], which has a final falling pitch starting at the height of a H tone. Note that the floating M has no effect on surface realization when located between a H and the L% boundary, just as it has no effect when located between a H and a L anywhere else.

3.7.3 The /M.M H/ noun tone pattern

The next tone pattern seen for the subset of non-depressors is /M.M H/. This pattern has a floating H at the end of the noun. This is a fairly rare tonal pattern, found in only six percent of nouns in my database of monomorphemic nouns.

The following are examples of this tone pattern in tonal frames, where /ōsī H/ 'wife, female, woman', and /ōnɔ̃̄ H/ 'mother' are the words used to represent this tonal pattern.[52] These words are realized in isolation as [ōsī°] and [ōnɔ̃̄°].

(148) Tonal frames for /M.M H/ noun tone pattern

a.	/ōsī H sɔ̃́/	[ōsī sɔ̃́]	The wife left.	sxw-L0089-clause frames-un.wav
b.	/ōsī H sē/	[ōsī sẽ]	The wife heard.	sxw-L0086-clause frames-un.wav
c.	/ōsī H gbɔ̃̀/	[ōsī gbɔ̃̀]	The wife returned.	sxw-L0087-clause frames-un.wav
d.	/M- é kpɔ̃́ ōsī H/	[é kpɔ̃́ ósí]	He saw his wife.	sxw-L0239-clause frames-un.wav
e.	/M- ō xɔ̄ ōsī H/	[ō xɔ̄ ōsī°]	You bought a wife.	sxw-L0240-clause frames-un.wav
f.	/M- é ɦwlɛ̃̀ ōnɔ̃̄ H/	[é ɦwlɛ̃̀ ònɔ̃̀°]	He saved his mother.	sxw-L0007-other clauses-un.wav

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[52] It is interesting to note that [ōsī°] 'wife' and [ōnɔ̃̄°] 'mother', both of which have this tone pattern, can also have the meaning 'his wife' or 'his/her mother'. This dual sense, however, is present only for the two words of this tonal pattern that are kinship terms.

In all respects except one, words of this tonal pattern function like those of the /M.M/ tone pattern. Utterance-medially, the floating H has no effect on either the TBU of the noun in question or the TBU of the following word. In (148)b, for example, the verb /sē/ does not show any evidence of association to this floating H. In general, lexical floating Hs do not become associated to TBUs in Saxwe.

The only environment in which this tone pattern is realized differently from the /M.M/ pattern is IP-finally. The floating H of the /M.M ^{H}/ tone pattern prevents the right $L_{\%}$ IP boundary tone from associating to the final TBU of a noun with this pattern. Because there is no association of the $L_{\%}$ boundary tone, there are none of the utterance-final falling pitches that are seen in (146). We can see this in (148)d /$^{M-}$ é kpɔ̃́ ōsī ^{H}/ 'he saw his wife' which has as its surface realization [é kpɔ̃́ ósí]. Note that H is spread in this utterance just as it is in (146)d /$^{M-}$ é kpɔ̃́ ōxɛ̄/ 'he saw a bird', which is realized as [é kpɔ̃́ óxɛ̂]. The difference is that while there is a final falling pitch in [é kpɔ̃́ óxɛ̂], there is no falling pitch in [é kpɔ̃́ ósí].

Essentially, the floating H of this tone pattern is a mechanism for helping to explain why the right edge $L_{\%}$ IP boundary does not associate to an utterance that ends in a noun of the /M.M ^{H}/ tone pattern. The hypothesis that there is a floating H at the end of these nouns is also supported by dialectical comparison; some of the words that have this tone pattern in Saxwe have a surface rising tone in Ewe. One can compare [āmāá] 'greens' in Ewe to non-falling [āmã̄°] 'greens/leaf' in Saxwe, and [àkpāá] 'fish' in Ewe to [ākpā°] 'species of fish' in Saxwe (Stahlke, 1971).

However, there is a problem that is created by the existence of this floating H. Unlike the floating H that is created through Contour simplification, this particular floating H has no other effects on surface realizations of utterances besides the prevention of $L_{\%}$ association. For example, in section 3.6.4, I describe the fact that the floating H obtained as a result of Contour simplification has the effect of blocking Tonal spread. This is not the case for the floating H of the /M.M ^{H}/ tone pattern.

(149) Additional tonal frames for /M.M ^{H}/ noun tone pattern

a.	/$^{M-}$ é kpɔ̃́ ōnɔ̃̄ ^{H} lē blɛ́/	[é kpɔ̃́ ónɔ́ lé ↓blɛ́]	He saw his mother there. sxw-L0008-other clauses-un.wav
b.	/$^{M-}$ é ɦwlɛ̃̀ ōnɔ̃̄ ^{H} lē blɛ́/	[é ɦwlɛ̃̀ ònɔ̃̀ lè blɛ́]	He saved his mother there. sxw-L0009-other clauses-un.wav

The question then is how to account for the difference between the role of this H and that of the H created through Contour simplification in the phonological component. The following is the list of general derivational operations established thus far and listed in order of application.

(150) $L_{\%}$ association
Contour simplification
Partial L spread
Tonal spread

One way to account for the difference between these two floating tones is to posit a rule of Nominal floating H deletion which is ordered just prior to Contour simplification.

(151) Nominal floating H deletion

H → Ø

It is important that the only floating Hs being deleted should be those that are lexically associated with monomorphemic nouns because there are grammatical floating Hs that must remain present throughout the derivation (section 5.4). It is also important that only floating Hs be deleted, because there are lexical floating Ms that need to remain present throughout the derivation in order to trigger non-automatic downstep (section 3.7.4).

The rule of Nominal floating H deletion enables us to differentiate between (a) the floating H of the /M.M ^{H}/ noun tone pattern which does not have continued relevance to the phonology and the phonetic implementation after the point in the derivation where $L_{\%}$ association occurs, and (b) the floating H that is created during Contour simplification which does have continued relevance to the phonology and the phonetic implementation after the point in the derivation where $L_{\%}$ association occurs.

The following then is the derivation of (149)a /$^{M-}$ é kpɔ̃́ ōnɔ̃̄ ^{H} lē blɛ́/.[53]

(152)

	e	kpɔ̃	onɔ̃		le	blɛ	
	|	|	/|		|	|	Underlying forms $L_{\%}$ association (NA)
M-	H	H	M	H	M	H	

	e	kpɔ̃	onɔ̃	le	blɛ	
	|	|	/|	|	|	Nominal floating H deletion Contour simplification (NA) Partial L spread (NA)
M-	H	H	M	M	H	

	e	kpɔ̃	onɔ̃	le	blɛ	
	|	|			|	Tonal spread
M-	H	H	M		H	

---

[53] The $^{M-}$ notation on the pronoun is the left floating M tone on nouns that do not have one of the initial vowels /a/, /ɛ/, or /o/. This is described in section 4.3.

The floating M between Hs triggers non-automatic downstep during the phonetic implementation and the utterance is realized as [é kpɔ̃́ ónɔ̃́ lé $^{\downarrow}$blɛ́].

3.7.4 The /M.H ^{M}/ noun tone pattern

The final tonal pattern from the non-depressor subset, /M.H ^{M}/, is seen in only two words in a noun database of 295, and is therefore a negligible part of the data. These two words, [ōklâ] 'soul' and [ōklô] 'day', are similar at the segmental level.[54] Bole-Richard (1983, 113-114) suggests that words like these may have resulted from the deletion of a vowel, which helps explain the presence of consonant clusters in these words. While they could probably be labeled as residue, the tonal behavior of these words is not hard to explain.

(153) Tonal frames for /M.H ^{M}/ noun tone pattern

a.	/ōklá ^{M} sɔ̃́/	[ōklá $^{\downarrow}$sɔ̃́]	The soul left.	sxw-L0131-clause frames-un.wav
b.	/ōklá ^{M} sē/	[ōklá sê]	The soul heard.	sxw-L0128-clause frames-un.wav
c.	/ōklá ^{M} gbɔ̃̀/	[ōklá gbɔ̃̀]	The soul returned.	sxw-L0129-clause frames-un.wav
d.	/ $^{M-}$ é kpɔ̃́ ōklá ^{M}/	[é kpɔ̃́ ó$^{\downarrow}$klâ]	He saw the soul.	sxw-L0249-clause frames-un.wav
e.	/ $^{M-}$ ō xɔ̄ ōklá ^{M}/	[ō xɔ̄ ōklâ]	You bought a soul.	sxw-L0250-clause frames-un.wav
f.	/$^{M-}$ é ɦwlɛ̃̀ ōklá ^{M}/	[é ɦwlɛ̃̀ òklâ]	He saved a soul.	sxw-L0010-other clauses-un.wav

Utterance-medially, the floating M at the end of this /M.H ^{M}/ tone pattern triggers non-automatic downstep when the word is followed by a H TBU. This non-automatic downstep occurs in (153)a [ōklá $^{\downarrow}$sɔ̃́], represented below.

(154)
```
okla   sɔ̃
|  |    |
M H (M) H
```

Because the rule of L$_{\%}$ association is sensitive to floating tones, nouns of the /M.H ^{M}/ tone pattern are associated to the L$_{\%}$ IP boundary when they appear utterance-finally, as illustrated below. This is why we see the final falling pitches in (153)d, e, and f. The isolation form of the word is shown below.

[54] While the speakers I consulted for this study do not include it among words that have this tonal pattern, I have heard [āklô] 'boat, canoe' pronounced with this tonal pattern as well.

(155)

okla

M H M L%

In (153)b /ōklá ^{M} sē/ 'the soul heard', we see that the floating M of the /M.H ^{M}/ tone pattern does not block the spread of H tone any more than a surface M would. Below is a derivation of this utterance.

(156)

okla se M H M M	Underlying forms
okla se M H M M L%	L% association Nominal floating H deletion (NA) Contour simplification (NA) Partial L spread (NA)
okla se M H M L%	Tonal spread

This utterance is realized as [ōklá sê]. I assume that the multiple floating Ms merge in accordance with the OCP as they do elsewhere when H or L spreads across multiple M TBUs.

This concludes the discussion of tone patterns seen on monomorphemic nouns of the non-depressor subset. In summary, we can say that these tone patterns are all made up of some combination of H and M. This is not true of the remaining four tone patterns—those found primarily on nouns that contain depressors. I turn now to this subset of tone patterns.

3.7.5 The /M.LH/ noun tone pattern

In these next sections I address tone patterns that are lexically assigned to nouns that have depressor consonants as well as to a handful of nouns with onsets of all other types within the category of non-depressors (sonorants, voiceless obstruents, [b], [m], [ɖ], and [n]). These tone patterns are summarized below.

(157) Tone patterns found on nouns with depressors as well as other nouns

/M.LH/	[ōgbɔ̀^{R}]	goat	16%
	[ōlĩ̀^{R}]	hoe	
/M.L/	[ōdã̀]	snake	22%
	[ōmɔ̃̀]	machine	
/M.L ^{H}/	[ōɦwè°]	fish	4%
	[ōtà°]	head	
/L.H/	[òdʒǔ]	rain	4%
	[òbǒ]	disabled person	

Looking at the tonal patterns in (157), we see that the first three patterns all have in common the fact that L is the first (and sometimes only) tone lexically associated to the second TBU in a position immediately following the consonant—a consonant which is, in most cases, a voiced obstruent. This observation is reminiscent of what was observed for verbs in section 3.6.5 and is addressed again in section 3.9 in the discussion of the historical development of these tone patterns.

Note also that there is one tone pattern among these four which has a L initial vowel rather than a M initial vowel. This is discussed in section 3.7.8, as well as in section 3.9 which addresses the historical development of tone patterns.

I turn now to a description of each of these four tone patterns. The first, /M.LH/, has an underlying /LH/ contour, just as with the /LH/ verbs described in section 3.6.4. The following are examples of tonal frames that include the nouns /ōvǔ/ 'dog' and /ōɦɔ̃́/ 'hawk', both of which have the /M.LH/ tone pattern.

(158) Tonal frames for /M.LH/ noun tone pattern

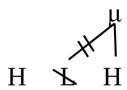
a.	/ōvũ̌/	[ōvũ̀^{R}]	dog	sxw-L0064-VCV nouns-dog-un
b.	/ōvũ̌ sɔ̃́/	[ōvũ̀ sɔ̃́]	A dog left.	sxw-L0065-clause frames-un.wav
c.	/ōvũ̌ lē/	[ōvũ̀ lẽ̀][55]	A dog is present.	sxw-L0061-clause frames-un.wav
d.	/ōvũ̌ gbɔ̃̀/	[ōvũ̀ gbɔ̃̀]	A dog returned.	sxw-L0063-clause frames-un.wav
e.	/$^{M-}$ é kpɔ̃́ ōvũ̌/	[é kpɔ̃́ óvũ̀^{R}]	He saw a dog.	sxw-L0225-clause frames-un.wav
f.	/$^{M-}$ ō xɔ̄ ōvũ̌/	[ō xɔ̄ ōvũ̀^{R}]	You bought a dog.	sxw-L0226-clause frames-un.wav
g.	/ōɲĩ̄ ɦwlɛ̃̀ ōɦɔ̃̌/	[ōɲĩ̄ ɦwlɛ̃̀ òɦɔ̃̀^{R}]	A cow saved a hawk.	sxw-L0447-clause

[55] This falling M is difficult to distinguish from a falling L in this particular context where it follows a L. Nevertheless, there is a slight instrumental difference.

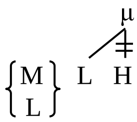
				frames-un.wav
h.	/ōvṽ̌ lē blɛ́/	[ōvũ̀ lē blɛ́]	A dog is there.	sxw-L0247-register tests-un.wav
i.	/ōvũ̌ nɔ̃̄ gbɔ̃̀/	[ōvũ̀ nɔ̃̄ gbɔ̃̀]	A dog (HAB) returns.	sxw-L0017-register tests-un.wav

To facilitate the understanding of these tonal frames, I repeat from section 3.6.4 the rules of Contour simplification, divided into two parts—A and B. Essentially, these rules reflect the fact that in Saxwe, it is generally preferred that underlying LH contours not be realized as surface contours (although there are some exceptions to this which are discussed later in this chapter). The following are the rules of Contour simplification.

(159) Contour simplification A:



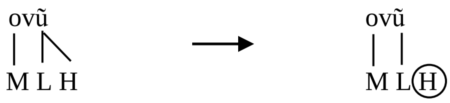
(160) Contour simplification B:



The rule of Contour simplification A states that in the environment of a preceding H, an underlying LH contour is simplified by deleting the L. The rule of Contour simplification B states that in the environment of a preceding non-H (a M or L), an underlying LH contour is simplified by delinking the H (thereby creating a floating H).

Having reviewed the rules of Contour simplification, we can proceed with a detailed look at the utterances in (158). In all of (158)a-i, the noun that has the underlying LH contour also has an underlying M initial vowel at the beginning of the word. Because of the presence of the M initial vowel, the rule of Contour simplification B is applied and the underlying LH contour is simplified by delinking the H. This creates a floating H.

(161)



underlying surface

Just as with the L–floating H sequence that is the result when /LH/ verbs undergo Contour simplification, the L–floating H sequence on nouns is responsible for several observations at the level of the phonetic implementation. All floating Hs have an effect on surface forms utterance-finally because of their role in preventing the right edge $L_{\%}$ boundary tone from associating to the final TBU of the utterance. Beyond merely having a pitch that doesn't fall or downglide utterance-finally, the surface realization of the underlying /M.LH/ pattern has a slight upglide on the L (represented by the superscript [^{R}]). This is demonstrated in sections 7.5.3 and 7.5.4.

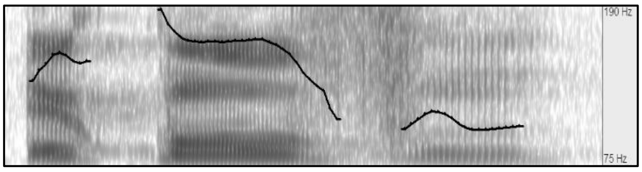
When a word with the /M.LH/ appears at the end of an utterance composed of multiple words, this upglide may or may no longer be as clearly discernible, but the noun always ends with a non-falling L. This is seen in [é kpɔ̃́ óvǜ^{R}] 'he saw a dog', derived from /$^{M-}$ é kpɔ̃́ ōvǔ̌/.[56]

(162)

e kpɔ̃ ovũ	Underlying forms
| | | \\	$L_{\%}$ association (NA)
M- H H M L H	Nominal floating H deletion (NA)
e kpɔ̃ ovũ	Contour simplification
| | | |	Partial L spread (NA)
M- H H M L H	
e kpɔ̃ ovũ	Tonal spread
| |/ |	
M- H H M L H	

The surface realization of this utterance is [é kpɔ̃́ óvǜ^{R}]. We see the pitch trace of this utterance in (163) below.

(163) /$^{M-}$ é kpɔ̃́ ōvǔ̌/ 'he saw a dog' → [é kpɔ̃́ óvǜ^{R}]



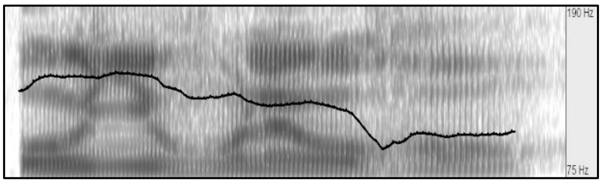
é kpɔ̃́ ó- **vǜ^{R}**

Besides triggering utterance-final upglide, the L–floating H sequence that is obtained through Contour simplification triggers other effects on surface realization. In some cases, there appears to be a lowering of the L of a L–floating H sequence in

[56] The $^{M-}$ notation on the pronoun is the left floating M tone on nouns that do not have one of the initial vowels /a/, /ɛ/, or /o/. This is described in section 4.3.

anticipation of the following H, even though this H may be a floating tone. This is reminiscent of the anticipatory lowering of L immediately preceding an IP-final H discussed in section 7.4. One may also observe a combination of a raising of pitch of the TBUs that surround this L (especially a following H) as well as a lowering of the L itself—thus a widening of the range of F_0 between the TBU associated to the L of the the L–floating H sequence and the surrounding TBUs. This raising of F_0 is discussed in section 7.5.4. In (164) below, we see the IP-final lowering of L in the environment of a floating H.

(164) /ōɲī̄ ɦwlɛ̏ ōɦɔ̌/ 'a cow saved a hawk' → [ōɲī̄ ɦwlɛ̏ òɦɔ̏^{R}]



ō- ɲī̄ ɦwlɛ̏ ò- **ɦɔ̏^{R}**

Another important role filled by the floating H obtained through simplification of the /M.LH/ tone pattern is that it blocks the spread of L to a following M TBU, just as a surface H blocks the spread of L (section 3.2). This can be seen in (158)h [ōvȕ lē blɛ́] 'a dog is there', derived from /ōvǔ lē blɛ́/. The derivation is shown below.

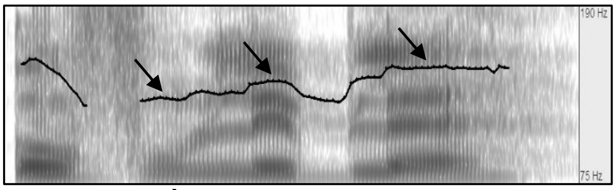
(165)

```
ovũ    le   blɛ          ovũ    le   blɛ
| |\   |    |     ──→    | |    |    |
M L H  M    H            M L(H) M    H

underlying               surface
```

When L spread is blocked by this underlying or floating H, we obtain the relatively rare situation of having a surface M appear in an utterance in a position where there has been a preceeding surface L. Normally, the rule of Tonal spread would cause any underlying M that follows a preceeding surface L to be realized L. However, because this floating H blocks the spread of L, underlying M is realized as surface M in this particular context. This is seen in the upward stair-stepping of the L–M–H sequence of TBUs in (166).

(166) /ōvũ̌ lē blɛ́/ 'a dog is there' → [ōvũ̀ lē blɛ́]



ō- **vũ̀** **lē** **blɛ́**

Before finishing the discussion of the /M.LH/ tone pattern, I touch on noun-noun compounds that contain this tone pattern. Polymorphemic forms are discussed in detail in section 4.4. Here, however, I give a few of these forms because they represent the only context in which the /LH/ TBU of a /M.LH/ noun can be immediately preceded by a H tone. Thus is gives us the chance to see what occurs in this environment.

In compounding, the initial vowel of a non-initial noun along with its tone is deleted. In addition, compounds are followed by a right edge H_ω boundary tone (like a floating H, but generated as a result of prosody rather than assigned lexically), discussed in section 4.1.

(167) Tonal frames for /M.LH/ noun tone pattern – noun-noun compounds

a.	/ōkɔ́-dã̌ $^{H\omega}$/	[ōkɔ́-dã́]	sand work	sxw-L0280-polymorphemic nouns-un.wav
b.	/ōtɔ̄-dã̌ $^{H\omega}$/	[ōtɔ̄-dã̌]	river work	sxw-L0281-polymorphemic nouns-un.wav
c.	/ōglè-dã̌ $^{H\omega}$/	[ōglè-dã̌]	field work	sxw-L0282-polymorphemic nouns-un.wav

In (167)a, the L of the /LH/ contour is deleted as described in rule A of Contour simplification.

(168)
```
okɔ-  dã                 okɔ-  dã
|  |   /|         ——→    |  |   |
M H   L H  Hω            M H    H  Hω

underlying               surface
```

In (167)b and c, the conditions would be right for the rule B of Contour simplification to be applied except that there is a boundary H_ω already present to the right of the underlying /LH/ contour. Example (167)c is shown below.

(169)
```
ogle-  dã
|  |   |\
M  L   L H  Hω
```

Delinking the H of the underlying /LH/ contour would produce two adjacent unlinked Hs, thereby creating an OCP-related violation. Therefore, no delinking happens and the underlying /LH/ contour from the /M.LH/ tone pattern is, rather exceptionally, realized as a surface [LH] contour. This is discussed further in section 4.4.

3.7.6 The /M.L/ noun tone pattern

Having discussed one of the more complicated noun tone patterns, I move to a simpler tone pattern to explain—the /M.L/ tonal pattern. The words /ōdȁ/ 'snake', /ōɦà/ 'pig', and /āɦɔ̏/ 'brain' are used in the following utterances to illustrate the behavior of this tone pattern in various tonal frames.

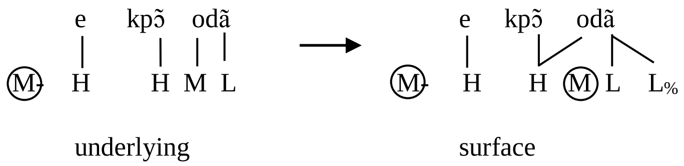
(170) Tonal frames for /M.L/ noun tone pattern

a.	/ōdȁ sɔ̋/	[ōdȁ sɔ̋]	A snake left.	sxw-L0053-clause frames-un.wav
b.	/ōdȁ lē/	[ōdȁ lè]	A snake is present.	sxw-L0049-clause frames-un.wav
c.	/ōdȁ gbɔ̏/	[ōdȁ gbɔ̏]	A snake returned.	sxw-L0051-clause frames-un.wav
d.	/ᴹ⁻ é kpɔ̋ ōdȁ/	[é kpɔ̋ ódȁ]	He saw a snake.	sxw-L0217-clause frames-un.wav
e.	/ᴹ⁻ ō xɔ̄ ōdȁ/	[ō xɔ̄ ōdȁ]	You bought a snake.	sxw-L0218-clause frames-un.wav
f.	/ōɲī̄ ɦwlɛ̏ ōɦà/	[ōɲī̄ ɦwlɛ̏ òɦà]	A cow saved a pig.	sxw-L0448-clause frames-un.wav
g.	/ōdȁ lē blɛ́/	[ōdȁ lè blɛ́]	A snake is there.	sxw-L0248-register tests-un.wav
h.	/ōdȁ nɔ̄ gbɔ̏/	[ōdȁ nɔ̏ gbɔ̏]	A snake (HAB) returns.	sxw-L0017-register tests-un.wav

The underlying L of the /M.L/ tone pattern blocks H spread. This is illustrated in (170)d and below, using as an example the utterance [é kpɔ̋ ódȁ] 'he saw a snake', derived from /ᴹ⁻ é kpɔ̋ ōdȁ/.[57]

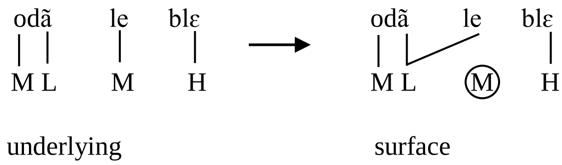
[57] The ᴹ⁻ notation on the pronoun is the left floating M tone on nouns that do not have one of the initial vowels /a/, /ɛ/, or /o/. This is described in section 4.3. It does not affect the surface output here.

(171)



The L of the /M.L/ tone pattern spreads to any M TBU to its right, delinking the M according to the rule of Tonal spread. This is seen in [ōdã̀ lè blɛ́] 'a snake is there', derived from /ōdã̀ lē blɛ́/.

(172)



The floating M has no effect between a L and a H in an utterance such as (172).

3.7.7 The /M.L ^{H}/ noun tone pattern

The next tone pattern to describe has a floating H at the right edge of the noun in its underlying form (similar to the floating H on the /M.M ^{H}/ tonal pattern). Unlike the floating H obtained as a result of Contour simplification operating on the /M.LH/ tone pattern (see section 3.7.5), the only influence this floating H has on the phonology or phonetics is to prevent association of the right $L_{\%}$ boundary. Utterances (either single word or multiple word) that end with a noun of this tone pattern do not have a final downglide on the utterance-final L. In any position other than utterance-final, this tone pattern behaves in the same manner as does the /M.L/ pattern. The following tonal frames contain the noun [ōɦwè°] 'fish', derived from /ōɦwè ^{H}/.

(173) Tonal frames for /M.L ^{H}/ noun tone pattern

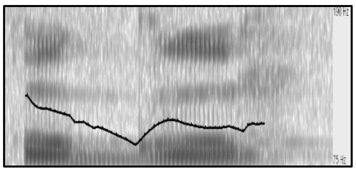
a.	/ōɦwè ^{H} sɔ̃́/	[ōɦwè sɔ̃́]	A fish left.	sxw-L0095-clause frames-un.wav
b.	/ōɦwè ^{H} lē/	[ōɦwè lè]	A fish is present.	sxw-L0091-clause frames-un.wav
c.	/ōɦwè ^{H} gbɔ̃̀/	[ōɦwè gbɔ̃̀]	A fish returned.	sxw-L0093-clause frames-un.wav
d.	/$^{M-}$ é kpɔ́ ōɦwè ^{H}/	[é kpɔ̃́ óɦwè°]	He saw a fish.	sxw-L0229-clause frames-un.wav
e.	/$^{M-}$ ō xɔ̄ ōɦwè ^{H}/	[ō xɔ̄ ōɦwè°]	You bought a fish.	sxw-L0230-clause frames-un.wav

f.	/ōɲĩ̄ ɦwlɛ̀̃ ōɦwè ^{H}/	[ōɲĩ̄ ɦwlɛ̀̃ òɦwè°]	A cow saved a fish.	sxw-L0012-other clauses-un.wav
g.	/ōɦwè ^{H} lē blɛ́/	[ōɦwè lè blɛ́]	A fish is there.	sxw-L0013-other clauses-un.wav
h.	/ōɦwè ^{H} nɔ̃̄ gbɔ̃̀/	[ōɦwè nɔ̃̀ gbɔ̃̀]	A fish (HAB) returns.	sxw-L0013-other clauses-un.wav

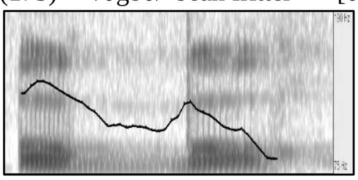
The important questions to answer in examing this tone pattern are: (1) how the /M.L ^{H}/ pattern differs from the /M.L/ pattern, and (2) how the /M.L ^{H}/ pattern differs from the /M.LH/ pattern.

The answer to the first question is that in their isolation forms, the /M.L ^{H}/ and /M.L/ patterns sound and look very distinct. The two patterns are demonstrated for four Saxwe speakers in sections 7.5.1 and 7.5.2. Here, I show one example of each pattern.

(174) /ōgò ^{H}/ 'bottle, container' → [ōgò°]



(175) /ōgbò/ 'bean fritter' → [ōgbò]



In comparing (174) and (175), we see clearly the downglide of F_0 on /ōgbò/, compared to the lack of downglide on /ōgò ^{H}/. Also, the initial M of /ōgbò/ is realized at a higher F_0 than the initial M of /ōgò ^{H}/.

The next question is how the /M.L ^{H}/ pattern differs from the /M.LH/ pattern. In their surface isolation forms, the /M.L ^{H}/ tone pattern differs in rather subtle ways from the surface realization of the /M.LH/ tone pattern. Both are realized with a final non-falling L. The differences have to do with how much of an upglide is realized and the degree of pitch F_0 difference between the initial M and the following L. These differences are explored for four Saxwe speakers in section 7.5.3.

We must turn to their realizations in noun-noun compounds in order to see more clearly how the /M.L ^{H}/ pattern differs from the /M.LH/ pattern. When a noun of the /M.L ^{H}/ pattern comes second in a noun-noun compound, the result is always a final non-falling surface L. This is seen in (176).

(176) Noun-noun compounds containing a noun of the /M.L ^{H}/ pattern

a.	/ōtɔ́-gò $^{H\ H\omega}$/	[ōtɔ́-gò°]	father's bottle	sxw-L0292-polymorphemic nouns-un.wav
b.	/ɛ̄sī̄-gò $^{H\ H\omega}$/	[ɛ̄sī̄-gò°]	water bottle	sxw-L0293-polymorphemic nouns-un.wav
c.	/āɦà̀-gò $^{H\ H\omega}$/	[āɦà̀-gò°]	beverage bottle	sxw-L0294-polymorphemic nouns-un.wav

This can be compared to cases where a noun of the /M.LH/ pattern comes second in a noun-noun compound. Here, the surface result is either a LH rising pitch or simply a final H.

(177) Noun-noun compounds containing a noun of the /M.LH/ pattern

a.	/ōkɔ́-dǎ̌ $^{H\omega}$/	[ōkɔ́-dá̌]	sand work	sxw-L0280-polymorphemic nouns-un.wav
b.	/ōtɔ̄-dǎ̌ $^{H\omega}$/	[ōtɔ̄-dǎ̌]	river work	sxw-L0281-polymorphemic nouns-un.wav
c.	/ōglè-dǎ̌ $^{H\omega}$/	[ōglè-dǎ̌]	field work	sxw-L0282-polymorphemic nouns-un.wav

Moreover, when these two underlying tonal patterns are followed by the definite marker [lá], the surface realizations are different.[58]

(178) Nouns of the /M.L ^{H}/ and /M.LH/ patterns followed by [lá]

a.	/ōɦwè ^{H}/	[ōɦwè là°]	the fish	sxw-L0077-noun phrases-un.wav
b.	/ōvǔ̌/	[ōvȕ lǎ]	the dog	sxw-L0021-noun phrases-un.wav

Another difference between the /M.LH/ pattern and the /M.L ^{H}/ pattern is that the floating H of the /M.L ^{H}/ tone pattern does not block L spread. To illustrate this, I derive here in (179) the utterances [ōɦwè lè blɛ́] 'a fish is there' (underlying /ōɦwè ^{H} lē blɛ́/), and [ōvȕ lē blɛ́] 'a dog is here' (underlying /ōvǔ̌ lē blɛ́/).

[58] The tonal behavior of the determiner [lá] is unusual and is discussed in greater detail in section 4.8.

(179) Derivations of /ōvǔ̏ lē blɛ́/ and /ōɦwè ^{H} lē blɛ́/

/ōvǔ̏ lē blɛ́/	/ōɦwè ^{H} lē blɛ́/	Underlying forms
--	--	$L_{\%}$ association
--	ōɦwè lē blɛ́	Nominal floating H deletion
ōvȕ ^{H} lē blɛ́	--	Contour simplification
--	--	Partial L spread
--	ōɦwè lè blɛ́	Tonal spread
[ōvȕ lē blɛ́]	[ōɦwè lè blɛ́]	Surface

To summarize, we see that the floating H of the /M.L ^{H}/ pattern only serves to prevent $L_{\%}$ association utterance-finally. Utterance-medially, the /M.L ^{H}/ pattern behaves exactly as does the /M.L/ pattern. Moreover, it is important in the output to the phonetic implementation that the floating H of the /M.L ^{H}/ pattern no longer be present, or be present in a different way than the floating H of the /M.LH/ pattern which has undergone Contour simplification. Given the derivational approach used in this study, one way to account for the subtle differences in surface realization of the isolation forms of the /M.L ^{H}/ and /M.LH/ patterns is to have a rule that erases the floating H of the /M.L ^{H}/ pattern at the necessary point in the derivation. This rule, the rule of Nominal floating H deletion, is given in (151). This rule, along with the rules of $L_{\%}$ association and Contour simplification, are the mechanisms that explain the different surface forms generated from the underlying three-way contrast between the patterns /ōvǔ̏/ 'dog', /ōɦwè ^{H}/ 'fish', and /ōdȁ̀/ 'snake'.

(180) Derivations of /ōvǔ̏/, /ōɦwè ^{H}/, and /ōdȁ̀/

/ōvǔ̏/	/ōɦwè ^{H}/	/ōdȁ̀/	Underlying form
--	--	ōdȁ̀ $^{L\%}$	$L_{\%}$ association
--	ōɦwè	--	Nominal floating H deletion
ōvȕ ^{H}	--	--	Contour simplification
--	--	--	Partial L spread
--	--	--	Tonal spread
[ōvȕ^{R}]	[ōɦwè°]	[ōdȁ̀]	Surface

One final note to make about the /M.L ^{H}/ pattern is that there is interspeaker variation regarding which lexical items are assigned this pattern. The analysis here is largely based on the data given by André Taïve, or speaker AT. In the instrumental studies carried out and summarized in section 7.5, we see that of the four speakers recorded, speakers BL, KS, and NG each assigned to two (out of ten) of speaker AT's /M.L ^{H}/ nouns a different tone pattern. Speaker BL did not include among words of the /M.L ^{H}/ pattern: [oɦjã] 'corn weevil' and [omlɛ̃] 'fishhook'. Speaker KS did not include among words of the /M.L ^{H}/ pattern: [omlɛ̃] 'fishhook' and [aɦa] 'side'. Speaker NG did not include among words of the /M.L ^{H}/ pattern: [oɦjã] 'corn weevil' and [aɦa] 'side'. This may indicate that this tone pattern is dying out.

3.7.8 The /L.H/ noun tone pattern

I finish the analysis of noun tone patterns with what is perhaps the most interesting noun tone pattern—that which is realized [L.LH] in isolation and which is underlyingly /L.H/. In (181), I repeat the overview of tone patterns that are seen in nouns of the depressor subset. The /L.H/ tone pattern accounts for 4% of the nouns in my data set.

(181) Tone patterns found on nouns with depressors as well as other nouns

/M.LH/	[ōgbɔ̀^{R}]	goat	16%
	[ōlĩ̀^{R}]	hoe	
/M.L/	[ōdã̀]	snake	22%
	[ōmɔ̃̀]	machine	
/M.L ^{H}/	[ōɦwè°]	fish	4%
	[ōtà°]	head	
/L.H/	[òdʒǔ]	rain	4%
	[òbǒ]	disabled person	

The unusual aspects of this [L.LH] noun tone pattern are two-fold. First, this tone pattern has an initial vowel that is not M, but instead L. Not only is this initial vowel realized at a lower pitch than that of the other initial vowels, but also its TBU blocks H spread. This is a situation unknown for any other noun tone pattern in Saxwe. Moreover, analyses of other Gbe languages usually claim to have only one underlying tone for the initial vowel of nouns. In Ewe, there are two surface tones seen on initial vowels of nouns. However, most analyses of Ewe (Ansre, 1961; N. Smith, 1968; Stahlke, 1971) interpret these as allotonic variations of a single underlying toneme.

The second observation is that this tone pattern, unlike the others which are typically found in words that have depressor consonants, does not have L as the first underlying tonal element following the consonant onset of the second syllable.

In the following table, I give examples of the tonal behavior of nouns that have the pattern in question. These examples include the /L.H/ nouns [òdʒǔ] 'rain' and [àgbã̌] 'dish'.

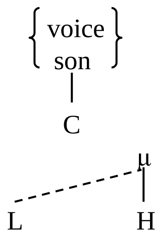
(182) Tonal frames for /L.H/ noun tone pattern

a.	/òdʒú sɔ̃́/	[òdʒǔ sɔ̃́]	The rain left.	sxw-L0113-clause frames-un.wav
b.	/òdʒú lē/	[òdʒǔ lê]	The rain is present.	sxw-L0109-clause frames-un.wav
c.	/òdʒú gbɔ̃̀/	[òdʒǔ gbɔ̃̀]	The rain returned.	sxw-L0111-clause frames-un.wav
d.	/$^{\text{M-}}$ é kpɔ̃́ òdʒú/	[é kpɔ̃́ òdʒǔ]	He saw the rain.	sxw-L0241-clause frames-un.wav
e.	/ $^{\text{M-}}$ ō xɔ̄ òdʒú/	[ō xɔ̄ òdʒǔ]	You bought the rain.	sxw-L0242-clause frames-un.wav
f.	/ $^{\text{M-}}$ é zũ̀ òdʒú/	[é zũ̀ òdʒǔ]	He insulted the rain.	sxw-L0015-other clauses-un.wav
g.	/òdʒú lē blɛ́/	[òdʒǔ lé ꜜblɛ́]	The rain is there.	sxw-L0016-other clauses-un.wav
h.	/òdʒú nɔ̃̄ dʒà/	[òdʒǔ nɔ̃́ dʒà]	The rain (HAB) falls.	sxw-L0017-other clauses-un.wav
i.	/āɖí-gbã́/	[āɖí-gbã́]	soap dish	sxw-L0295-polymorphemic nouns-un.wav
j.	/ɛ̄sĩ̄-gbã́/	[ɛ̄sĩ̄-gbã́]	water dish	sxw-L0296-polymorphemic nouns-un.wav
k.	/āɦã̀-gbã́/	[āɦã̀-gbã̌]	drink dish	sxw-L0297-polymorphemic nouns-un.wav

Looking at all of the tonal forms in (182), we see that the initial vowel is realized L in every environment and is not susceptible to becoming H through Tonal spread. We also see that [òdʒǔ] and [ògbǎ] are realized with a surface [LH] rise in all tonal environments where the initial vowel is present—a situation which is very different from that of the /M.LH/ pattern of nouns described in section 3.7.5. Moreover, in (182)b, g and h, we see that H is the tone that spreads from a noun of the /L.H/ pattern onto a following M TBU.

Given that this tone pattern is underlyingly /L.H/, it is the rule of Partial L spread which is responsible for the surface [L.LH] realization. That rule is repeated here for ease of reference.

(183) Partial L spread



All of the words with the surface [L.LH] pattern have either a sonorant or a voiced obstruent as the onset of the second syllable of the V.C(C)V noun. In addition, all of these words have a L as the initial vowel. Therefore the environment is right for the underlying /L.H/ pattern to be realized as [L.LH]. An example is given below from (182)d, /$^{M-}$ é kpɔ̃́ òdʒú/ 'he saw rain'.[59]

(184)

	e	kpɔ̃	odʒu	Underlying forms L% association (NA) Nominal floating H deletion (NA) Contour simplification (NA)
M-	H	H	L H	

	e	kpɔ̃	odʒu	Partial L spread Tonal spread (NA)
M-	H	H	L H	

The surface realization of this utterance is [é kpɔ̃́ òdʒǔ].

In addition, we can see the spread of H from a noun of the /L.H/ pattern below in the utterance (182)g /òdʒú lē blɛ́/ 'the rain is there'.

(185)

odʒu	le	blɛ	Underlying forms L% association (NA) Nominal floating H deletion (NA) Contour simplification (NA)
L H	M	H	

odʒu	le	blɛ	Partial L spread
L H	M	H	

odʒu	le	blɛ	Tonal spread
L H	M	H	

The surface realization of this utterance is [òdʒǔ lé ꜜblɛ́].

Research into this group of words shows that at least some of the words may be borrowings from neighboring Yoruboid languages. Section 1.1 describes the historical relationship Saxwe is hypothesized to have with the Yoruboid languages. In addition to this historical relationship, there is ongoing interaction between the Saxwe people and their neighbors to the east, many of whom speak Yoruba or

[59] The floating M- tone to the left of the pronoun [é] is present on nouns that do not have an initial vowel which is /a/, /ɛ/, or /o/. It is discussed in section 4.3 and does not affect the surface output of the pronoun in this derivation.

Yoruboid languages. In Yoruba, the initial vowel of nouns is either M or L, so if some of these words are borrowed from Yoruba, this would help to explain the anomalous appearance of L as the initial vowel in these nouns. The fact that this L initial vowel was not raised to adapt to Saxwe phonology suggests that the borrowing may have occurred among a population of Saxwe speakers that had a relatively high level of bilingualism.

Others of these words seem to have been derived from verbs. The verbs in question are mentioned in (186) below.

The following is a complete list of the words from my data set bearing this tone pattern and possible sources for some of these nouns. The proposed relationship is more straightforward for some nouns than for others.

Note that two of these words were initially produced by my primary consultant (speaker AT) with a /L.H/ tone pattern and then later this pronunciation was abandoned in favor of the pronunciation associated with a /M.LH/ tone pattern.

(186) Words with the /L.H/ tone pattern

/L.H/ pattern confirmed by speaker AT

/àdó/	dirt wall	Yoruba: [ādódó] 'conical house' (Fakinlede, 2003)
/àgbã́/	dish	Yoruba: [àgbá] 'cylindrical container' (Fakinlede, 2003)
/òdʒú/	rain	Yoruba: [òdʒò] 'rain' (Akinlabi, p.c.)
/àmɔ̃́/	tofu	Idaasha: [àmɔ̃̌] 'locally produced cheese'
/àdɔ́/	nest	
/òbó/	disabled person	
/òdṹ/	trash	
/òvwɛ̃́/	evil	in Saxwe /vɔ̌/ v. means 'to fear'
/òdʒló/	desire	in Saxwe /dʒlǒ/ v. means 'to desire'
/ògbá/	hat	in Saxwe /gbǎ/ v. means 'to roof'
/òɦjã́/	need	in Saxwe /ɦjã̌/ v. means 'to be in need of'

/L.H/ pattern used and then abandoned by speaker AT

/àgbó/	ram	Yoruba: [àgbò] 'ram' (Akinlabi, p.c.)
/àdá/	penis	Yoruba: [àdã́mɔ̃́] 'hereditary trait' (Abraham 1962)

/L.H/ pattern used by other speakers

/òɦɔ̃́/	hawk

One final observation is that this surface [L.LH] realization is the surface realization in Ewe and Gen for the primary non-high tone pattern for nouns of the depressor subset. That is to say that in those languages, the cognate of the Saxwe /M.LH/ tone pattern (analyzed as /M.H/ in Ewe, /L.H/ in Gen, and /L.H/ in Fon) is realized [L.LH]. For example, [ōvũ̀^{R}] 'dog' in Saxwe is [àvùú] in Ewe and [àvǔ̃] in Fon and Gen (Bole-Richard, 1983; Brousseau, 1993; Stahlke, 1971).

In addition, /L.H/ is a pattern that exists in Yoruba—a language in which initial vowels of nouns can be either L or M—and this pattern is realized the same way in Saxwe ([L.LH]) as it would be in Yoruba. Yoruba has a rule which spreads L to a following H without delinking the H (Pulleyblank, 1986, p. 112), reminiscent of the rule of Partial L spread in Saxwe (183).[60]

What this means is that the /L.H/ pattern in Saxwe, although it is a minor tone pattern in Saxwe, is realized with a surface realization that is a frequently-heard surface realization in surrounding Gbe and Yoruboid languages. It is perhaps for this reason that words are being incorporated into the Saxwe lexicon with this surface realization despite its oddities with respect to the general Saxwe tone system.[61]

This concludes the overview of the eight observed underlying tone patterns of nouns. It does not conclude, however, the entire discussion of these tone patterns. In section 3.8, I look at the nouns that do not have depressor consonants but that display the same tone patterns as nouns of the depressor subset. In section 3.9, I explore some ideas as to how the noun tone patterns developed.

3.8 Inconsistencies in the distribution of noun tone patterns

In the study of verbs, we see evidence that depressors in Saxwe are voiced obstruents excluding /b/ and /ɖ/, while non-depressors are voiceless obstruents, sonorants, /ɖ/ and /b/. This division is clearly established for verbs, but for nouns, the clear distinction begins to crumble. Assuming this definition of depressors, we see in the summary of tone patterns given in this chapter that there are four tone patterns that only nouns with non-depressor onsets will be assigned. On the other hand, there are four other tone patterns—those that involve L—that are usually assigned to nouns with depressor onsets, but can also be assigned to nouns with non-depressor onsets.

The following are the words in my data set which are exceptional in the sense that they have a tone pattern usually assigned to words that have a depressor consonant. These nouns, however, do not include a depressor consonant.

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[60] The L spread rule in Yoruba applies in all contexts, whereas the rule of Partial L spread in Saxwe applies only when the consonant preceding the H is underlyingly voiced or is a sonorant.

[61] My prediction would be that the lexical assignment of words to this /L.H/ tone pattern will increase gradually at the expense of the /M.LH/ pattern—reflecting an increasing departure from the landscape painted by the old system in which L tone was generated in the presence of a depressor through a phonological operation. I believe the intraspeaker and interspeaker variation seen in section 7.5 is part of this tendency.

(187) Exceptional words with tone patterns usually connected with depressors

/M.LH/	[ōmì̀R]	excrement
	[ānɔ̀R]	breast
	[ɛ̄nɛ̀R]	palm kernel
	[ōlìR]	hoe
/M.L/	[ābɔ̀]	cooked beans
	[ōbà]	manioc dish
	[ōmɔ̀]	machine
	[ōɖɔ̀]	fishing net
/M.L H/	[ōmlɛ̀°]	fishhook
	[ōjɛ̀°]	spider
	[ōtà°]	head
/L.H/	[òbǒ]	disabled person
	[àmɔ̌]	tofu (recent word)

The fact that a noun that doesn't include a depressor consonant can be lexically assigned a tonal pattern like /M.LH/ or /M.L/ is evidence that L in Saxwe cannot be generated solely by an operation that would insert L following an underlyingly voiced consonant. Such a rule may have been part of the diachronic phonology. In the synchronic phonology, however, tone patterns that include contrastive L tone have become lexicalized such that they may now be assigned to words that contain non-depressor consonants. Voicing is no longer a conditioning factor for L.

It is true that in several cases, these exceptional words contain /b/, its allophone [m], /ɖ/, or its allophone [n]. It may be that the ambiguity as to the status of these consonants (see section 1.4.4) contributed to the current inconsistencies. However, there are other consonants to be found among these exceptional words, including sonorants and one consonant that is not even voiced at the surface level, seen in /ōtà H/ 'head'. The L which is a part of the tone pattern assigned to this word cannot be generated by a phonological rule inserting L in the environment of a voiced consonant.

The following are tonal frames that show these exceptional words behaving tonally in the same way as their counterparts with depressor onsets.

(188) Non-depressor consonant with /M.LH/ noun tone pattern

a.	/$^{\text{M-}}$ kō kpɔ̃́ **ōlĩ̌** lē blɛ́/	[kō kpɔ̃́ **ólĩ̀** lē blɛ́] sxw-L0034-Exceptional tone patterns-un.wav	I saw a hoe there.
b.	/$^{\text{M-}}$ jē $^{\text{H}}$ sē **ōlĩ̌**/	[jē sē ōlĩ̀$^{\text{R}}$] sxw-L0004-Exceptional tone patterns-un.wav	They heard a hoe.

(189) Non-depressor with /M.L/ noun tone pattern

a.	/$^{\text{M-}}$ kō kpɔ̃́ ōɖɔ̰̀ lē blɛ́/	[kō kpɔ̃́ óɖɔ̰̀ lè blɛ́] sxw-L0033-Exceptional tone patterns-un.wav	I saw a fishing net there.
b.	/$^{\text{M-}}$ jē $^{\text{H}}$ sē ōɖɔ̰̀/	[jē sē ōɖɔ̰̀] sxw-L0017-Exceptional tone patterns-un.wav	They heard a fishing net.

(190) Non-depressor /M.L $^{\text{H}}$/ noun tone pattern

a.	/$^{\text{M-}}$ kō kpɔ̃́ ōjɛ̀ $^{\text{H}}$ lē blɛ́/	[kō kpɔ̃́ ójɛ̀ lè blɛ́] sxw-L0032-Exceptional tone patterns-un.wav	I saw a spider there.
b.	/$^{\text{M-}}$ jē $^{\text{H}}$ sē ōjè $^{\text{H}}$/	[jē sē ōjɛ̀°] sxw-L0013-Exceptional tone patterns-un.wav	They heard a spider.

In all these examples, there is no presence of a depressor consonant to explain the tonal behavior of the nouns in these utterances—in particular to explain the presence of L tone.

Next to to the inconsistencies in alignment of tone patterns with consonant quality, the presence of the /L.H/ tone pattern is perhaps the next most outstanding example of an inconsistency in the paradigm of noun tone patterns. This is for two reasons. First, the initial vowel for these nouns is L rather than M, as it is for all other noun tone patterns. Second, this tone pattern is of the depressor subset of tone patterns, and yet it does not have a L immediately following the consonant, as do all the other tone patterns in that subset.

3.9 Thoughts on the historical development of noun tone patterns

The tonal landscape of nouns is quite a bit more complex than that of verbs. Not only are there more tonal patterns for nouns than there are for verbs, but also the possible choice of tone patterns is not assigned consistently with regard to consonant quality the way it is with verbs. All of these complexities are consistent with Smith's (2011) observation that nouns often show more phonological contrasts than do words of other grammatical categories.

The reason for this complexity in nouns may have to do with the history of the Saxwe language having developed from the contact of a Yoruboid language with a Gbe language (see section 1.1).

The first three tone patterns in each subset (depressors and non-depressors) are those which clearly have correlates in another Gbe language. These are shown in (191).

(191) Six underlying tone patterns for nouns in Saxwe with surface forms

	Voiceless obstruents, sonorants, some /ɖ/ and some /b/	
/M.H/	[ōsɔ́]	horse
/M.M/	[ōxɛ̄]	bird
/M.M H/	[ōsī°]	female, wife
	Voiced obstruents, but also at least one each of all other types of consonants	
/M.LH/	[ōgbɔ̀R]	goat
/M.L/	[ōdȁ]	snake
/M.L H/	[ōɦwè°]	fish

We can compare these to the tone patterns of nouns in Ewe (Peki dialect). These data in (192) come from Ansre (1961) and are organized in light of Stahlke's (1971) ideas regarding underlying forms. These are discussed in greater detail in section 2.8.1.

(192) Underlying tone patterns for nouns in Ewe

	Voiceless obstruent or sonorant onset			
	CV-shaped noun		VCV-shaped noun	
/(M.)H/	[tú]	gun	[àkpé]	thanks
/(M.)M/	[klò]	knee	[àfì]	mouse
/(M.)MH/	[pɛ̄ɛ́]	chisel	[àkpāá]	fish
	Voiced obstruent onset			
	CV-shaped noun		VCV-shaped noun	
/(M.)H/	[gbɔ̀ɔ́]	goat	[àvùú]	dog
/(M.)M/	[bè]	thatch	[àdzò]	riddle
/(M.)MH/	[gòó]	gourd	[àdèé]	saliva

The relationship between the Saxwe tone patterns and the Ewe tone patterns is fairly easy to describe if one hypothesizes certain historical tone changes. I begin the earlier stage in Gbe tone development with a reconstructed underlying two-way /H, Ø/ tonal contrast. I have reconstructed three possible tone patterns for nouns.

(193) Hypothesized historical progression of Saxwe nouns – early stage

*2-tone system
Ø.H
Ø.Ø
Ø.ØH

To arrive at Stahlke's (1971) underlying structures for Ewe shown in (192), a simple change from toneless TBUs to lexical assignment of M is needed at this stage. For Saxwe, however, the underlying /Ø.ØH/ pattern must be modified such that the H is floating rather than linked to the skeletal structure.

(194) Hypothesized historical progression of Saxwe nouns – first intermediate stage

*2-tone system		*floating tone
Ø.H	→	Ø.H
Ø.Ø	→	Ø.Ø
Ø.ØH	→	Ø.Ø ^{H}

The next tone change follows the phonologization of phonetic effects of consonant interaction. In this tone change, L is lexically inserted in any syllable that has a depressor consonant onset in a position immediately following the onset. This process may have been galvanized by the contact of such a two-tone language with a three-tone Yoruboid language that already had L in its inventory of underlying contrasts. The relevant tone change is shown in (195).

(195) *L insertion

C μ
[voice] L

This would have yielded the following progression.

(196) Hypothesized historical progression of Saxwe nouns – 2nd intermediate stage

	*2-tone system		*floating tone		*L insertion
Non-depressors	Ø.H	→	Ø.H	→	Ø.H
	Ø.Ø	→	Ø.Ø	→	Ø.Ø
	Ø.ØH	→	Ø.Ø^{H}	→	Ø.Ø^{H}
Depressors	Ø.H	→	Ø.H	→	Ø.LH
	Ø.Ø	→	Ø.Ø	→	Ø.L
	Ø.ØH	→	Ø.Ø^{H}	→	Ø.L^{H}

Finally, the completion of the process would require M to be lexically assigned rather than simply being the default surface realization of a toneless TBU. This tone change is the same that is needed for reconstructing the Ewe tone patterns of (192) directly from the reconstructed earlier tone patterns of (193). This tone change is shown below.

(197) *M insertion

Ø → M

The entire progression is as follows.

(198) Hypothesized historical progression of Saxwe nouns – final

	*2-tone system		*floating tone		*L insertion		*Ø→M
Non-depressors	Ø.H	→	Ø.H	→	Ø.H	→	M.H
	Ø.Ø	→	Ø.Ø	→	Ø.Ø	→	M.M
	Ø.ØH	→	Ø.Ø^{H}	→	Ø.Ø^{H}	→	M.M^{H}
Depressors	Ø.H	→	Ø.H	→	Ø.LH	→	M.LH
	Ø.Ø	→	Ø.Ø	→	Ø.L	→	M.L
	Ø.ØH	→	Ø.Ø^{H}	→	Ø.L^{H}	→	M.L^{H}

What we arrive at in the final column of (198) is six of the eight current tone patterns that exist for nouns in Saxwe. We also have a good explanation for why, in the majority of cases, tone patterns are distributed according to the type of consonant in the noun.

In section 3.6.5, we see that if we only considered Saxwe verbs, we could imagine that these rules of L insertion and M insertion still have the status of being phonological rules within a synchronic system, and that Saxwe is still a tone system with an underlying two-way contrast. Looking at nouns, however, we can no longer feasibly make this claim. There are (at least) four reasons why this is so. First, the distribution of noun tone patterns is no longer consistent along lines of consonant type; there are a number of nouns that do not include a depressor consonant but that carry a tone pattern that is typically associated with depressors.[62] Second, the fourth tone pattern associated with non-depressors, /M.H ^{M}/, would be /Ø.H ^{Ø}/ if there was a synchronic rule of M insertion—meaning that the pattern would involve a toneless TBU that was floating. This notion of a floating toneless TBU requires several degrees of abstraction that are not necessarily warranted. Third, the fourth tone pattern in the depressor subset is /L.H/. The initial L of this tone pattern cannot be obtained through a rule of L insertion. Lastly, the /L.H/ tone pattern doesn't have a L following the onset, even though in many cases this onset is a depressor consonant.

3.10 Conclusions

This chapter has focused on the analysis of underlying tone patterns of verbs and nouns in Saxwe and the description of the derivational rules needed to explain surface forms. In this conclusion, I briefly summarize these topics and discuss why the Saxwe tone system is of interest within the study of Gbe tone.

The underlying patterns of Saxwe noun and verbs are compared in the table below. In this table, I leave out the /M.H ^{M}/ tone pattern because of its rarity.

(199) Saxwe nouns and verbs – underlying tone patterns summary

Voiceless obstruents, sonorants, /ɖ/ and /b/—non-depressors

Verbs	**Nouns**
/H/	/M.H/
/M/	/M.M/
	/M.M ^{H}/

Typically voiced obstruents—depressors

Verbs	**Nouns**
/LH/	/M.LH/
/L/	/M.L/
	/M.L ^{H}/
	/L.H/

[62] There is also the number 'six' /ɛ̄dɛ̌́/ which includes a depressor consonant but carries a tone pattern (/M.H/) typically associated with non-depressors.

When we compare the underlying patterns for nouns and verbs and disregard the initial vowel, we see that the four tone patterns of verbs are identical to the four most frequent tone patterns of nouns. Nouns, however, are far more complex than verbs. Not only are there more tone patterns to account for among nouns, but the distribution of tone patterns with relation to consonant quality is not consistent in nouns as it is in verbs. Section 3.8 discusses these questions of distribution and the fact that a tone pattern such as /M.L/ can be lexically assigned to a word that does not include a depressor consonant.

Since it is the /M/ *vs.* /L/ distinction which is the one that is not usually attested in Gbe languages, (Bole-Richard, 1983; Brousseau, 1993; Clements, 1978; Stahlke, 1971), this is the contrast which requires the most justification. In sections 3.8 and 3.9, I discuss the fact that the case for /L/ as a distinct toneme finds its best support from among the noun data. There are 23 out of 295 nouns in my database—roughly 8%—that are not able to be well explained otherwise. These include the nouns of the /L.H/ pattern and the nouns that do not contain depressor consonants, but still have lexically assigned tone patterns that include L.[63]

This is not to say, however, that the case for /L/ as a distinct toneme is made only through the data from nouns. There are other words in the language that support this underlying three-way contrast. Beyond the category of monomorphemic nouns, there are words and morphemes in the lexicon that include L in their lexically-assigned tone patterns and that do not contain depressor consonants. These include borrowed words (see section 4.5), ideophones (see section 4.9), floating grammatical morphemes that mark negation, YNQs, and fronted topics (see sections 5.2, 5.6, and 5.7), and the following grammatical morphemes.

(200) Morphemes that have L tone but that do not contain a depressor

/ò/	anterior (TAM) marker
/ɔ̃̀/	negation marker
/mĩ̀/	2PL
/mɔ̃̀/	repetitive (TAM) marker
/tèjē/	1SG POSS
/tɔ̀wē/	2SG POSS

We can take the words out of this list that are TAM markers (both of which are L) and contrast them with M and H TAM markers.

[63] Individual nouns that fit into both categories are not counted twice in this calculation.

(201) Contrast of /H/, /M/, and /L/ TAM markers

a.	/ōsɔ́ ò sɔ̃́/	[ōsɔ́ ò sɔ̃́]	The horse had (ANT) left.	sxw-L0161-auxiliaries-un.wav
b.	/ōsɔ́ mɔ̃̀ sɔ̃́/	[ōsɔ́ mɔ̃̀ sɔ̃́]	The horse (REPET) left again.	sxw-L0197-auxiliaries-un.wav
c.	/ōsɔ́ nã̄ sɔ̃́/	[ōsɔ́ nã́ ↓sɔ̃́]	The horse will (FUT) leave.	sxw-L0001-auxiliaries-un.wav
d.	/ōsɔ́ nɔ̃̄ sɔ̃́/	[ōsɔ́ nɔ̃́ ↓sɔ̃́]	The horse (HAB) leaves.	sxw-L0073-auxiliaries-un.wav
e.	/ōsɔ́ á sɔ̃́/	[ōsɔ́ á sɔ̃́]	The horse may (SBJV) leave.	sxw-L0037-auxiliaries-un.wav
f.	/ōsɔ́ nĩ́ sɔ̃́/	[ōsɔ́ nĩ́ sɔ̃́]	The horse should (JUSS) leave.	sxw-L0018-other clauses-un.wav

Here we see three different surface melodies depending on the underlying tone of the TAM marker.

In this chapter, six derivational operations are described to account for the tonal alternations in Saxwe utterances. They are given below. The ordering of the first five of these operations relative to each other is discussed in sections 3.6 and 3.7. The only operation for which the ordering has not been established in this chapter is the rule of Grammatical tone docking (with parts A and B), which is discussed further in section 5.4.

(202) Operations that generate surface tone patterns in Saxwe

Ordered
$L_{\%}$ association (94)
Nominal floating H deletion (151)
Contour simplification A (159) and B (160)
Partial L spread (106)
Tonal spread (72)

Not yet ordered
Grammatical tone docking A and B (102)

Note that all of the operations listed in (202) are postlexical operations. Section 2.4 discusses the fact that lexical operations are only word-internal and cannot apply across words. Moreover, lexical operations cannot refer to phrasal boundaries. The very first operation in (202) refers to the right boundary of the IP, therefore it must be a postlexical operation. This being the case, the rules that follow must also describe postlexical operations. We see that many of the rules involve interactions between tones that may be found across word boundaries.

This chapter includes some discussion of downstep. I describe in section 3.3 the phenomenon of automatic downstep, described as the lowering of the 'ceiling' of H following a surface L. The related phenomenon, non-automatic downstep, is addressed in section 3.4. Non-automatic downstep of H is described as the lowering of the 'ceiling' of H whenever a floating M comes between surface Hs. One of the interesting things about the Saxwe tone system is that automatic and non-automatic downstep of H are not triggered by the same thing; automatic downstep of H is triggered by a surface L, whereas non-automatic downstep of H is triggered by a floating M.

Finally, I end this chapter with some hypotheses regarding the historical development of the present-day Saxwe tone pattern. It is likely that consonant-tone interaction in an early Gbe stage began with phonetically-motivated processes whereby the physics of voicing an obstruent resulted in a situation where pitch levels were, on average, lower following voiced obstruents than they were following other consonants—a situation well attested elsewhere (Hombert, Ohala, & Ewan, 1979). Eventually this could have resulted in a redundantly contrastive situation where a phonological operation inserted L following depressors.

It seems clear, however, from the many inconsistencies observed in the noun data as well as in other grammatical categories that L in Saxwe now has a life of its own independent of depressors and can be lexically assigned to words that contain consonants of all types or no consonant at all.

It is impossible to know whether the diachronic tone changes hypothesized in section 3.9 would have occurred progressively over a long period of time or in a relatively short period. It seems likely that the catalyst for much of the change was the contact between two languages—one with an underlying two-way tonal contrast and significant phonological interaction between consonants and tone, the other with a three-way tonal contrast and no phonological (but some phonetic) interaction between consonants and tone. The majority of the Saxwe data reflect the first language source, while the 'inconsistent' forms reflect the second. Whether the 'inconsistent' forms represent an ever-increasing trend is a question that can only be answered through long-term study of this tone system. In any case, this tone system provides an interesting case study for what can happen when two fairly different tone systems are brought into contact.

4 Word-level phenomena beyond monomorphemic tone patterns

In this chapter, I go beyond the identification of monomorphemic tone patterns and examine futher tonal phenomena, including those which are associated with a variety of strategies used in Saxwe to build the lexicon. This direction of study leads to observations about what may constitute the phonological word (PW) in Saxwe and how word-level prosodic structure plays a significant role in the tone system of Saxwe.

In section 4.1, I look at the right H_{ω} PW boundary—a prosodic boundary tone that is generated in the presence of certain prosodic structures and which is observed in many word-formation strategies. In section 4.2, I discuss a process of initial vowel elision that occurs between words. Although this process is not word-internal, the discussion of this initial vowel elision is intended as background for later comparisons with word-internal vowel elision. In section 4.3, I look at the floating M- tone on the left side of those nouns which do not have an initial vowel, and I explore the relationship of between this M- tone and the initial vowel on monomorphemic nouns.

The discussion of structurally-driven boundaries in section 4.1 is foundational to the description of complex nouns in the following sections. The complex nouns discussed in section 4.4 are those derived through either compounding or derivational reduplication of a verb. Then in section 4.5, I look at another kind of reduplication other than the derivational reduplication seen in section 4.4.

The chapter ends with a variety of other word-level topics involving interesting tonal phenomena. In section 4.6, I look at the affixation of the first and third singular object suffixes to the verb and describe how tone is dealt with in the ensuing morphophonemic changes. Section 4.7 addresses the tonal treatment of nouns that have been borrowed into Saxwe from English. In section 4.8, I look at the morphemes [lá] and [nã́], which are enclitics with unusual tonal behavior. In section 4.9, I look at tone as it relates to ideophones. Finally, section 4.10 ends with conclusions regarding the various topics of this chapter.

4.1 Word-level prosodic structures and the H_{ω} boundary

In Saxwe, there is a H_{ω} prosodic boundary tone that is found on the right edge of certain structures, such as a noun-noun compound. In this section, I first give some background on prosodic boundaries. I then describe the prosodic structure that must be present to generate this H_ω boundary and give examples of conditions where the boundary exists and conditions where it does not exist. I demonstrate that phrase-level prosodic structures are not responsible for the H_ω boundary. Rather, this boundary is related to word-level prosodic structures and specifically to recursion at the level of the phonological word which yields a $]_{PW}]_{PW}$ structure.

4.1.1 Background on tonal boundaries

In the literature, there are many examples of how tonal phenomena may be either assigned with relation to prosodic structure or bounded by prosodic structure (section 2.5). A frequent finding is that tonal phenomena can be related to how the phonological phrase (PhP) is constructed. For example, edges of PhPs may be established with reference to the right or left edge of either the head or the maximal projection of a morphosyntactic structure ((Selkirk, 1986), building on Chen (1987)).

While much of the literature has focused on phonological phrases, there is also some discussion of how tonal phenomena may be related to prosody at the level of the PW. An example of this is described by Myers (1995) for Shona. In Shona, the PW can include what he terms a 'full word' together with a string of procliticized 'function words'. Within this domain, various rules may operate: a rule of stress, a rule of epenthesis, and Meeussen's Rule.

Some examples are shown in (203) and (204). The brackets and subscript labeling of PWs are my addition.

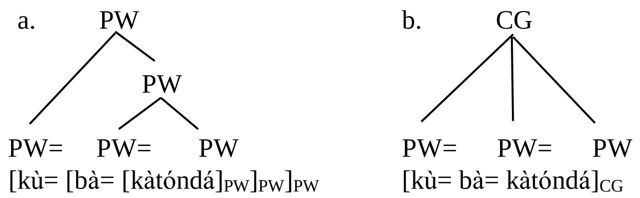
(203)	[babá]$_{PW}$	[vá-babá]$_{PW}$	[vángu]$_{PW}$
	father	of-father	my
	father of my father (Myers (1995:85))		

(204)	[ívo]$_{PW}$	[ndí-babá]$_{PW}$	[vángu]$_{PW}$
	he	COP-father	my
	he is my father (Myers (1995:85))		

Myers states that languages may differ on how they divide closed word classes; some are assigned 'full word' status while others are assigned 'function word' status.

According to Hyman (2008), when there are multiple procliticized elements, there are two possible ways this may be structured in a language. This is shown below, where CG stands for the clitic group.

(205) Possible structures for Luganda [kù-bà-kàtóndá] 'on the gods' from Hyman (2008, p. 339)



Note that in Hyman's depictions shown in (205), the proclitics are assumed to be bound PWs. In (205)a, there is a nesting of PWs, with the prosodic category of PW being found at multiple levels in the hierarchy.[64] In (205)b, there is a flat structure of PWs within a single CG.

Hyman (2008) also discusses the fact that in a given language, affixes (such as an inflectional prefix or a plural prefix) may be equivalent to cliticized words (such as a preposition), or they may not. Equivalence in this case can be judged by whether these affixes are treated in the phonology as being part of certain PWs or not, reflected in the geometry and particularly in the branching patterns of PWs.

In summary, languages may vary as to which smaller units make up the PW and how these smaller units are structured within the PW. Before seeing how this applies to Saxwe, I touch briefly on some data points from Gen and Ewe which will become relevant in the following discussion. These data points deal with noun compounding—a process through which the PW may be composed of smaller units.

In other Gbe languages, H has been documented to be associated with noun compounding. For example, Bole-Richard (1983) notes that in noun compounds in Gen, there is always a raising of pitch at the right edge of the compound (p. 253).

(206)

	Isolation form	**At right edge of compound**
all consonants	CV̀	CV̌
depressors	CV̌	CV́
non-depressors	CV́	CV́

Ameka (1999; 1991) documents that in Ewe, there is a H tone suffix that co-occurs with a variety of structures, all of which are polymorphemic: certain kinds of complex nominal duplication structures, adjectivals derived by a process of verbal reduplication, adjectivals derived without affixation from verbs that have a CVCV

[64] Selkirk (1984) proposes that any given level of prosodic hierarchy (*e.g.* PhP or PW) cannot appear recursively in a nested fashion. This is known as the Strict Layer Hypothesis (Selkirk, 1984). However, Selkirk and Lee (2015) include a number of modifications on Selkirk's earlier work, including a recognition of the possibility of recursivity in prosodic structure.

structure, adjectivals derived by compounding a verb and a nominal element, adjectivals derived through the compounding of a certain inverse marker and a verb, and adjectivals derived through the chaining of constituents of a clause—usually with the inclusion of a negative marker.

So we see that in general, there seems to be some connection across several of the Gbe languages between compounding or derivational processes and right edge H tone phenomena.

4.1.2 The right H_ω boundary

In Saxwe, the assignment of the H_ω boundary is related not to structures at the level of the PhP, but rather at the level of the PW. Recursivity in the prosodic structure at the level of the PW is an important notion in the explanation of the H_ω boundary in Saxwe.

There are two categories that are important when considering the structure of PWs and the assignment of the H_ω boundary in Saxwe. These two categories are: (1) PWs, and (2) affixes. The H_ω boundary is generated whenever there is a juxtaposition of two right edge PW boundaries in a nested hierarchical structure. This is shown in (207).

(207) Prosodic conditions for the generation of the H_ω boundary

$\ldots]_{PW}]_{PW}$ H_ω

I take first the example of a N-N compound. Compounding serves a variety of semantic functions, including marking a part-whole relationship, a relationship of ownership, and a qualifying relationship. In the process of compounding, the second noun in a N-N compound loses both its initial vowel and the tone associated to this initial vowel.[65] This is seen in (208).

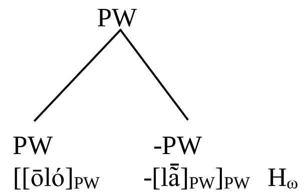
[65] As discussed in section 4.4, the bisyllabic minimality condition for nouns is satisfied in a structure like a noun-noun compound, so the initial vowel and its TBU is no longer necessary and is deleted along with its tone. This is different from the loss of the initial vowel of a noun in normal to fast speech; in that case, the features of the vowel are elided, but the tone remains. See sections 4.2 and 4.4.

(208) N-N compounds with a right edge H_ω boundary

a. /ōló + ōlã̄ $^{H\omega}$/ [ōló-lã́] crocodile meat
sxw-L0269-polymorphemic nouns-un
b. /āɖí + ōfṹ $^{H\omega}$/ [āɖí-fṹ] soap fur (soapsuds)
sxw-L0051-polymorphemic nouns-un
c. /ōtō + ōgǎ $^{H\omega}$/ [ōtō-gǎ] village leader
sxw-L0169-polymorphemic nouns-un

The initial vowel of the second noun is elided, along with its TBU. We know this initial vowel is deleted because in (208)b [āɖí-fṹ], which is derived from /āɖí/ 'soap' and /ōfṹ/ 'fur', there is no downstep between the first H and the second H. If there was a floating M between the two nouns of the compound, the second H would be downstepped. The compound [ōló-lã́] 'crocodile meat' in (208)a comes from /ōló/ 'crocodile' and /ōlã̄/ 'meat, animal' and its structure is as follows.

(209) Structure of [ōló-lã́] 'crocodile meat'



Three phonological phenomena support the idea that these N-N compounds are hierarchically organized under a single PW and that this new PW has a H_ω boundary at its right edge. First, there is the obligatory loss of the initial vowel of the second noun along with its TBU—which would not happen if the bisyllabic minimality condition were not considered to be met in the new word.

Second, there is the failure of the utterance-final $L_\%$ boundary to associate to the final TBU of this PW when the underlying tone is M or L—an operation which would normally result in final fall or downglide of F_0. (There is no final fall or downglide on any of the compounds in (208).)

Third, there is the failure of the rule B of Contour simplification (121) to be applied in these N-N compounds (section 4.4.2). This operation would normally simplify an underlying LH contour which follows a L or M TBU by delinking the H. We see in (208)c [ōtō-gǎ] 'village leader', derived from /ōtō/ 'village' and /ōgǎ/ 'ruler, leader' that the contour is not simplified in order to avoid a case of OCP violation whereby a floating H delinked because of simplification would be adjacent to the H_ω boundary.

The failure of the $L_\%$ boundary to associate and the failure of the H of the underlying LH contour to dissociate can both be explained by the presence of a H_ω

boundary. Some support of the existence of this H_ω boundary comes from the observation that other Gbe variants have a surface H tone linked to their right edge of compounds (section 4.1.1). In Saxwe, the H_ω boundary does not ever link to a TBU, but operates instead as a floating tone.

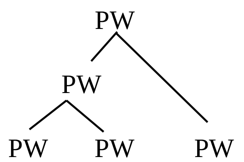
We can now turn to more examples of compounds that have on their right edge a H_ω boundary.

(210) More compounds which have on their right edge a H_ω boundary

N-V-N	a.	/ōnṹ-tʃī-kã̄ Hω/	[ōnṹ-tʃí-kã́]	thing-sew-cord (thread)
		sxw-L0020-right H boundary tests-un.wav		
	b.	/āwū-tʃī-kã̄ Hω/	[āwū-tʃī-kã̄°]	shirt-sew-cord (thread)
		sxw-L0021-right H boundary tests-un.wav		
	c.	/āvɔ̀-tʃī-kã̄ Hω/	[āvɔ̀-tʃì-kã̀°]	cloth-sew-cord (thread)
		sxw-L0022-right H boundary tests-un.wav		
N-N	d.	/ōwĩ́-sĩ̄ Hω /	[ōwĩ́-sĩ́]	bee-water (honey)
		sxw-L0173-polymorphemic nouns-un.wav		
N-V-V	e.	/ōxó-kã̄-sē Hω /	[ōxó-kã́-sé]	word-search-hear (question)
		sxw-L0023-right H boundary tests-un.wav		

If we look at these complex nouns, we see that none of them have a final falling or downgliding F_0. The pitch level throughout the final syllable is stable—either H, M, or L depending on whether Tonal spread has occurred. The right $L_\%$ boundary has not linked to any of these utterances. In addition (and not coincidentally), they all have a …$]_{PW}]_{PW}$ structure on the right edge of the utterance. The example illustrated in (211) is [ōnṹ-tʃĩ́-kã́] 'thread', derived from /ōnṹ/ 'thing', /tʃī/ 'sew', and /ōkã̄/ 'cord'.

(211) N-V-N complex nouns



$[[[$ōnṹ$]_{PW}$ -$[$tʃī$]_{PW}]_{PW}$ -$[$kã̄$]_{PW}]_{PW}$ H_ω

It is not just compounding that generates the right H_ω boundary. This boundary is also seen when complex words are created through verbal reduplication. Reduplication in Saxwe can be used to create either an action nominalization form or an adjectival form. This is shown in (212).

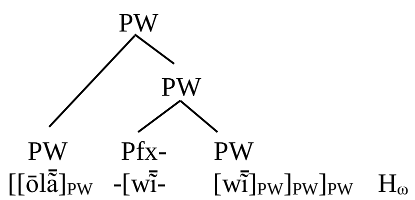
(212) Reduplicated forms which have on their right edge a H_ω boundary

N-redupV-V	a.	/ōsɔ́-wī̄-wī̄ $^{H\omega}$/	[ōsɔ́-wī́-wī́]	horse REDUP-raise
(action		sxw-L0007-right H boundary tests-un.wav		(horse-raising)
nominalization)	b.	/ōlā̄-wī̄-wī̄ $^{H\omega}$/	[ōlā̄-wī̄-wī̄°]	animal REDUP-raise
		sxw-L0008-right H boundary tests-un.wav		(animal-raising)
	c.	/ōɦà-wī̄-wī̄ $^{H\omega}$/	[ōɦà-wī̀-wī̀°]	pig REDUP-raise
		sxw-L0009-right H boundary tests-un.wav		(pig-raising)
N redupV-V	d.	/ōnū́ xī-xɔ̄ $^{H\omega}$/	[ōnū́ xí-xɔ́]	thing REDUP-buy
(N + modifier)		sxw-L0004-right H boundary tests-un.wav		(purchased thing)
	e.	/āwū xī-xɔ̄ $^{H\omega}$/	[āwū xī-xɔ̄°]	shirt REDUP-buy
		sxw-L0005-right H boundary tests-un.wav		(purchased shirt)
	f.	/āvɔ̀ xī-xɔ̄ $^{H\omega}$/	[āvɔ̀ xì-xɔ̀°]	cloth REDUP-buy
		sxw-L0006-right H boundary tests-un.wav		(purchased cloth)

The details of derivation for these reduplicated forms in (212)a-f are discussed in section 4.4.3. Here, I focus on the prosodic structure, stating simply that there is a reduplication prefix that is used to produce both the nominal and adjectival forms derived from verbs.

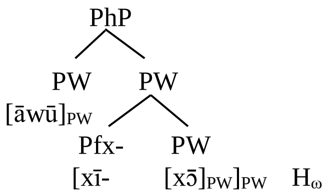
The depiction in (213) represents the action nominalization from (212)b, [ōlā̄ wī̄-wī̄°] 'animal-raising/animal husbandry'. Here, the entire structure represents a single PW. The right edge H_ω boundary is reponsible for the final non-falling M tone.

(213) Verbal reduplication (action nominalization)



If we look at (212)e [āwū xī-xɔ̄°] 'purchased shirt', we see that it is a noun phrase composed of two PWs—one which is the noun head of the noun phrase and one which is a deverbal modifier. For this noun phrase, we have the structure in (214). At the top of the hierarchy is the level of PhP rather than PW. Under the level of PhP are two PWs, one of which is the modifier derived through verbal reduplication.

(214) Verbal reduplication (deverbal modifier)



In both cases, we have nested PW brackets on the right edge of the utterance, giving the $]_{PW}]_{PW}$ prosodic structure which generates a H_{ω} boundary. The evidence of this H_{ω} boundary is the non-falling pitch at the end of the utterance, despite the fact that the underlying tone on this TBU is M.

One may wonder whether the H_{ω} boundary is not related to phrase-level prosody rather than word-level prosody. We have looked at examples of structures where the H_{ω} right edge boundary is present. I now turn to examples of noun phrases where there is clearly no H_{ω} boundary. In all of the noun phrases shown in (215), the word on the right edge of the noun phrase is realized with a final falling F_0; the right edge $L_{\%}$ boundary has clearly been linked to the final TBU. Not coincidentally, the morpheme on the right edge of the NP is a PW that is not involved in any sort of word-formation process. One indication that this is the case is that the initial vowel is present on all these morphemes.

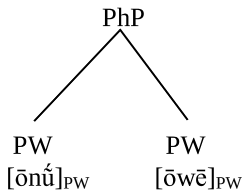
(215) Noun phrases which do not have a H_{ω} right edge boundary

a.	simple N	/ōxɛ̄/	[ōxɛ̂]	bird
		sxw-L0262-VCV nouns-bird-un.wav		
b.	N AM N	/ɛ̄mɛ̃̄ wé ōtō/	[ɛ̄mɛ̃̄ wé ótô]	person AM village
		sxw-L0008-associative construction-un.wav		(person's village)
c.	N numeral	/ōnű ōwē/	[ōnű ówê]	thing two
		sxw-L0012-numbers-un.wav		(two things)
d.	N complex numeral	/āwū kō nũ̄kű ōwē/	[āwū kō nũ̄kű ówê]	shirt 20 and[66] 2
		sxw-L0030-right H boundary tests-un.wav		(22 shirts)

If we take the example of (215)c, we can show the prosodic structure involved. Here, the top level shown is the PhP. There are two PWs under this PhP.

[66] The form [nũ̄kű] has no clear meaning, but it does appear to be related to such words as [ŋʷũ̄kűsí̄] 'eye' and [ŋʷũ̄kɔ̂] 'area in front/area before'. As such, it seems to indicate a number that is ordered first prior to that which follows. Grammatically, it could be a modifier or a connective.

(216) Noun phrase composed of noun + numeral



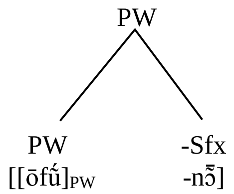
There are word-formation processes that do not generate a right H_ω boundary. I turn now to examples where the H_ω right edge boundary is absent because there is a suffix rather than a lexical morpheme at the right edge of the utterance. In (217), we see these examples.

(217) Words involving affixation which do not have a H_ω right edge boundary

a.	N-deriv suffix	/ōfű-nɔ̿/ sxw-L0015-polymorphemic nouns-un.wav	[ōfű-nɔ̂]	fur-ATTRIB (hairy person)
b.	[N-N]-deriv suffix	/ōwı̋-sı̿-nɔ̿/ sxw-L0001-right H boundary tests-un.wav	[ōwı̋-sı̋-nɔ̂]	bee-water-ATTRIB (honey salesperson)
c.	[N-V]-deriv suffix	/ōtó-kú-nɔ̿/ sxw-L0002-right H boundary tests-un.wav	[ōtó-kú-nɔ̂]	ear-die-ATTRIB (deaf person)
d.	N pronoun-poss suffix	/ōtú jē-tɔ̿/ sxw-L0021-possessive pronouns-un.wav	[ōtú jé-tɔ̂]	gun 3PL-POSS (their gun)
e.	N N-poss suffix	/āwū kōfí-tɔ̿/ sxw-L0003-right H boundary tests-un.wav	[āwū kōfí-tɔ̂]	shirt Kofi-POSS (Kofi's shirt)

The suffix /-nɔ̿/ is an attributive suffix that means roughly 'one characterized by X', where X is the base that it is affixed to. The structure of (217)a [ōfű-nɔ̂] 'hairy person' is given below.

(218) N-suffix complex noun



Because affixes are not PWs, there is not a nested $]_{PW}]_{PW}$ structure at the right edge of this larger PW. Thus the conditions for the generation of the H_ω boundary are not present. The same holds true for (217)b through e, further examples of complex nouns that have suffixes—either the attributive suffix /-nɔ̃̄/ or the possessive suffix /-tɔ̃̄/. In the absence of a right H_{ω} boundary, the IP-final left $L_{\%}$ links to the right TBU of these complex forms.

To summarize thus far, we see that when there are two nested PW boundaries at the right edge of a PW (as a result of compounding processes), a H_{ω} right edge boundary is generated. When there is a suffix at the right edge of a PW (as a result of affixation processes), the H_{ω} right edge boundary is not generated. It is possible therefore to have the following progression as words are built.

(219) Progressive word-formation processes and the H_{ω} right edge boundary

a.	/ɛ̄sī̄/	[ɛ̄sĩ̀]	water	sxw-L0099-VCV nouns-water-un.wav
b.	/ōwí̄-sī̄ $^{H\omega}$ /	[ōwí̄-sí̄]	bee-water (honey)	sxw-L0173-polymorphemic nouns-un.wav
c.	/ōwí̄-sī̄ $^{H\omega}$ -nɔ̃̄/	[ōwí̄-sí̄-nɔ̃̂]	bee-water-ATTRIB (honey-seller)	sxw-L0001-right H boundary tests-un.wav

Once a suffix is added to a compound, the conditions on the rightmost edge of the word are no longer met for the generation of the right H_{ω} boundary. We see evidence of the right H_{ω} boundary in (219)b (where there is no final falling pitch), but not in (219)c (where there is a final falling pitch). The structure of (219)c is shown below. The conditions for the generation of the H_{ω} right edge boundary exist word-medially, but not word-finally. Because the H_{ω} boundary only serves to prevent right $L_{\%}$ association and does not ever link directly to a TBU, its presence is not felt at the surface level if it is generated word-medially.

(220) N-N-nɔ̃̄ complex noun

PW
PW
PW -PW -Sfx
[[[ōwí̄]$_{PW}$ -[sī̄]$_{PW}$]$_{PW}$ H_{ω} -nɔ̃̄]

Before finishing with this topic, I point out that there seems to be a connection between the H_{ω} boundary and the floating H that is part of the lexically assigned noun tone patterns /M.M ^{H}/ and /M.L ^{H}/.

Compounding in Saxwe is a form which is used for a number of different semantic functions. For example, compounds can be used for a part-whole relationship, a qualifying relationship, a kinship relationship, a relationship of possession, a relationship of association without possession, and a relationship of spatial orientation. Interestingly, a number of the words in my inventory that are assigned the /M.M ^{H}/ and /M.L ^{H}/ are words that frequently appear in compounds and which, in their most common usages, involve these kinds of semantic relationships with another element.

Recall that the underlying tone patterns that include a floating H are relatively unusual; the /M.M ^{H}/ tone pattern is found in six percent of the nouns in my database and the /M.L ^{H}/ tone pattern is found in four percent of these nouns (section 3.7).

There are two nouns in Saxwe that reference body parts and that, when in a compounding construction, locate entities in space. These nouns are /ōtà ^{H}/ 'head' and /ōnũ̄ ^{H}/ 'mouth', both of which have a floating H in their lexically-assigned tone pattern. The locative senses derived from these nouns when they follow a noun in a compound structure are /tà ^{H}/ 'at the top of' and /nũ̄ ^{H}/ 'at the opening to' (note the deletion of the initial vowel). It is interesting that these words whose semantics involve a connection between one element and a larger whole are assigned a tone pattern with a floating H.

The next case to examine is that of color terms. There are three monomorphemic color terms in Saxwe: /wé/ 'white, bright', /wī ^{H}/ 'black, dark', and /vὲ ^{H}/ 'red'.[67] All three color terms have a linked or pre-associated H in their adjectival and nominal forms. (The former two are derived from the verbs /wé/ 'be white, be bright' and /wī/ 'be black, be dark'; the term /vὲ ^{H}/ 'red' seems to be the only underived color word.) These color terms all have a nominalized V.CV form: /ōwé/ 'that which is white/bright', /ōwī ^{H}/ 'that which is black/dark', and /ōvὲ ^{H}/ 'that which is red'. When a noun is modified by a color word, the color word immediately follows the noun in a structure that looks very much like a compound.

Another case is kinship terms. When a relationship of kinship is given, one possibility is that the kinship term comes second in what looks like a compounding construction.[68] The initial vowel of the word denoting the kinship relationship is deleted, along with its TBU. For example, /$^{M-}$ kōfí-nɔ̃̄ $^{H\omega}$/, realized [kōfí-nɔ̃́] 'Kofi's mother', comes from /$^{M-}$ kōfí/ 'Kofi (proper noun)' and /ōnɔ̃̄ ^{H}/ 'mother'. It is interesting to note that all monomorphemic kinship terms have either a floating or a pre-associated H in their lexically-assigned tone patterns; they are assigned the tone patterns /M.H/, /M.LH/, or /M.M ^{H}/.

A cursory look at some of the other words which have the /M.M ^{H}/ and /M.L ^{H}/ tone patterns shows that a number of them are words that would normally

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[67] The rest of the color words are noun compounds referencing items such as leaves or egg yolks.

[68] Another possibility is that the kinship terms is given in an associative construction using the associative morpheme. In the compounding construction, there is often also a toneless suffix ([-ɛ] or [-a]) associated to this form which is incorporated into the final syllable of the compound following a process of resyllabification.

appear in a context where they describe a part of a whole or would receive some sort of qualification in a compounding construction. This would be true of /ōkjɔ̄̃ ^{H}/ 'root', /āmā̃ ^{H}/ 'leaf', /ākpā ^{H}/ 'bark, peel, shell', and /āɦà ^{H}/ 'side'.

In all of these cases, a lexically-assigned floating H on the V.CV form renders the prosodically assigned H_{ω} boundary on complex forms redundant. One wonders if it is because these words so often appear in a context where they are assigned a right H_{ω} boundary that their V.CV forms have been reinterpreted as having a floating H as part of their underlying tone patterns.

It must be said that the proposed correlation does not explain the existence of all of the words that are assigned the /M.M ^{H}/ and /M.L ^{H}/ tone patterns.[69] For example /ōkpō ^{H}/ 'stick', /ōɦwè ^{H}/ 'fish', /ɛ̄glɛ̀ ^{H}/ 'species of black snake', and /ōɦjà̃ ^{H}/ 'corn weevil' do not clearly suggest a relationship with another element. Perhaps the safest conclusion that can be drawn is that we observe that some of the words that have a /M.M ^{H}/ or /M.L ^{H}/ tone pattern in today's lexicon are words that often appear together with another element in a relationship that often takes the form of a compound, and there is a possibility that the floating H of their tone patterns is related diachronically to that circumstance.

4.2 Word-initial elision of the initial vowel of a noun

In Saxwe, the initial vowel of a monomorphemic V.C(C)V noun is either /a/, /ɛ,/ or /o/ (section 1.4.6).[70] These initial vowels are presumed to have had a historic role as class marker prefixes, although current Saxwe and other Gbe varieties show little indication of this still being a relevant role (Good, 2012; Williamson, 1989).

Another possibility is that these initial vowels might have had a role as derivational prefixes, deriving a noun from a verb (Lefebvre & Brousseau, 2002, p. 193). This possibility is suggested by pairings where verbs and nouns are clearly semantically related, the difference being the presence of the initial vowel (*e.g.* [kú] 'die' and [ōkú] 'death'). However, addition of a word-initial vowel to a verb in order to derive a noun is not a productive process from a synchronic perspective.

The initial vowel has a predilection for being elided in processes such as noun compounding and in fast speech. Sometimes it is merely the segmental features of the vowel that are lost, and sometimes the loss includes the segmental features together with the tone. In this section, I explore the details of word-initial elision of the initial vowel of a noun. This is done to provide a backdrop for the discussion in section 4.4 of the word-medial elision of the initial vowel that occurs in lexical compounding processes.

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[69] It may be that another means for obtaining these tone patterns diachronically was that some of these nouns were derived from other parts of speech in a way that is no longer transparent. This might explain why there are a number of consonant clusters among these nouns.

[70] The prefix /o/ in Saxwe corresponds to the prefix /e/ in cognate words in neighboring languages such as Gen and Aja.

In normal to fast speech, the initial vowels /o/ and /ɛ/ of an object noun are optionally elided following a verb. Since verbs and most other monomorphemic parts of speech usually have the form C(C)V, this elision is a means of maintaining the preferred C(C)V pattern throughout the utterance.

There are many factors that play into whether an initial vowel is elided. For example, vowel elision is most frequent for common nouns such as [ōnṹ] 'thing', [ɛ̄mɛ̃̄] 'person', [ōxó] 'word, utterance', [ōgbè] 'speech, voice, language'. The tendency to elide the initial vowel of a noun is also more pronounced when these nouns are used in phrasal verbs, where the semantic meaning of the verb phrase is greater than the sum of its parts. Futhermore, an initial vowel is more likely to be elided when the vowel of the verb and the initial vowel of the noun share the same features. The following are examples of initial vowel elision identified from oral texts.

(221)	/sɔ́ ōnṹ/	→	[sɔ́ ꜜnṹ]	gather one's things sxw-T0040-texts-un.wav	lit. take thing
	/ɖē ōkɔ̄/	→	[ɖē kɔ̄]	turn head sxw-T0046-texts-un.wav	lit. remove neck
	/ɖū ōgǎ/	→	[ɖū gà^{R}]	become the leader sxw-T0055-texts-un.wav	lit. eat leader
	/kã̄ ɛ̄mɛ̃̄/	→	[kã̄ mɛ̃̀]	look for someone sxw-T0099-texts-un.wav	lit. look for person
	/jī ōtō mɛ̃̄/	→	[jī tō mɛ̃̀]	go to town sxw-T0099-texts-un.wav	lit. go town in
	/ɖū ōnṹ/	→	[ɖū nṹ]	eat sxw-T0131-texts-un.wav	lit. eat thing
	/ɲɛ̃̄ ōmĩ̌/	→	[ɲɛ̃̄ mĩ̀^{R}]	defecate sxw-T0132-texts-un.wav	lit. expel feces
	/kplã́ ōdã̌/	→	[kplã́ dã̀^{R}]	learn a job sxw-T0150-texts-un.wav	lit. learn work
	/kplã́ ōnṹ/	→	[kplã́ ꜜnṹ]	learn something sxw-T0155-texts-un.wav	lit. learn something
	/nã́ ōɦǒ/	→	[nã́ ɦò^{R}]	give money sxw-T0172-texts-un.wav	lit. give money
	/xɔ̄ ōnṹ/	→	[xɔ̄ nṹ]	buy something sxw-T0173-texts-un.wav	lit. buy thing
	/sō ōmɔ̃́/	→	[sō mɔ̃́]	cross a street sxw-T0063-texts-un.wav	lit. cut [archaic] path

The more infrequent or unusual the noun, the less likely it is that its prefix vowel will be elided in normal speech. A brief examination of several of the texts in my corpus also indicates that a noun that has discourse-level pragmatic focus on it is also less likely to have its prefix vowel elided. This is a topic that merits further study.

The initial vowel /a/ is not generally subject to being elided.[71] Note the difference for this phrasal verb when /ōmɔ̋/ 'path' is changed to the compound /āwɔ̄̃-mɔ̋/ 'asphalt-path'.

(222)	/sō ōmɔ̋/	→	[sō mɔ̋] sxw-T0063-texts-un.wav	cross a street	lit. cut [archaic] path
	/sō āwɔ̄̃-mɔ̋ Hω/	→	[sō āwɔ̄̃-mɔ̋] *[sō wɔ̄̃-mɔ̋] sxw-T0104-texts-un.wav	cross a paved street	lit. cut [archaic] asphalt-path

Word-initially, the tone of an initial vowel of a noun is not deleted when the vowel features are elided.[72] The tone remains present on the autosegmental tier as a floating tone. In the examples below, the tonal realization of these verb phrases is the same whether the vowel features of the initial vowel are elided or not.

(223)	a.	/kplă̋ ōdă̌/	→	[kplă̋ ódà̀ᴿ] *or*	'learn a job' (lit. learn work)
	b.		→	[kplă̋ dà̀ᴿ]	
	c.	/kplă̋ ōnű/	→	[kplă̋ ó↓nű] *or*	'learn something' (lit. learn thing)
	d.		→	[kplă̋ ↓nű]	

It is the floating M which is responsible for the manner in which the underlying LH contour of /ōdă̌/ 'work' is simplified in (223)b. As shown in the rule of Contour simplification A (120), an underlying contour which follows a H would be simplified by deleting the L of the LH contour. If there were no floating M, the surface realization would be *[kplă̋ dă̋].

Again in (223)d, there is a floating M. This floating M between the two surface Hs is what triggers non-automatic downstep of the second H during the phonetic implementation.

The rule of Optional vowel elision can be represented as follows.

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[71] The one case I am aware of where the prefix vowel /a/ is elided is in /ɖī āsā/, a phrasal verb meaning 'go for a stroll', which is pronounced as [ɖī sā].

[72] Word-medially, tone is deleted along with vowel features. This is discussed in section 4.4.

(224) Optional vowel elision (postlexical)

$$\begin{array}{c} \text{T} \\ \not| \\ \mu \\ | \\ \text{V} \\ | \\ \left\{\begin{array}{c} \text{o} \\ \varepsilon \end{array}\right\} \end{array} \;\rightarrow\; \text{T} \quad / \quad \text{V}]_{\text{Verb}}\ {}_{\text{Noun}}[\ \_\_$$

This rule states that at the boundary between a verb and a following noun, the initial vowels /o/ or /ɛ/ of the noun may be optionally elided. The tone, however, remains present when vowel features are elided. This is a postlexical rule, as it operates across word boundaries.

The rule of Optional vowel elision does not have to be ordered in any particular way with respect to the other derivational rules in the Saxwe tone system. Tonal phenomena and alternations are unaffected by the segmental features associated to a vowel. It is simply the presence of the tone—whether associated to the initial vowel or whether floating—which is important.

Against this backdrop of floating tones that result from fast speech elision of the noun-initial vowel, we can turn to an examination of the left M- floating tone that is found on nouns that do not have in their lexical form any initial vowel.

4.3 The left floating M- tone on nouns

The canonical shape of monomorphemic nouns in Saxwe that are not borrowed or ideophonic is V.C(C)V. As mentioned in section 4.2, there is a word-initial vowel (either /a/, /ɛ/ or /o/) which is usually associated to M tone for these canonical monomorphemic nouns. In a few cases, this initial vowel is associated to L tone (section 3.7).

There is a hypothesis that holds that these initial vowels in Gbe historically had a role as class marker prefixes and are now a vestige of that system (Good, 2012; Williamson, 1989). As has been argued for other Kwa languages (Bradshaw, 1999; Lefebvre & Brousseau, 2002), in Saxwe these initial vowels are no longer part of a functioning class system. They are merely the remnants of such a system. However, there is reason to believe that these are not the only vestige of historical class marking systems; there is in addition to these vowels one other vestige of class prefix marking which is purely tonal in nature. This is the topic of this section.

In Saxwe, there are many words which may function as the head of a noun phrase which do not have a V.C(C)V shape in isolation. Examples of this include borrowed nouns, nouns of ideophonic origin, noun compounds, derived nouns, pronouns, and words of other syntactic categories which have been nominalized.

Regardless of whether it has a V.C(C)V shape or not (and whether it begins with an initial vowel or not), any PW that functions as the head of a noun phrase in Saxwe has an initial M- tone preceding it on its left edge. When the noun does not have the initial vowel of the canonical V.C(C)V shape (because it is a compound, a borrowed noun, a derived noun, ideophonic, etc.), there is instead a left floating M- tone on the noun. In an effort to visually distinguish this tone from lexically assigned floating tones (and as a nod to the possibility of it being derived historically from a noun class prefix, a subject discussed further at the end of this section), I use the notation M- to represent this tone which is assigned to the left edge of nouns.

Just as the right edge boundary H_{ω} in Saxwe never associates to a TBU (section 4.1.2), so too the left M- floating tone never associates to a TBU. However, it has the same influence that any floating M would have on the surrounding tones within the utterance. Specifically, it triggers non-automatic downstep on a following H, and it influences the manner in which a following underlying LH contour is simplified (see section 3.4 and operations described in (120) and (121)).

In this section, I show evidence for the existence of this M- floating tone on nouns. I then discuss cognates of this tone that have been observed in other Gbe varieties, as well as other possible evidences for the historical development of this tone.

Subject pronouns, which are monosyllabic in Saxwe, have a M- floating tone on their left edge. This is not discernible when the pronoun itself is M (as is the case for /kō/ '1SG', /ō/ '2SG', or /jē ^{H}/ '3PL'). On the other hand, it is discernible for /é/ '3SG' and /mɪ̃́/ '1PL'. In (225) and (226), the left M- floating tone triggers non-automatic downstep between the H of the pronoun and the H of the word which precedes.

(225) /$^{M-}$ é kpɔ̃́ $^{M-}$ mɪ̃́/
[é kpɔ̃́ ↓mɪ̃́]
3SG see 1PL
He saw us. sxw-L0046--pronouns-un.wav

(226) /blɛ́ $^{M-}$ é lē Ø $^{H\%}$/ [73]
[blɛ́ ↓é lé]
there 3SG be.at
There he is. sxw-L0021-left boundary tests-un.wav

Borrowed nouns also have this left M- floating tone. In (227), we see non-automatic downstep triggered between the H of the borrowed noun and the H of the preceding verb.

[73] The Ø and the H% boundary are not relevant to the topic at hand and can be ignored for the moment. They are discussed in section 5.8.

(227) /$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ tʃītʃā lá/
[é kpɔ̃́ $^{\downarrow}$tʃītʃá $^{\downarrow}$lá]
3SG see teacher DEF
He saw the teacher. sxw-L0055-borrowed words-un.wav

Complex nouns obtained through compounding or derivation have on their left edge a M- floating tone in every case where the complex noun has no initial vowel. For example, for certain complex nouns, the initial vowel is absent by convention. This is the case in (228). Here, despite the fact that the initial vowel is absent by convention, the underlying LH contour in the complex noun 'hunter' is simplified in a manner that happens only when there is a preceding L or M tone—that is, the H of the underlying LH contour is delinked (see the rules of Contour simplification described in (120) and (121)).

(228) /$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ gbě-ɲā̃-tɔ́/
[é kpɔ̃́ gbè-ɲā̃-tɔ́]
3SG see grass-chase-AGENT
He saw a hunter. sxw-L0010-NP boundary tests-un.wav

Words that are not from the class of nouns but that function as the head of an NP in a given utterance also have this initial M- floating tone assigned to them.

In the examples below, the demonstrative [xé] has no boundary tone when it is not being nominalized, as can be seen in (229) where there is no non-automatic downstep of H triggered between [ōtú] and the demonstrative. However, it is assigned a M- floating tone when it fills the slot of head of the NP in (230).

(229) / $^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ ōtú xé/
[jē kpɔ̃́ ó$^{\downarrow}$tú xé]
3PL see gun DEM
They saw this gun. sxw-L0002-NP boundary tests-un.wav

(230) / $^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ $^{\text{M-}}$ xé/
[jē kpɔ̃́ $^{\downarrow}$xé]
3PL see DEM
They saw this [one]. sxw-L0003-NP boundary tests-un.wav

The possessive adjective in (231) has no left M- floating tone, but this boundary tone is generated when the possessive adjective fills the noun slot in (232).

(231) /$^{\text{M-}}$ é kpɔ̃́ ājá é-tɔ̃̄/
[é kpɔ̃́ á↓já é-tɔ̃̂]
3SG see comb 3SG-POSS
He saw his comb. sxw-L0007-NP boundary tests-un.wav

(232) /$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ é-tɔ̃̄/
[é kpɔ̃́ ↓é-tɔ̃̂]
3SG see 3SG-POSS
He saw his. sxw-L0006-NP boundary tests-un.wav

Similarly, the numeral in (233) has no left M- floating tone when it functions to modify the noun, but the M- floating tone is present when the numeral becomes the head of the NP in (234).

(233) / $^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ ōtú ɖókpó lá/
[jē kpɔ̃́ ó↓tú ɖókpó lá]
3PL see gun one DEF
They saw the one gun. sxw-L0020-NP boundary tests-un.wav

(234) / $^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ $^{\text{M-}}$ ɖókpó lá/
[jē kpɔ̃́ ↓ɖókpó lá]
3PL see one DEF
They saw the one. sxw-L0022-NP boundary tests-un.wav

And again in (235) and (236), the same pattern is seen. Here the adjective created through verbal reduplication in (235) functions as the head of the noun phrase in (236).

(235) / $^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ ōwĩ́ kú-kú lá jē $^{\text{H}}$ /
[jē kpɔ̃́ ó↓wĩ́ kú-kú lá jé]
3PL see bee RED-die DEF PL
They saw the dead bees. sxw-L0025-NP boundary tests-un.wav

(236) /$^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ $^{\text{M-}}$ kú-kú lá jē $^{\text{H}}$ /
[jē kpɔ̃́ ↓kú-kú lá jé]
3PL see RED-die DEF PL
They saw the dead [ones]. sxw-L0026-NP boundary tests-un.wav

The absence and presence of the M- floating tone is again shown below. In (237), the underlying LH contour on the first vowel of the adjective /zě̆tɛ́/ 'all' is simplified by deleting the L. This is what occurs when there is an immediately preceding H. In (238), the same underlying LH contour is simplified by delinking the H. This is the process that occurs when there is an immediately preceding L or M. The M that is responsible for the contour simplifying in this manner is the M-floating tone which is present at the left edge of the NP head, which in (238) is filled by the adjective /zɛ̌tɛ́/.

(237)	/$^{\text{M-}}$jē $^{\text{H}}$	kpɔ̃́	ōnṹ	zɛ̌tɛ́	jē $^{\text{H}}$/
	[jē	kpɔ̃́	ó↓nṹ	zɛ́tɛ́	jé]
	3PL	see	thing	all	PL

They saw all of the things. sxw-L0030-NP boundary tests-un.wav

(238)	/$^{\text{M-}}$jē $^{\text{H}}$	kpɔ̃́	$^{\text{M-}}$zɛ̌tɛ́	jē $^{\text{H}}$/
	[jē	kpɔ̃́	zɛ̀tɛ́	jé]
	3PL	see	all	PL

They saw all [of them]. sxw-L0032-NP boundary tests-un.wav

I have stated that the M- tone is found at the left edge of the head of a noun phrase (assuming that the word there does not already have an initial vowel). The M- tone is not found word-internally within compounds. This is demonstrated below and in section 4.4.2 which deals with compounding.

(239)	/$^{\text{M-}}$jē $^{\text{H}}$	jɔ́	$^{\text{M-}}$gɔ̀sú-tá̃lĩ́-ɛ́/ [74]
	[jē	jɔ́	gɔ̀sú-tá̃lĩ́-ɛ̃́]
	3PL	call	Gosu-paternal.aunt-POSS

They called Gosu's paternal aunt. sxw-L0044-NP boundary tests-un

In (239), the kinship relationship is structured within a single PW looking like a noun-noun compound.[75] There is no M- tone immediately to the left of /tá̃lĩ́/ 'paternal aunt' because the head of the NP is the entire PW [gɔ̀sú-tá̃lĩ́-ɛ̃́]. In an alternative structure in (240) involving the associative marker /wé/, a M- floating tone is present at the left edge of /tá̃lĩ́/ 'paternal aunt', because that is the head of a noun phrase in this utterance.

(240)	/ōtɔ́	wé	$^{\text{M-}}$tá̃lĩ́-ɛ́/
	[ōtɔ́	wé	↓tá̃lĩ́-ɛ̃́]
	father	AM	paternal.aunt-POSS

his father's paternal aunt. sxw-L0047-NP boundary tests-un

Before closing this section, I consider evidence from other Gbe varieties in support of the existence of the M- floating tone described here. In these Gbe varieties, the cognate of the M- floating tone (a non-high tone in all these varieties)

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[74] I have been told by other speakers that 'paternal aunt' is /táɲĩ́/. My consultant consistently pronounced it as [tá̃lĩ́].

[75] Internally within compounding constructions, there is obligatory deletion of any noun-initial vowel that is normally part of the lexical form of the second noun.

docks to a TBU and is therefore observed not merely indirectly through its effect on adjacent tones, but at the level of surface implementation.

Ameka (1999) notes that in Ewe, when a verb undergoes nominalization through reduplication processes, the reduplication prefix is assigned the same tone as the verb if it is preceded by a complement. If there is no preceding complement in the nominalized form (*i.e.* the verb is left-most in the nominalized form), a high-tone verb will have a low-tone prefix (p.79, 80). We can say that the reduplicated forms of the verb have either nominal or adjectival roles. These are illustrated below for the Peki dialect from Ansre (1961, p. 39) and Stahlke claims they are the same in the Kpando dialect.

(241)

Underlying form		**Nominal derivation**		**Adjectival derivation**	
/bú/	to lose	[bùbú]	loss	[búbú]	lost
/bū/	to respect	[bùbù]	respect	[būbūú]	respected
/vó/	to rot	[vòvó]	rottenness	[vóvó]	rotten
/vō/	to be free	[vòvò]	freedom	[vōvōó]	free
/tú/	to shut	[tùtú]	shutting	[tútú]	closed
/tū/	to grind	[tùtù]	grinding	[tūtūú]	ground

Stahlke (1971) explains these and other data by saying that *all* nouns in Ewe have a prefix. Where there is no segmental element to that prefix, the prefix is simply a floating M (which is lowered to L preceding an obstruent).

Specifically in the case of verbal reduplication to create a nominalized form, Stahlke asserts that the reduplication prefix does not have any pre-assigned tone. In cases where the reduplicated form serves as a noun, the floating tone that is the noun prefix (Stahlke employs the term 'prefix' for this tone) becomes linked to the vowel of the reduplication prefix. Otherwise, the tone of the prefix is presumably obtained through spread from the verb root, although this is not explicitly stated by Stahlke.

Unlike Saxwe, Ewe has a number of monomorphemic nouns which in their lexical forms have a C(C)V shape, with no initial vowel present. The following is taken from Stahlke (1971, p. 167) and is claimed to be representative of both the Peki and the Kpando dialects. Here, Stahlke shows examples where a H verb that is followed by a H noun is realized with a falling [HL] contour.

(242) Ewe data from Stahlke (1971, p. 167)

kpɔ́ + àtí	see + tree	→	[kpɔ́ àtí]
kpɔ́ + `tó	see + ear	→	[kpɔ́ɔ̀ tó]

As we can see in (242), the verb /kpɔ́/ 'see' does not have a HL contour when followed by a noun that has an /a-/ prefix (Stahlke also uses the term 'prefix' to speak of initial vowels such as /a/). But when the noun does not have an initial vowel prefix as with /tó/ 'ear', Stahlke argues that a floating M prefix on this noun (lowered to L by a rule of M prefix lowering) becomes associated leftward to the vowel of the preceding verb. This is the reason then for the HL contour appearing on the verb /kpɔ́/ 'see' when it precedes /tó/ 'ear'.

I turn now to question of how this left floating M- tone came to exist on nouns. If we consider the initial vowels /a/, /ɛ/, and /o/ with their associated tones to be vestiges of a historical noun class prefix system, the left floating M- tone could also be considered to be a vestige of a noun prefix marker—reduced to a floating tone and generalized to be found on any noun not having the more canonical initial vowel. The reduction of noun class systems in some Niger-Congo languages to a minimal number of categories is attested, as is the existence of class prefixes that are tonal in nature with no segmental association (Akumbu & Hyman, 2017; Ernst, 1992; Maho, 1999).

I do not, however, consider this left floating M- tone to be a true prefix at the present time, whether derivational or inflectional. It is not productive by itself in the derivation of nouns; one cannot add this tone to a verb or other part of speech to create a noun (although when the reduplication prefix is affixed to a verb in the derivation of a noun, it also appears). It is not clearly inflectional either; if /a/, /ɛ/, /o/ and this floating tone are considered in a paradigmatic relationship, there are no semantically-driven reasons for these to be considered class markers, nor is there any grammatical agreement that would signal them to be class markers.

While no longer playing a role in a functional class system, the floating M- may function today to satisfy certain phonological templatic requirements for nouns: (1) that all PWs functioning as nouns begin with a TBU associated to a non-high tone, and (2) that this TBU precede the initial consonant within the PW.

Theoretically, nouns that have one of the initial vowels /a/, /ɛ/, or /o/ could also have this left floating M- tone in addition to their initial vowel. This possibility is untestable, as the floating tone would in no context provide additional information relevant to the conditioning of surrounding tonal phenomena. For the purposes of this study, I will not mark it on nouns that have one of the initial vowels /a/, /ɛ/, or /o/. In so doing, I make the assumption that this floating tone is the default in the absence of one of these initial vowels, but that it exists in a paradigmatic relationship with the three vestigial prefixes /a/, /ɛ/, and /o/—all four being vestiges of a historic noun class prefix system.

We now move to the discussion of complex nouns. In this discussion, we observe further evidence for the floating M- tone.

4.4 Complex nouns

4.4.1 Two elision processes seen in complex nouns

When morphemes are combined to create complex nouns, one or both of two different elision processes may enter into play to determine what happens to the initial vowel of a monomorphemic noun which becomes part of the complex form.

First, I look at what happens to the initial vowel of a monomorphemic noun when, after word-formation, it appears on the left edge of a complex noun. In complex nouns, the bisyllabic minimality condition is met without the presence of the initial vowel of the monomorphemic noun. The result is that in their isolation forms, some noun compounds are realized by convention with an initial vowel, while others are realized by convention without this initial vowel. The rule of Word-initial vowel elision is as follows.

(243) Word-initial vowel elision (optional, lexical)

$$\mathrm{V} \rightarrow \varnothing \quad / \ \#[[\_\_\ldots]_{\mathrm{PW}}\ldots]_{\mathrm{PW}}$$

This rule states that on the left edge of a complex noun, there is optional deletion of a word-initial vowel together with its tone. This rule is lexical because it deals only with word-formation processes and it represents an operation which is limited to the internal boundaries of the PW.

In (244), we see examples of complex nouns that are conventionally pronounced with an initial vowel, while in (245), we see examples of complex nouns that are conventionally pronounced without an initial vowel. There is a fair amount of variation in this regard and some people make an effort to include the initial vowel (assuming they know from the lexeme what it should be) in written form even if they do not pronounce it orally.

(244) Complex nouns which conventionally have an initial vowel

a.	/āzǐ̄/ + /āmī̄/ Hω	peanut+oil	[āzı̄̀-mī̄°]	peanut oil
			sxw-L0075-polymorphemic nouns-un	
b.	/ɛ̄kpjɔ̄́/ + /wé/ Hω	cough+white	[ɛ̄kpjɔ̄́-wé]	tuberculosis
			sxw-L0085-polymorphemic nouns-un	
c.	/āfɔ̄/ + /kú/ Hω	foot+die	[āfɔ̄-kú]	accident
			sxw-L0054-polymorphemic nouns-un	

(245) Complex nouns which conventionally do not have an initial vowel

a.	/ōgȁ/ + /ōnű/ $^{H\omega}$	metal+thing	[gȁ-nǔ̌]	metal bowl
			sxw-L0099-polymorphemic nouns-un	
b.	/ōfi̋/ + /āzɔ̀/ $^{H\omega}$	ashes+smoke	[fi̋-zɔ̀°]	dust
			sxw-L0089-polymorphemic nouns-un	
c.	/āfɔ̄/ + /ākpā ^{H}/ $^{H\omega}$	foot+shell	[fɔ̄-kpā°]	shoe
			sxw-L0091-polymorphemic nouns-un	
d.	/ōti̋/ + /ōkjɔ̿ ^{H}/ $^{H\omega}$	tree+root	[ti̋-kjɔ̋]	tree root
			sxw-L0190-polymorphemic nouns-un	

Note that unlike with the postlexical rule of Optional vowel elision which operates at the boundary between a noun and a verb (see section 4.2), in this rule of Word-initial vowel elision there is no distinction made between the prefixes /a-/, /ɛ-/, and /o-/; all are equally likely to be lost in the lexical form of the new word. In addition, the same monomorphemic form may have its initial vowel elided in the conventional pronunciation of one complex form (such as the /a-/ of /āfɔ̄/ in (245)c), but not in another form (as in (244)c).

When the initial vowel is elided, the alternative left M- floating tone on nouns described in section 4.3 appears by default. This left M- tone triggers non-automatic downstep in (246) and (247).[76]

(246)	/ $^{M-}$ jē ^{H}	kpɔ̋	$^{M-}$ fi̋-zɔ̀ $^{H\omega}$	lē	blɛ́/
	[jē	kpɔ̋	↓fi̋-zɔ̀	lè	blɛ́/
	3PL	see	ashes-smoke	at	there

They saw dust there. sxw-L0019-other clauses-un.wav

(247)	/ $^{M-}$ jē ^{H}	kpɔ̋	$^{M-}$ ti̋-kjɔ̿ $^{H\ H\omega}$	lá	lē	blɛ́/
	[jē	kpɔ̋	↓ti̋-kjɔ̋	↓lá	lé	↓blɛ́/
	3PL	see	tree-root	DEF	at	there

They saw that tree root there. sxw-L0020-other clauses-un.wav

I turn now to a discussion of the initial vowel of a lexeme that is word-internal. In complex noun formation, the initial vowel of any word-internal noun is obligatorily elided along with its TBU. Bisyllabic minimality constraints provide the motivation for the presence of this initial vowel in monomorphemic nouns. Word-medially in a complex noun, there is no motivation for preserving this initial vowel, and there is motivation to elide it, as this maintains the preferred CV syllable patterns throughout the word. Moreover, the obligatory loss of this initial vowel appears to be a way of indicating that the lexeme is part of a larger PW—assuming

[76] One could argue that the segmental features of the initial vowel are deleted, but its tone remains behind as a floating tone. Either way, we end up with the same results with regard to surface tone.

that there is recursivity at the level of the PW. The following is the rule of Word-internal vowel elision in Saxwe.

(248) Word-internal vowel elision (obligatory, lexical)

V → Ø / [$_{PW}$… [__ …]$_{PW}$…]$_{PW}$

This rule states that the initial vowel of a noun, along with its TBU, is obligatorily elided when the vowel in question is word-internal, together with its tone. This rule is a lexical rule as it refers to an operation that is only relevant during processes of word formation. There is a single exception to this rule: the noun /ɛ̄mɛ̄/ 'person' sometimes appears with its initial vowel in complex nouns. I do not know why this noun is exceptional in this way.

There is a difference between vowel elision that occurs word-initially (where there is evidence of a floating tone to the left of the noun) and this Word-internal vowel elision (where the tone is deleted with its vowel and there is no evidence of a floating tone). This can be seen below.

(249)	a.	/kplā́ ōdā̌/	→	[kplā́ dā̀^{R}]	learn a job (lit. learn work)
	b.	/ōló/ + /ōvǐ/ $^{H\omega}$	→	[ōló-ví]	baby crocodile (lit. crocodile child)
	c.	/kplā́ ōnū́/	→	[kplā́ ꜜnū́]	learn something (lit. learn thing)
	d.	/āɖí/ + /ōfū́/ $^{H\omega}$	→	[āɖí-fū́]	soapsuds (lit. soap fur)

In (249)b, we see that an underlying LH contour is simplified in the compound [ōló-ví] by deleting the L (rather than by delinking the H as in (249)a). This is the kind of simplification that is seen when there is an immediately preceding H. We can therefore assume that there is no floating M between the two nouns in this noun-noun compound, while there is between the verb and noun in (249)a.

In (249)d, we see that there is no non-automatic downstep between the two Hs in this noun-noun compound (as there is in (249)c). This is evidence that there is no floating M between these morphemes, while there is such a floating tone between the verb and the noun in (249)c.

The rules of Word-initial and Word-internal vowel elision both apply in the context of noun-noun compounds, which is the topic of the next section.

4.4.2 Noun-noun compounds

The tonal behavior of noun-noun compounds is accounted for using the analytical tools provided thus far: (1) the postlexical operations described in chapter 3 (repeated below), (2) the lexical Word-initial and Word-internal rules of vowel elision discussed in section 4.4.1, and (3) the left M- floating tone and right edge H_ω boundary tones discussed in sections 4.1 and 4.3.

(250) Postlexical operations that generate surface tone patterns in Saxwe

$L_\%$ association (94)
Nominal floating H deletion (151)
Contour simplification A (159) and B (160)
Partial L spread (106)
Tonal spread (72)

In this section, I show how the surface forms of noun-noun compounds are obtained given the mechanisms and operations described above. To begin with, we see evidence of Word-internal vowel elision in (251). The initial prefix /ō-/, including its TBU, is elided in the formation of the compound. There is no non-automatic downstep between the two Hs, which indicates that there is no floating M between the two Hs.

(251) /āɖí/ + /ōfű/ $^{H\omega}$ soap+fur [āɖí-fű] soapsuds
sxw-L0051-polymorphemic nouns-un.wav

This rule of Word-internal vowel elision is a word-formation rule, as is the rule of Word-initial vowel elision. Being word-formation rules, these apply during the lexical component and precede all other operations discussed in this section.

Next, we must account for the fact that there is no final falling or downgliding pitch on the surface realization of any noun-noun compound. This is true of the noun compound in its isolation form and it is also true of the noun compound within a larger utterance when it appears utterance-finally. We can compare (252), where there is an utterance-final surface falling tone, with (253), where there is no utterance-final falling tone.

(252) / $^{M-}$ kōfí ɖū ōlā̋/
[kōfí ɖú ólâ̂]
Kofi eat meat
Kofi ate meat. sxw-L0021-other clauses-un.wav

(253) / $^{M-}$ kōfí ɖū ōɲī̄-lā̄ $^{H\omega}$/
[kōfí ɖú óɲī́-lā́]
Kofi eat cow-meat
Kofi ate beef. sxw-L0021-other clauses-un.wav

The difference is due to the right H_ω boundary that is generated on the noun-noun compound. As discussed in section 4.1.2, a right H_ω boundary is generated whenever there are two adjacent right-edge PW boundaries due to recursivity at the level of the PW—a structure represented as $]_{PW}]_{PW}$. Compounding involves this type of recursivity at the level of the PW, and therefore the right H_ω boundary is generated at the right edge of all noun-noun compounds. The assignment of the right H_ω boundary is the last operation that happens in the lexical stage prior to the application of postlexical tone rules. The derivations of (252) and (253) are as follows.

(254) Derivations of / $^{M-}$ kōfí ɖū ōlā̄/ and / $^{M-}$ kōfí ɖū ōɲī̄+ōlā̄/

/kōfí ɖū ōlā̄/	/kōfí ɖū ōɲī̄+ōlā̄/	Lexical forms
--	kōfí ɖū ōɲī̄-lā̄	Word-internal vowel elision
--	--	Word-initial vowel elision (opt.)
$^{M-}$ kōfí ɖū ōlā̄	$^{M-}$ kōfí ɖū ōɲī̄-lā̄	Left M- floating tone
--	$^{M-}$ kōfí ɖū ōɲī̄-lā̄ $^{H\omega}$	Right H_ω boundary assignment

TRANSITION FROM LEXICAL STAGE TO POSTLEXICAL STAGE

$^{M-}$ kōfí ɖū ōlâ̄	--	$L_{\%}$ association
--	--	Nominal floating H deletion
--	--	Contour simplification
--	--	Partial L spread
$^{M-}$ kōfí ɖú ólâ̄	$^{M-}$ kōfí ɖú óɲī́-lā́	Tonal spread
[kōfí ɖú ólâ̄]	[kōfí ɖú óɲī́-lā́]	Surface

Here we see that because of the presence of the right H_ω boundary on the noun compound, the utterance-final $L_{\%}$ IP boundary is prevented from associating to the final TBU of the compound. Without the association of this $L_{\%}$ boundary, there is no falling of pitch on the final TBU of the compound.

Continuing in the discussion of how the postlexical tone operations discussed in chapter 3 apply to noun compounds, I turn to the rules of Contour simplification. The rules of Contour simplification A and B (see (159) and (160)) state that following a H, an underlying LH contour is simplified by deleting the L. Following a M or L, an underlying LH contour is simplified by delinking the H.

Both rules of Contour simplification can be observed at work in noun-noun compounds. In (255), the initial vowel of the noun /ōvǐ/ 'child' is elided word-medially, so the LH contour immediately follows the H of /ōsɔ́/. As a result, we see that the underlying LH contour of /ōvǐ/ is simplified by deleting the L.

(255) /ōsɔ́/ + /ōvǐ/ $^{H\omega}$ horse+child [ōsɔ́-ví] baby horse
sxw-L0012-polymorphemic nouns-un.wav

In (256) and (257), the underlying LH contours of /ɛ̄dě/ 'palm' and /ōvǐ/ 'child' both follow an initial M vowel and are simplified by delinking the H.

(256) /ɛ̄dě/+ /ōtĩ́/ $^{H\omega}$ palm+tree [ɛ̄dè-tĩ́] palm tree
sxw-L0084-polymorphemic nouns-un.wav

(257) /ōvĩ̌/ + /ōnɔ̃̄ ^{H}/ $^{H\omega}$ child+mother [ōvì-nɔ̃̄°] young mother
sxw-L0172-polymorphemic nouns-un.wav

In both cases, a floating H is created when the H of the underlying LH contour is delinked. In (257), this floating H blocks Tonal spread (the last operation of the postlexical stage), which is why M is realized on the compound-final TBU.

There is, however, one way in which Contour simplification is slightly different for complex nouns than it is for monomorphemic nouns. When a word with a final underlying LH contour appears at the right edge of a complex noun which has a H_{ω} boundary, the LH contour does not undergo contour simplification if this would mean delinking the H. This is shown in (258) and (259).

(258) /ɛ̄sĩ̄/ + /ōɦũ̌/ $^{H\omega}$ water+drum (percussion) [ɛ̄sĩ̄-ɦũ̌] water drum
sxw-L0087-polymorphemic nouns-un.wav

(259) /āvɔ̀/ + /ōvǐ/ $^{H\omega}$ cloth+child [āvɔ̀-vǐ] handkerchief
sxw-L0070-polymorphemic nouns-un.wav

In each of these noun compounds, the underlying LH contour which follows a M or L is not simplified by delinking the H. Rather, the LH contour is realized at the surface level as a [LH] contour, a situation not seen in the monomorphemic data (compare with surface monomorphemic forms [ōɦũ̀^{R}] and [ōvì^{R}]).

The contour is not simplified in these cases because of the constraint against creating a floating H in an environment where a H_{ω} boundary already exists. There is an OCP-related sensitivity to adjacent unassociated H tones in Saxwe. Note that there is no corresponding sensitivity to adjacent unassociated M tones; tonal spread creates floating M tones adjacent to the M- floating tone on nouns. For L tone, the question of sensitivity to adjacent unassociated tones never arises because

L tones are never delinked from a TBU in Saxwe phonology; they are only ever deleted.

Continuing with the way postlexical tone operations are seen applied to noun compounds, we can also see that the rule of Partial L spread applies within noun compounds. The rule of Partial L spread states that when a L tone is followed by a H tone and there is a segment between the two tones which is voiced at the surface level, there is partial spread of L to the following H TBU. This results in a surface [LH] rising tone. This rising tone is seen in (260), where a voiced obstruent is between the L and H, and (261), where a sonorant is in a similar position.

(260)	/ōjɛ̀ ^{H}/ + /àdɔ́/ $^{H\omega}$	spider+nest	[jɛ̀-dɔ̌]	spider web
			sxw-L0211-polymorphemic nouns-un.wav	
(261)	/ōgã̀/ + /ōnṹ/ $^{H\omega}$	metal+thing	[gã̀-nũ̌]	metal bowl
			sxw-L0099-polymorphemic nouns-un.wav	

Finally, we can see examples of how Tonal spread is a relevant process within compounds. Tonal spread is the rightward spread of L or H to any adjacent M TBU, a process which delinks the M and leaves it floating. The following are all examples of Tonal spread within a compound.

(262) Tonal spread within noun compounds

a.	/ōló/ + /ōlã̄/ $^{H\omega}$	crocodile+meat	[ōló-lã́]	crocodile meat
			sxw-L0269-polymorphemic nouns-un.wav	
b.	/ōtĩ́/ + /ōkjɔ̃̄ ^{H}/ $^{H\omega}$	tree+root	[tĩ́-kjɔ̃́]	tree root
			sxw-L0190-polymorphemic nouns-un.wav	
c.	/ōgã̀/ + /ōkã̄/ $^{H\omega}$	metal+cord	[gã̀-kã̀°]	metal cable
			sxw-L0095-polymorphemic nouns-un.wav	
d.	/āzɔ̀/ + /āmã̄ ^{H}/ $^{H\omega}$	smoke+leaf	[zɔ̀-mã̀°]	tobacco
			sxw-L0219-polymorphemic nouns-un.wav	
e.	/ōdã̀/ + /ōlã̄/ $^{H\omega}$	snake+meat	[ōdã̀-lã̀°]	snake meat
			sxw-L0273-polymorphemic nouns-un.wav	

Again, because of the generation of the H_{ω} boundary tone and the subsequent failure of the $L_{\%}$ IP tone to associate TBU, there is no fall or downglide on the final TBU of any of these forms.

The following are paradigms of noun-noun compounds—some more natural than others—made with the possible combinations of tone patterns for monomorphemic nouns. The only compounds excluded are compounds containing words of the /M.H ^{M}/ tone pattern—due to the extreme rarity of that tone pattern.

(263) Compounds ending with a /M.H/ noun

a.	/āɖí/ + /ōfṹ/ $^{H\omega}$	soap+fur	[āɖí-fṹ]	soapsuds
		sxw-L0051-polymorphemic nouns-un.wav		
b.	/āfɔ̄/ + /ōkɔ́/ $^{H\omega}$	foot+sand	[āfɔ̄-kɔ́]	foot dirt
		sxw-L0053-polymorphemic nouns-un.wav		
c.	/ōkpō ^{H}/ + /ōtĩ́/ $^{H\omega}$	stick+tree	[kpō-tĩ́]	big stick
		sxw-L0139-polymorphemic nouns-un.wav		
d.	/ɛ̄dě/ + /ōtĩ́/ $^{H\omega}$	palm nut+tree	[ɛ̄dè-tĩ́]	palm tree
		sxw-L0084-polymorphemic nouns-un.wav		
e.	/āɦwà/ + /ōtĩ́/ $^{H\omega}$	locust bean+tree	[āɦwà-tĩ́]	locust bean tree
		sxw-L0059-polymorphemic nouns-un.wav		
f.	/ōtà ^{H}/ + /ōká/ $^{H\omega}$	head+calabash	[tà-ká]	skull
		sxw-L0188-polymorphemic nouns-un.wav		
g.	/àdó/ + /ōkpá/ $^{H\omega}$	mud wall+fence	[à-dǒ-kpá]	mud enclosure
		sxw-L0305-polymorphemic nouns-un.wav		

(264) Compounds ending with a /M.M/ noun

a.	/ōló/ + /ōlā̃/ $^{H\omega}$	crocodile+meat	[ōló-lã́]	crocodile meat
		sxw-L0269-polymorphemic nouns-un.wav		
b.	/ālī̃/ + /ōkā̃/ $^{H\omega}$	waist+cord	[ālī̃-kā̃°]	belt
		sxw-L0063-polymorphemic nouns-un.wav		
c.	/āmā̃ ^{H}/ + /ɛ̄sī̃/ $^{H\omega}$	leaf+water	[āmā̃-sī̃°]	herbal liquid
		sxw-L0299-polymorphemic nouns-un.wav		
d.	/āzĩ̌/ + /āmī̃/ $^{H\omega}$	peanut+oil	[āzĩ̀-mī̃°]	peanut oil
		sxw-L0075-polymorphemic nouns-un.wav		
e.	/ōgã̀/ + /ōkā̃/ $^{H\omega}$	metal+cord	[gã̀-kã̀°]	metal cable
		sxw-L0095-polymorphemic nouns-un.wav		
f.	/ōɦwè ^{H}/ + /ɛ̄sī̃/ $^{H\omega}$	fish+water	[òɦwè-sĩ̀°]	fish water
		sxw-L0300-polymorphemic nouns-un.wav		
g.	/àdó/ + /ōxɔ̄/ $^{H\omega}$	mud wall+room	[àdǒ-xɔ́]	mud building
		sxw-L0304-polymorphemic nouns-un.wav		

(265) Compounds ending with a /M.M ^{H}/ noun

a.	/ōtī́/ + /ōkjɔ̄̄ ^{H}/ $^{H\omega}$	tree+root	[tī́-kjɔ̄́]	tree root
		sxw-L0190-polymorphemic nouns-un.wav		
b.	/ɛ̄mɛ̄̄/ + /ōnɔ̄̄ ^{H}/ $^{H\omega}$	person+mother	[ɛ̄mɛ̄̄-nɔ̄̄°]	uterus
		sxw-L0086-polymorphemic nouns-un.wav		
c.	/ōsī ^{H}/ + /ōnɔ̄̄ ^{H}/ $^{H\omega}$	wife+mother	[sī-nɔ̄̄°]	mother-in-law
		sxw-L0180-polymorphemic nouns-un.wav		
d.	/ōvī̌/ + /ōnɔ̄̄ ^{H}/ $^{H\omega}$	child+mother	[ōvì-nɔ̄̄°]	mother of a child
		sxw-L0172-polymorphemic nouns-un.wav		
e.	/āzɔ̀/ + /āmā̄ ^{H}/ $^{H\omega}$	smoke+leaf	[zɔ̀-mā̀°]	tobacco
		sxw-L0219-polymorphemic nouns-un.wav		
f.	/ōɦwè ^{H}/ + /ōnɔ̄̄ ^{H}/ $^{H\omega}$	fish+mother	[ōɦwè-nɔ̄̀°]	fish mother
		sxw-L0301-polymorphemic nouns-un.wav		
g.	/òbó/ + /ōsī ^{H}/ $^{H\omega}$	disabled person +female	[òbǒ-sí]	disabled female
		sxw-L0303-polymorphemic nouns-un.wav		

(266) Compounds ending with a /M.LH/ noun

a.	/ōsɔ́/ + /ōvǐ/ $^{H\omega}$	horse+child	[ōsɔ́-ví]	baby horse
		sxw-L0012-polymorphemic nouns-un.wav		
b.	/ɛ̄sī̄/ + /ōɦū̌/ $^{H\omega}$	water+drum	[ɛ̄sī̄-ɦū̌]	water drum
		sxw-L0087-polymorphemic nouns-un.wav		
c.	/ōsī ^{H}/ + /ōvǐ/ $^{H\omega}$	wife+child	[āsī-vǐ]	wife's child
		sxw-L0068-polymorphemic nouns-un.wav		
d.	/ōgbě/ + /ōɦwǐ/ $^{H\omega}$	grass+knife	[gbè-ɦwǐ]	hunting knife
		sxw-L0117-polymorphemic nouns-un.wav		
e.	/āvɔ̀/ + /ōvǐ/ $^{H\omega}$	cloth+child	[āvɔ̀-vǐ]	handkerchief
		sxw-L0070-polymorphemic nouns-un.wav		
f.	/ōɦwè ^{H}/ + /ōɦǒ/ $^{H\omega}$	fish+money	[ōɦwè-ɦǒ]	budget for fish
		sxw-L0306-polymorphemic nouns-un.wav		
g.	/àgbā́/ + /ōɦǒ/ $^{H\omega}$	dish+money	[àgbā̌-ɦó]	budget for dishes
		sxw-L0307-polymorphemic nouns-un.wav		

(267) Compounds ending with a /M.L/ noun

a.	/ōfí̃/ + /āzɔ̀/ $^{H\omega}$	ashes+smoke	[fí̃-zɔ̀°]	dust
		sxw-L0089-polymorphemic nouns-un.wav		
b.	/ālɔ̄/ + /ōgà̃/ $^{H\omega}$	hand+metal	[ālɔ̄-gà̃°]	metal bracelet
		sxw-L0064-polymorphemic nouns-un.wav		
c.	/ōtū ^{H}/ + /ōdò/ $^{H\omega}$	rag+edge	[ōtū-dò°]	edge of rag
		sxw-L0308-polymorphemic nouns-un.wav		
d.	/ɛ̄dě/ + /āɦà̃/ $^{H\omega}$	palm+drink	[dè-ɦà̃°]	palm wine
		sxw-L0079-polymorphemic nouns-un.wav		
e.	/ōzò/ + /ōmɔ̃̀/ $^{H\omega}$	fire+machine	[zò-mɔ̃̀°]	mill
		sxw-L0218-polymorphemic nouns-un.wav		
f.	/ōɦɔ̃̀ ^{H}/ + /ōdò/ $^{H\omega}$	door+edge	[ōɦɔ̃̀-dò°]	edge of door
		sxw-L0310-polymorphemic nouns-un.wav		
g.	/àdó/ + /ōglì/ $^{H\omega}$	red mud+wall	[àdǒ-glì°]	mud wall
		sxw-L0311-polymorphemic nouns-un.wav		

(268) Compounds ending with a /M.L^{H}/ noun

a.	/ābɔ́/ + /ōtà ^{H}/ $^{H\omega}$	arm+head	[ābɔ́-tà°]	shoulder
		sxw-L0048-polymorphemic nouns-un.wav		
b.	/ōxɔ̄/ + /ōtà ^{H}/ $^{H\omega}$	room+head	[ōxɔ̄-tà°]	roof
		sxw-L0176-polymorphemic nouns-un.wav		
c.	/ōnɔ̃̄/ + /ōtà ^{H}/ $^{H\omega}$	mother+head	[ōnɔ̃̄-tà°]	his mother's head
		sxw-L0316-polymorphemic nouns-un.wav		
d.	/ōvũ̌/ + /ōtà ^{H}/ $^{H\omega}$	dog+head	[ōvũ̀-tà°]	dog head
		sxw-L0317-polymorphemic nouns-un.wav		
e.	/ōzò/ + /ōgò ^{H}/ $^{H\omega}$	fire+container	[zò-gò°]	pottery oven
		sxw-L0215-polymorphemic nouns-un.wav		
f.	/ōɦwè ^{H}/ + /ōtà ^{H}/ $^{H\omega}$	fish+head	[ōɦwè-tà°]	fish head
		sxw-L0318-polymorphemic nouns-un.wav		
g.	/òbó/ + /ōtà ^{H}/ $^{H\omega}$	handicapped person+head	[òbǒ-tà°]	head of handicapped person
		sxw-L0320-polymorphemic nouns-un.wav		

(269) Compounds ending with a /L.H/ noun

a.	/ōká/ + /àgbã́/ $^{H\omega}$	calebash+bowl	[ōká-gbã́]	calebash bowl
		sxw-L0321-polymorphemic nouns-un.wav		
b.	/āmĩ̄/ + /àgbã́/ $^{H\omega}$	oil+bowl	[āmĩ̄-gbã́][77]	oil bowl
		sxw-L0326-polymorphemic nouns-un.wav		
c.	/āmã̄ ^{H}/ + /ògbá/ $^{H\omega}$	leaf+hat	[āmã̄-gbá]	leaf hat
		sxw-L0327-polymorphemic nouns-un.wav		
d.	/ōgǎ/ + /ògbá/ $^{H\omega}$	leader+hat	[ōgà-gbǎ]	leader's hat
		sxw-L0328-polymorphemic nouns-un.wav		
e.	/āɦã̀/ + /àgbã́/ $^{H\omega}$	drink+bowl	[āɦã̀-gbã̌]	drink bowl
		sxw-L0332-polymorphemic nouns-un.wav		
f.	/ōjɛ̀ ^{H}/ + /àdɔ́/ $^{H\omega}$	spider+nest	[jɛ̀-dɔ̌]	spider web
		sxw-L0211-polymorphemic nouns-un.wav		
g.	/òdʒú/ + /ògbá/ $^{H\omega}$	rain+hat	[òdʒǔ-gbá]	rain hat
		sxw-L0333-polymorphemic nouns-un.wav		

Before closing this section on noun-noun compounds, I mention that we can see an interesting distinction made when we compare noun-noun compounds that include the noun /ōnɔ̃̄ ^{H}/ 'mother' with nouns that are derived by affixing the attributive suffix /-nɔ̃̄/ to a noun base. The attributive suffix /-nɔ̃̄/ has the meaning of "person characterized by X", if X is the noun of the base. This suffix is sometimes claimed to be derived historically from the word for 'mother'. The following are examples of nouns derived by affixation of the attributive suffix.

(270) Nouns derived with the attributive suffix /-nɔ̃̄/

a.	/ɛ̄fĩ̄/	theft-ATTRIB	[ɛ̄fĩ̄-nɔ̃̀]	thief
			sxw-L0009-polymorphemic nouns-un.wav	
b.	/ājā/	suffering-ATTRIB	[ājā-nɔ̃̀]	sufferer, poor person
			sxw-L0010-polymorphemic nouns-un.wav	
c.	/ōkpó/	mountain-ATTRIB	[ōkpó-nɔ̃̂]	person with a humpback
			sxw-L0014-polymorphemic nouns-un.wav	
d.	/ōfṹ/	fur-ATTRIB	[ōfṹ-nɔ̃̂]	hairy person
			sxw-L0015-polymorphemic nouns-un.wav	

These derived nouns, unlike the noun-noun compounds seen in this section, clearly do not have a right edge H_{ω} boundary tone. The right edge $L_{\%}$ IP boundary tone is free to associate to the final TBU of the word, causing a final falling tone to be observed. Affixes are not PWs and therefore the prosodic environment that would

[77] This and the following compound, [āmã̄-gbá], sometimes sound like they have a [MH] rising pitch on the final syllable.

generate a H_{ω} boundary (represented as $]_{PW}]_{PW}$) does not exist on the right edge of these derived forms.

This can be compared with noun-noun compounds that include the word 'mother'.

(271) Nouns compounds that include /ōnɔ̄̃ ^{H}/ 'mother'

a.	/ɛ̄mɛ̄̃/ + /ōnɔ̄̃ ^{H}/ $^{H\omega}$	person+mother	[ɛ̄mɛ̄̃-nɔ̄̃°]	uterus
		sxw-L0086-polymorphemic nouns-un.wav		
b.	/ōsī ^{H}/ + /ōnɔ̄̃ ^{H}/ $^{H\omega}$	wife+mother	[sī-nɔ̄̃°]	mother-in-law
		sxw-L0150-polymorphemic nouns-un.wav		
c.	/ōvǐ/ + /ōnɔ̄̃ ^{H}/ $^{H\omega}$	child+mother	[ōvì-nɔ̄̃°]	mother of a child
		sxw-L0172-polymorphemic nouns-un.wav		

For these compounds, no final fall is observed. The H_{ω} boundary is present, although its presence is in some ways redundant because the morpheme /ōnɔ̄̃ ^{H}/ also has a floating H in its lexically-assigned tone pattern. (Whether this is a coincidence or not is discussed in section 4.1.2.) What is interesting here is that if the suffix /-nɔ̄̃/ is historically derived from the word 'mother' /ōnɔ̄̃ ^{H}/, there has been a tonal change made to accommodate or reflect the fact that the suffix /-nɔ̄̃/ does not appear in a prosodic environment conditioning the presence of the H_{ω} boundary, while the morpheme 'mother' often does.

The issue of prosodic structure is also relevant in the examination of nominal forms derived through verbal reduplication, which is the topic of section 4.4.3.

4.4.3 Nouns derived through verbal reduplication

A process of reduplication can be applied to Saxwe verbs to generate either a nominal or an adjectival form. A reduplicated form that is nominal may include a complement or it may not. If the complement is included, it precedes the reduplicated verb. Often a generic complement such as /ōnǘ/ 'thing' or /ɛ̄mɛ̄̃/ 'person' will be used in the absence of a more specific complement.

When verbal reduplication is used to create an adjective, the adjective usually has a passive or stative interpretation. This deverbal adjective is often found in a position following the noun where it modifies the noun head.

The following are examples of verbal reduplication in Saxwe. Two possible meanings (depending on whether a nominal form or an adjectival form is created) are given.

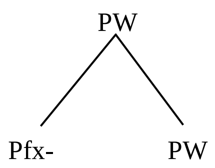
(272)	a.	/lī/	[ōnṹ lí-lí]	'grinding sth' or 'sth ground' sxw-L0007-verb reduplication-un.wav
	b.	/gɔ̀/	[ōnṹ gì-gɔ̀°]	'healing sth' or 'sth healed' sxw-L0011-verb reduplication-un.wav
	c.	/tʃĭ/	[ōnṹ tʃĭ-tʃĭ]	'turning sth off', or 'sth turned off' sxw-L0051-verb reduplication-un.wav
	d.	/gblĕ/	[ōnṹ gbí-gblé]	'ruining sth' or 'sth ruined' sxw-L0039-verb reduplication-un.wav

The reduplication template, which is the same for either the nominal or adjectival variant, is a C/i/- prefix. If the verb begins with a consonant cluster, only the initial consonant of the verb stem is copied to this prefix, as seen in [ōnṹ gbí-gblé] 'something ruined', derived from the verb /gblĕ/ 'ruin'. The prefix vowel is [i] unless the verb stem contains the vowel [u]. In the latter case, the prefix vowel becomes [u] by spread of the feature [back]. This is seen in [ōnṹ ɦũ̀-ɦũ̀°] 'opening something/something opened', derived from the verb /ɦũ̀/ 'open'.

For some speakers, the reduplication prefix becomes nasalized by spread of the feature [nasal] if the verb stem is nasalized. For speakers for whom nasal harmony is a normal part of this process, the verb /kã̄/ 'search for' would give [ōnṹ kĩ́-kã́] 'searching for something/something searched for'. Otherwise, the reduplicated form would be [ōnṹ kí-kã́]. The consultant whose data are used in this section varies between no nasalization and light nasalization on the prefix.

Words derived through verbal reduplication, like noun compounds, show evidence of having a H_ω PW boundary on their right edge; when these forms are pronounced in isolation or clause-finally, they are never realized with a final fall or downglide in pitch. This can be explained by looking at the prosodic structure of a reduplicated verbal form.

(273) Prosodic structure in verbal reduplication



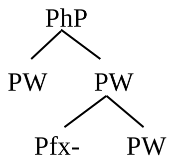
This prosodic structure has two adjacent PW boundaries at its right edge because of recursivity at the level of the PW. This is the environment in which a H_ω boundary is generated in Saxwe (see section 4.1.2). It is therefore consistent that any form (nominal or adjectival) derived through verbal reduplication should have a right H_ω boundary.

When we look further up in the prosodic structure, we see that the noun modified by the deverbal adjective (*e.g.* 'something healed') can have the structure in

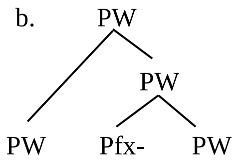
(274)a, while the nominalization which includes a complement (*e.g.* 'healing something') can have the structure in (274)b.

(274) Prosody of (a) noun with deverbal modifier *vs.* (b) nominalization incorporating a complement

a.



b.



When the C/i/- template is prefixed to the verb stem, the tone of the verb stem is copied onto the TBU of the C/i/- prefix and the H_{ω} boundary is generated during the lexical stage. Following this, both TBUs in the reduplicated form are submitted to the same postlexical derivational rules as any other form. The following are the derivations of (272)a and (272)d.

(275) Derivations of [ōnṹ lí-lí] and [ōnṹ gbí-gblé]

/ōnṹ [C]i-lī/	/ōnṹ [C]i-gblě/	Underlying
ōnṹ lī-lī	ōnṹ gbǐ-gblě	Copy initial C and tone to prefix
--	--	Word-internal vowel elision
--	--	Word-initial vowel elision (opt.)
--	--	Left M- floating tone
ōnṹ lī-lī $^{H\omega}$	ōnṹ gbǐ-gblě $^{H\omega}$	Right H_{ω} boundary assignment

TRANSITION FROM LEXICAL STAGE TO POSTLEXICAL STAGE

--	--	$L_{\%}$ association
--	--	Nominal floating H deletion
--	ōnṹ gbí-gblé $^{H\omega}$	Contour simplification
--	--	Partial L spread
ōnṹ lí-lí $^{H\omega}$	--	Tonal spread
[ōnṹ lí-lí]	[ōnṹ gbí-gblé]	Surface

So far, we have seen examples of nominalization where the complement is included in the nominalized form together with the reduplicated verb. However, nominalization through the process of verbal reduplication does not always have to include a complement.

For example, a reduplicated verb can be followed by the determiner /lá/ and can be interpreted in one of two ways. First, it can reference a discourse-specific action nominalization, as in (276)b and d. In these utterances, the object on which the action is performed is assumed to be understood from the context of the utterance. Second, it can be interpreted as a nominalized form of the deverbal adjective, as in (276)a and c.

In both cases, the bare reduplicated form now functions syntactically as the head of the noun phrase. This being the case, we see a left M- floating tone on the noun (see section 4.3).

(276) Reduplicated forms that appear alone as head of the NP

a.	/$^{M-}$ lī-lī $^{H\omega}$/	[é kpɔ̃́ <u>lílí</u> ↓lá]	'He saw the ground [one].' sxw-L0073-verb reduplication-un.wav
		[jē xɔ̄ <u>līlī</u> lá]	'They bought the ground [one].' sxw-L0074-verb reduplication-un.wav
b.	/$^{M-}$ gì-gɔ̀ $^{H\omega}$/	[é kpɔ̃́ <u>gìgɔ̀</u> là°]	'He saw the healing.' sxw-L0071-verb reduplication-un.wav
		[jē sē <u>gìgɔ̀</u> là°]	'They heard about the healing.' sxw-L0072-verb reduplication-un.wav
c.	/$^{M-}$ tí-tá $^{H\omega}$/	[é kpɔ̃́ <u>↓títá</u> lá]	'He saw the drawn [one].' sxw-L0077-verb reduplication-un.wav
		[jē xɔ̄ <u>títá</u> lá]	'They bought the drawn [one].' sxw-L0078-verb reduplication-un.wav
d.	/$^{M-}$ zǐ-zã̌ $^{H\omega}$/	[é kpɔ̃́ <u>zìzã̌</u> lá]	'He saw the mistreating.' sxw-L0081-verb reduplication-un.wav
		[jē sē <u>zìzã̌</u> lá]	'They heard about the mistreating.' sxw-L0082-verb reduplication-un.wav

The presence of this left M- floating tone is detected by its role in triggering: (1) the non-automatic downstep observed in (276)c, and (2) the delinking of the H of the LH contour in (276)d. The following are the derivations of (276)c and d.

(277) Derivations of [é kpɔ̃́ ↓<u>títá</u> lá] and [é kpɔ̃́ <u>zìzã̌</u> lá]

/$^{\text{M-}}$ é kpɔ̃̄ [C]i-tá lá/	/ $^{\text{M-}}$ é kpɔ̃́ [C]i-zã̌ lá/	Underlying
$^{\text{M-}}$ é kpɔ̃̄ tí-tá lá	$^{\text{M-}}$ é kpɔ̃́ zǐ-zã̌ lá	Copy initial C and tone to prefix
--	--	Word-internal vowel elision
--	--	Word-initial vowel elision (opt.)
$^{\text{M-}}$ é kpɔ̃̄ $^{\text{M-}}$ tí-tá lá	$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ zǐ-zã̌ lá	Left M- floating tone on nouns
$^{\text{M-}}$ é kpɔ̃̄ $^{\text{M-}}$ tí-tá $^{H\omega}$ lá	$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ zǐ-zã̌ $^{H\omega}$ lá	Right H_ω boundary assignment

TRANSITION FROM LEXICAL STAGE TO POSTLEXICAL STAGE

--	--	$L_\%$ association
--	--	Nominal floating H deletion
--	$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ zì-zã́ $^{H\omega}$ lá	Contour simplification
--	$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ zì-zã̌ $^{H\omega}$ lá	Partial L spread
--	--	Tonal spread
[é kpɔ̃́ ↓títá lá]	[é kpɔ̃́ zìzã̌ lá]	Surface

To summarize, we see that a nominal form derived from a verb without an accompanying complement has two different PW boundaries generated on it for two different reasons. It has a left M- floating tone because it is functioning syntactically as the head of a noun phrase (section 4.3). It has a right H_ω boundary because it has at its right edge two adjacent PW brackets (adjacent because of recursivity at the level of the PW).

We now have all the background necessary for looking at the isolation forms of derived nouns which are created though a process of verbal reduplication and which do not include a complement.

(278) Isolation forms: nouns derived from verbs by reduplication

a.	$^{\text{M-}}$ /jī-jī/ $^{H\omega}$	[jī-jī°]	'going/travel'
		sxw-L0103-verb reduplication-un.wav	
b.	$^{\text{M-}}$ /gbɪ̃̀-gbɔ̃̀/ $^{H\omega}$	[gbɪ̃̀-gbɔ̃̀°]	'returning/return'
		sxw-L0104-verb reduplication-un.wav	
c.	$^{\text{M-}}$ /sɪ̃́-sɔ̃́/ $^{H\omega}$	[sɪ̃́-sɔ̃́]	'leaving/departure'
		sxw-L0105-verb reduplication-un.wav	
d.	$^{\text{M-}}$ /vǐ-vǎ/ $^{H\omega}$	[vì-vǎ]	'coming/arrival'
		sxw-L0106-verb reduplication-un.wav	

In these isolation forms, the M- floating tone triggers the delinking of the H of the underlying LH contour in (278)d. The H_ω boundary accounts for the absence of final pitch fall on all forms.

This ends the discussion of verbal reduplication involving a reduplication prefix. I turn now to the discussion of another kind of reduplication which applies to other word classes and which involves a process of copying rather than prefixation.

4.5 Reduplication by copy rather than by prefixation

There is a second process of reduplication in Saxwe that is unlike the verbal reduplication discussed in section 4.4.3. In this section, I describe a type of reduplication which is not limited to verbs and does not involve a reduplication prefix. In this process of reduplication, a copy is made of a word and the two copies are juxtaposed.

The kind of reduplication I discuss here is a subgroup of forms created by a phenomenon Ameka (1999) describes as 'syntactic iteration'—the repetition of words or phrases for a number of reasons, including to express intensity, emphasis, serial ordering, multiplicity, repetition, and durativity (p. 82-84). This kind of repetition is applied to words of various classes, including nouns, adjectives, numerals, adverbs, and ideophones serving various syntactic functions. Here, I look only at the forms that involve the copying of a single morpheme.

What is interesting from a tonal point of view is that in these cases of reduplication by copy, there is evidence of a floating M between the two copies of the word which is being reduplicated. The following are some examples of this type of reduplication. The left column shows the likely etymology of the forms which clearly have undergone this process of reduplication by copy, but which do not have an obvious stem form in the lexicon.

(279) Word reduplication by copy with intervening floating M

a.	/āgɔ̀/ tardiness	[jē sɔ̃́ ágɔ̀-àgɔ̀] they left very late	sxw-L0020-alternate reduplication-un.wav
b.	/ōbú/ that which is other	[ōnṹ bú-ꜜbú] different things	sxw-L0027-alternate reduplication-un.wav
c.	/āmṹ/ that which is raw	[ōnṹ mṹ-ꜜmṹ] a raw thing	sxw-L0033-alternate reduplication-un.wav
d.	/ɖ̯ókpó/ one	[jē sɔ̃́ ɖ̯ókpó-ꜜɖ̯ókpó] they left one by one	sxw-L0028-alternate reduplication-un.wav
e.	*etymology unknown*	[ōnṹ tó-ꜜtó] an empty thing	sxw-L0024-alternate reduplication-un.wav

f.	*etymology unknown*	[ōnṹ mã́-ꜜmã́] a naked thing	sxw-L0031-alternate reduplication-un.wav
g.	*etymology unknown*	[jē sɔ̃́ kpɔ́-ꜜkpɔ́] they left together	sxw-L0035-alternate reduplication-un.wav
h.	/ɖāxó/ big	[ōnṹ ɖáꜜxó-ɖáꜜxó] a very big thing	sxw-L0023-alternate reduplication-un.wav
i.	/tɛ̄gbɛ̀/ always	[jē nɔ̃̄ sɔ̃́ tɛ́gbɛ̀-tɛ̀gbɛ̀] they (HAB) always leave	sxw-L0030-alternate reduplication-un.wav

In (279)a-c, the morpheme which has been reduplicated to create an adjectival or adverbial form has a stem which is a noun. This type of reduplication is not a productive process. In (279)d, a numeral has been reduplicated. This is a very productive process for indicating serial ordering (*e.g.* 'two-by-two'). In (279)e-g, the etymology of these reduplicated adjectival and adverbial forms is unknown. However, it is clear that reduplication has occurred. In (279)h-i, an adjective or adverb is copied to express intensity or emphasis. This is a productive process.

In all cases, there is a floating M between the two copies of the morpheme. In (279)b-g, this floating M triggers non-automatic downstep at the boundary between the two morphemes, since there are Hs on both sides of the boundary.

To summarize the differences between this reduplication and the verbal reduplication discussed in section 4.4.3, we see that in this process of reduplication by copy, there is no templatic reduplication prefix. The morpheme or word is copied in its entirety. There is, however, a floating M inserted between the two copies. Postlexical tonal operations are applied to these forms as they are elsewhere.

4.6 Pronominal suffixes affixed to the verb

Another topic where we see tone-related morphophonological processes at work in Saxwe is the affixation of certain pronominal suffixes to the verb. When a Saxwe verb is followed by the first singular (1SG) or third singular (3SG) object pronoun, the form that represents this object is a suffix vowel which is, to a great degree, unspecified as to its segmental features.

4.6.1 First person singular object suffix

The data in (280) illustrate what happens when the 1SG pronominal suffix is affixed to a verb stem. The underlying form shows the final vowel of the verb in isolation, while the second form shows the result following suffixation.

(280) Verb followed by 1SG pronominal suffix

a.	/s**í**/ → [é s**jû:**]	he respected me	sxw-L0030-verb plus pronoun-un.wav
b.	/w**ĩ́**/→ [é w̃**jũ̂:**]	he awakened me	sxw-L0032-verb plus pronoun-un.wav
c.	/kp**é**/ → [é kp**jô:**]	he met me	sxw-L0034-verb plus pronoun-un.wav
d.	/gb**ɛ̌**/ → [é gb**jɔ̂:**]	he refused me	sxw-L0036-verb plus pronoun-un.wav
e.	/ɦ**ɛ̃̀**/→ [é ɦ**jɔ̃̀:**]	he supported me	sxw-L0038-verb plus pronoun-un.wav
f.	/b**ú**/ → [é b**û:**]	he lost me	sxw-L0040-verb plus pronoun-un.wav
g.	/z**ũ̀**/→ [é z**ũ̀:**]	he insulted me	sxw-L0042-verb plus pronoun-un.wav
h.	/k**ó**/ → [é k**ô:**]	he laughed at me	sxw-L0044-verb plus pronoun-un.wav
i.	/s**ɔ́**/ → [é s**ɔ̂:**]	he took me	sxw-L0046-verb plus pronoun-un.wav
j.	/kp**ɔ̃́**/ → [é kp**ɔ̃̂:**]	he saw me	sxw-L0048-verb plus pronoun-un.wav
k.	/t**á**/ → [é t**â:**]	he drew me	sxw-L0052-verb plus pronoun-un.wav
l.	/f**ã́**/ → [é f**ã̂:**]	he embraced me	sxw-L0054-verb plus pronoun-un.wav

In (280), we see that following affixation of the 1SG pronominal suffix, all of the resulting forms end in a back vowel. The height of the vowel in the morphologically complex form is the same as the height of the vowel in the isolation form of the verb. If the verb in isolation is nasalized, the morphologically complex form is also nasalized. We also see that the vowel of the morphologically complex form is slightly lengthened.

Looking at tone, we see that if the verb in isolation has H tone, the tone of the morphologically complex form has a surface [HL] contour utterance-finally. If the verb has L tone, the tone of the morphologically complex form is surface [L] utterance-finally.

The following is the Saxwe vowel inventory copied from section 1.6.[78]

[78] In section 1.6, I discuss arguments for why [ɛ] is considered the completely underspecified vowel.

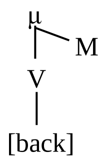
Table 5 - Saxwe vowel inventory (repeated)

			[back]			
		[nasal]		[nasal]	[round]	
						[nasal]
[high]	i	ĩ			u	ũ
[ATR]	e				o	
	ɛ	ɛ̃			ɔ	ɔ̃
[low]			a	ã		

Note that the vowel [a] in Saxwe is specified as [back] in the lexicon and that not all [back] vowels are [round]. This is an important aspect of the distribution of Saxwe vowels that plays into the analysis of pronominal affixation to the verb.

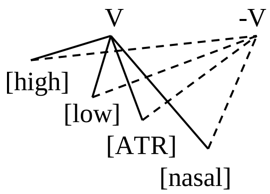
The 1SG pronominal suffix is comprised of a mora associated to M tone and a vowel segment that is linked only to the feature [back]. Thus we have the structure in (281) for the 1SG pronominal suffix.

(281) 1SG pronominal suffix



The features [high], [low], [ATR], and [nasal] are spread rightward from the nucleus of the verb to the suffix. The following is the lexical rule of Feature spread which describes this.

(282) Feature spread (lexical)

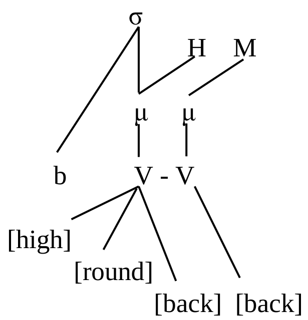


This rule states that the features [high], [low], [ATR], and [nasal] are spread rightward at the boundary beween a vowel and a following affixed vowel.

The following is the lexical derivation of /bú/ 'lose', which has the surface form [bû:] 'lose-1SG' utterance-finally once the 1SG pronominal suffix is attached.

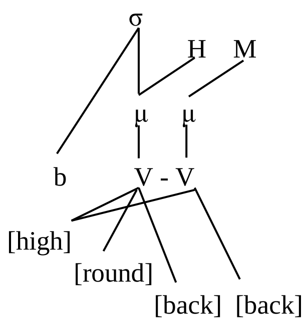
(283) Verb /bú/ + 1SG pronominal suffix V̄[back] → [bû:]

a.



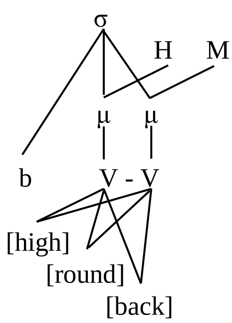
Input to lexical stage

b.



Feature spread

c.



Default rounding and resyllabification

In (283)b, lexical Feature spread causes the feature [high] to become associated to the vowel of the suffix. Following this, the feature [round] is assigned by default to the suffix, since the inventory of vowels has no other option for a [back], [high] vowel. Then all adjacent identical features are merged in accordance with the OCP, and the suffix vowel is incorporated into the syllable, giving at the output from the lexical stage the structure shown in (283)c, where the presence of two moras produces lengthening in the syllable. This is the clearest case of evidence in the language for the claim that the mora, rather than the syllable, is the TBU.

Postlexically, if the structure in (283)c is utterance-final, $L_{\%}$ association (94) will cause the final TBU to be associated to a right $L_{\%}$ IP boundary and Tonal spread (72) will spread the H tone, delinking the M. This creates a final surface [HL] contour. [79]

On the other hand, if the structure in (283)c is utterance-medial and followed by a H tone, Tonal spread still spreads the H, the M tone from the pronominal suffix is delinked, and the resulting floating M triggers non-automatic downstep between the two Hs during the phonetic implementation. This is seen by comparing (284) with (285) and (286) with (287).

(284)	/$^{\text{M-}}$ é	bú=V̄[back]/	
	[é	bû:]	
	3SG	lose-1SG	
	He lost me. sxw-L0040-verb plus pronoun-un.wav		

(285)	/$^{\text{M-}}$ é	bú=V̄[back]	fí/
	[é	bú:	$^{\downarrow}$fí] [80]
	3SG	lose-1SG	now
	He lost me just now. sxw-L0069-verb plus pronoun-un.wav		

(286)	/$^{\text{M-}}$ é	kó=V̄[back]/	
	[é	kô:]	
	3SG	laugh.at-1SG	
	He laughed at me. sxw-L0044-verb plus pronoun-un.wav		

(287)	/$^{\text{M-}}$ é	kó=V̄[back]	fí/
	[é	kó:	$^{\downarrow}$fí]
	3SG	laugh.at-1SG	now
	He laughed at me just now. sxw-L0070-verb plus pronoun-un.wav		

Here we see that if a H verb is followed by the 1SG suffix and then another H morpheme, the second H (that following the suffix) is downstepped by the floating M of the pronominal suffix.

---

[79] Note that there is no right H_{ω} boundary on this form in (283)b. As discussed in section 4.1.2, affixes are not PWs in Saxwe phonology and therefore the conditioning environment for the generation of the H_{ω} boundary—adjacent right edge $]_{PW}]_{PW}$ brackets—is not present in this case.

[80] This can also be compared to [é bú fí] 'He got lost just now', where pronominal suffix is absent.

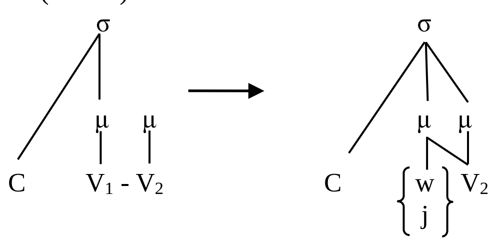
I return now to the data from (280), focusing on verb stems that have a vowel not specified for the feature [back]. For ease of reference, these are repeated in (288).

(288) Verbs with a front vowel followed by 1SG pronominal suffix

a.	/s**í**/ → [é s**jû:**]	he respected me	sxw-L0030-verb plus pronoun-un.wav
b.	/w**ĩ́**/→ [é w̃**jũ̂:**]	he awakened me	sxw-L0032-verb plus pronoun-un.wav
c.	/kp**é**/ → [é kp**jô:**]	he met me	sxw-L0034-verb plus pronoun-un.wav
d.	/gb**ɛ̌**/ → [é gb**jɔ̂:**]	he refused me	sxw-L0036-verb plus pronoun-un.wav
e.	/ɦ**ɛ̃̀**/→ [é ɦ**jɔ̃̀:**]	he supported me	sxw-L0038-verb plus pronoun-un.wav

In the course of the resyllabification that follows Feature spread, the first of two non-identical vowels in the morphologically complex form is strengthened so that it is realized as a glide. The rule of lexical Glide formation is shown in (289).

(289) Glide formation (lexical)



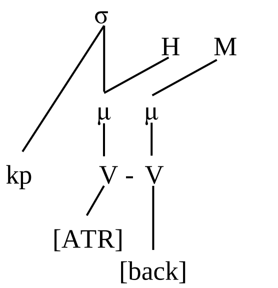
(if V_1 is [round] ⊃ glide is [w]; otherwise glide is [j])

This rule of lexical Glide formation states that when non-identical vowels are incorporated into a single syllable, the first vowel is strengthened to a glide—[w] if the vowel is [round] and [j] otherwise.

For illustration purposes, I show the lexical derivation of the combination of the verb /kpé/ 'meet' followed by the 1SG pronominal suffix.

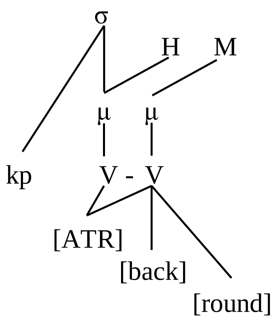
(290) Verb /kpé/ + 1SG pronominal suffix V̄[back] → [kpjô:]

a.



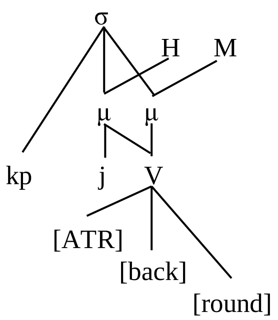
Input to lexical stage

b.



Feature spread and default rounding

c.



Glide formation and resyllabification

Here we see that the suffix vowel which is preassigned the feature [back] and gains the feature [ATR] by Feature spread is again assigned the feature [round] by default. Following this, the vowel of the verb stem is strengthened to become a glide. Because it is not a [round] vowel itself, it becomes the palatal sound [j].

When the verb stem vowel is strengthened, the tone associated to its mora is not lost. Instead, that mora and its associated tone is linked to the final vowel in the polymorphemic form. At the postlexical stage, if the structure in (290)c is utterance-final, $L_{\%}$ association (94) will first cause the final TBU to be associated to a right $L_{\%}$ IP boundary and then Tonal spread (72) will spread the H tone, delinking the M. This creates a final surface [HL] contour. If there is a H following the structure in (290)c, Tonal spread will spread the H tone, delinking the M. This floating M between Hs will trigger non-automatic downstep in the phonetic implementation.

Having looked at the 1SG pronominal suffix, we turn now to the 3SG pronominal suffix. Most of the phenomena observed in the affixation of the 3SG suffix can be explained given the rules developed in the study of the 1SG suffix.

4.6.2 Third person singular object suffix

When a verb is followed by the 3SG pronominal suffix, the following paradigm is observed.

(291) Verb followed by 3SG pronominal suffix

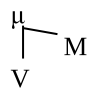
a.	/tʃ**í**/ → [é tʃ**î:**]	he turned it off	sxw-L0001-verb plus pronoun-un.wav
b.	/w**ĩ́**/→ [é w̃**ĩ̂:**]	he awakened it	sxw-L0003-verb plus pronoun-un.wav
c.	/fl**é**/ → [é fl**ê:**]	he husked it	sxw-L0005-verb plus pronoun-un.wav
d.	/b**ɛ́**/ → [é b**ɛ̂:**]	he gathered it	sxw-L0007-verb plus pronoun-un.wav
e.	/tl**ɛ̃́**/→ [é tɾ**ɛ̃̂:**]	he ripped it	sxw-L0009-verb plus pronoun-un.wav
f.	/b**ú**/ → [é b**wî:**]	he lost it	sxw-L0013-verb plus pronoun-un.wav
g.	/t**ũ̄**/→ [é t**wĩ̂:**]	he untied it	sxw-L0015-verb plus pronoun-un.wav
h.	/t**ó**/ → [é t**wê:**]	he pounded it	sxw-L0018-verb plus pronoun-un.wav
i.	/s**ɔ́**/ → [é s**wɛ̂:**]	he took it	sxw-L0020-verb plus pronoun-un.wav
j.	/kp**ɔ̃́**/ → [é kp**wɛ̃̂:**]	he saw it	sxw-L0022-verb plus pronoun-un.wav
k.	/t**á**/ → [é t**jɛ̂:**]	he drew it	sxw-L0024-verb plus pronoun-un.wav
l.	/kp**ã́**/ → [é kp**jɛ̃̂:**]	he carried him on his back	sxw-L0026-verb plus pronoun-un.wav

Here we see that the morphologically complex form always ends with a front vowel. Once again the suffix is realized at the same height as the vowel of the verb stem except in cases where the verb stem ends with [a]. In these cases, the final vowel of the morphologically complex form is [ɛ]. If the verb has a nasalized vowel, the morphologically complex form also has a nasalized vowel. In all cases, there is slight lengthening of the vowel in the morphologically complex form.

Tonal behavior related to the affixation of the 3SG suffix is the same as that seen in the affixation of the 1SG suffix in section 4.6.1. For instance, if the isolation verb is H, the morphologically complex form will be realized with a [HL] contour tone utterance-finally.

The 3SG suffix is a vowel completely unspecified for features which is associated to a mora that has M tone lexically assigned to it. This is seen in (292).

(292) 3SG pronominal suffix

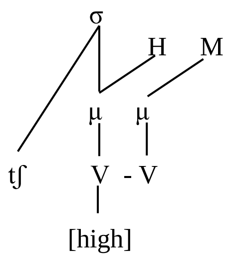


As with the 1SG suffix, for the 3SG suffix, lexical Feature spread (282) is the operation which causes the features [high], [low], [ATR], and [nasal] to be spread to the suffix vowel from the vowel of the verb stem. Logically, because they do not participate in this spreading process and they cannot originate from the suffix vowel, we find that the features [back] and [round] are absent from all 3SG suffix vowels.

If we take the form [tʃĭː] 'turn off-3SG', derived from the verb /tʃĭ/ in (291)a, we have the following derivational structures.

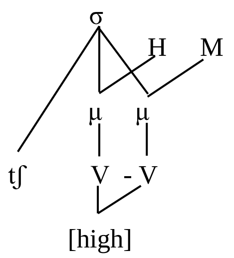
(293) Verb /tʃĭ/ + 3SG pronominal suffix V̄ → [tʃĭː]

a.



Input to lexical stage

b.



Feature spread
and resyllabification

The lexical operation Feature spread causes the feature [high] to be shared by both vowel segments. During syllabification, the suffix vowel is incorporated into the syllable. Because the two vowels share identical features, the rule of Glide formation does not effect any change. The result is a morphologically complex form with slight vowel lengthening.

When the verb stem has the vowel [a] or [ã], as in (291)k and l, application of the lexical rule of Feature spread becomes slightly more complicated. Of the features specified for [a] and [ã]—that is, [back], [low] and, in the latter case, [nasal]—only the features [low] and [nasal] would be eligible to participate in

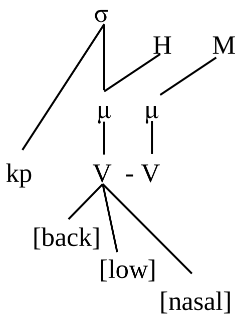
Feature spread. However, the spread of [low] would create a conflict, as there is no vowel in the Saxwe inventory which is [low] but not also [back].

The feature [back] cannot be assigned by default to resolve this problem, as happens for the feature [round] in (283)c and (290)b, because the very absence of the feature [back] is the single thing that differentiates the 3SG suffix from the 1SG suffix. Therefore, due to a constraint that prevents this impossible and unresolvable feature combination, [low] is simply not spread. In the absence of any feature specifications, the suffix vowel is realized as [ɛ], which is the completely unspecified vowel in Saxwe. If the single feature [nasal] is specified, the realization of the suffix vowel is [ɛ̃].

The following is the derivation of the form [kpjɛ̃̂ː] 'carry on back-3SG', which comes from the affixation of the 3SG suffix to the verb [kpã́] 'carry on the back'.

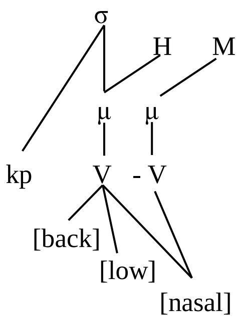
(294) Verb /kpã́/ + 3SG pronominal suffix V̄ → [kpjɛ̃̂ː]

a.



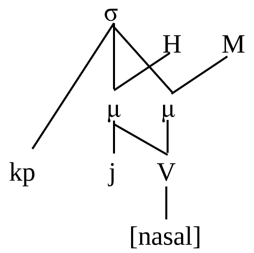
Input to the lexical stage

b.



Feature spread
([low] prohibited from spreading)

c.



Glide formation
and resyllabification

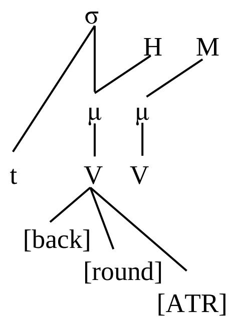
In (294)b, we see that the feature [low] is not permitted to spread because its spread would create a non-existent and unresolvable feature assignment. This being the case, the suffix vowel remains unspecified for all features but [nasal] (the one feature that does spread), and the vowel is realized [ɛ̃]. The stem vowel of the verb is [ã]. During glide formation, this vowel becomes [j] because it is not specified as having the feature [round].

Here in (294) is where the feature [round] becomes especially relevant as a phonologically active feature having a role which is different from the role of the feature [back]. The stem vowel [ã] is clearly [back]; if it were not, there would be no conflict during the affixation of the 3SG suffix; this suffix would be realized [ã] instead of [ɛ̃]. However, despite being [back], the stem vowel [ã] becomes [j] during the operation Glide formation, and not [w] as do the other [back] vowels.

To see an example of a [back] stem vowel that becomes [w] as a result of Glide formation, we can look at a different example, that of [twê:] 'pound-3SG'. This polymorphemic form results from the affixation of the 3SG pronominal suffix to the verb [tó] 'pound'.

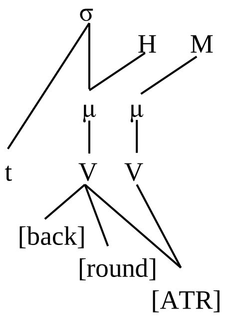
(295) Verb /tó/ + 3SG pronominal suffix V̄ → [twê:]

a.



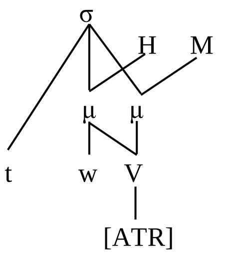
Input to the lexical stage

b.



Feature spread

c.



Glide formation
and resyllabification

During the operation Glide formation, the vowel of the verb stem is changed to [w] because the feature [round] is associated to the verb stem vowel.

Postlexically, the tonal behavior of the 3SG pronominal suffix is the same as that of the 1SG pronominal suffix. That is, if the structure in (295)c is utterance-final, $L_{\%}$ association (94) will cause the final TBU to be associated to a right $L_{\%}$ IP boundary and Tonal spread (72) will spread the H tone, delinking the M and resulting in a final surface [HL] contour. If the structure is not utterance-final, any following H tone will be realized as a downstepped H; Tonal spread will spread the H tone and the floating M will be the trigger for non-automatic downstep in the phonetic implementation.

4.7 Nouns borrowed from English

Words borrowed into Saxwe from European languages come mainly from three sources: English (likely Ghanaian or Nigerian English), French, and Portuguese. The majority of the borrowed words that I have in my data are borrowed from English, so I will focus primarily on those in this section.

When words are borrowed from English, closed syllables are resyllabified into open syllables, often by the addition of an epenthetic vowel—usually [u] if the preceding vowel is rounded and [i] if the preceding vowel is unrounded. Words that end orthographically in *er* in English are pronounced with a final [a].

The default tonal assignment for borrowed words is that the nucleus of a syllable that would normally bear primary stress in the original language is assigned

H tone and the nuclei of all other syllables are assigned L tone. This is seen in the following examples. In all of these examples, primary stress (and therefore H tone) falls on a non-final syllable of the word.

(296) Borrowed nouns—H on non-final syllable, L elsewhere

a.	/ $^{M-}$ bíjà/	[bíjà]	beer	sxw-L0008-borrowed words-un.wav
b.	/ $^{M-}$ bɔ́lù/	[bɔ́lù]	ball	sxw-L0010-borrowed words-un.wav
c.	/ $^{M-}$ kábìtà/	[kábìtà]	carpenter	sxw-L0011-borrowed words-un.wav
d.	/ $^{M-}$ zígì/	[zígì]	roofing (zinc)	sxw-L0016-borrowed words-un.wav
e.	/ $^{M-}$ kótù/	[kótù]	coat	sxw-L0015-borrowed words-un.wav
f.	/ $^{M-}$ fádà/	[fádà]	priest (Father)	sxw-L0012-borrowed words-un.wav
g.	/ $^{M-}$ ɦlɔ́bà/	[ɦlɔ́bà]	rubber, plastic	sxw-L0021-borrowed words-un.wav
h.	/ $^{M-}$ tʃɛ̃́dʒì/	[tʃɛ̃́dʒì]	change	sxw-L0022-borrowed words-un.wav
i.	/ $^{M-}$ sɔ́dʒà/	[sɔ́dʒà]	soldier, police	sxw-L0023-borrowed words-un.wav
j.	/ $^{M-}$ télà/	[télà]	tailor	sxw-L0025-borrowed words-un.wav
k.	/ $^{M-}$ tájà/	[tájà]	tire	sxw-L0028-borrowed words-un.wav
l.	/ $^{M-}$ sóɖà/	[sóɖà]	baking soda	sxw-L0040-borrowed words-un.wav
m.	/ $^{M-}$ bɔ́tà/	[bɔ́tà]	butter, margarine	sxw-L0030-borrowed words-un.wav
n.	/ $^{M-}$ kã́tà/	[kã́tà]	vending table (counter)	sxw-L0033-borrowed words-un.wav
o.	/ $^{M-}$ kàtàpílà/	[kàtàpílà]	bulldozer (Caterpillar)	sxw-L0006-borrowed words-un.wav
p.	/ $^{M-}$ kã̀tátà/	[kã̀tátà]	drama, play (cantata)	sxw-L0034-borrowed words-un.wav

Here we see that consonant quality of the syllable onset plays no role in the assignment of tone in borrowed words. Syllables that begin with voiced obstruents do not necessarily have L tone assigned to them, and L tone is present in many syllables that do not begin with a voiced obstruent.

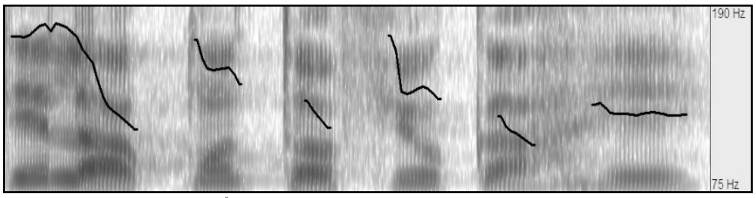
A L which is assigned to a borrowed word interacts with other tones in a manner which is just like any other L in the language. The L on a borrowed word blocks H spread, and any following H is realized at a level which is automatically downstepped in the phonetic implementation. This is seen in (297).

(297) /ᴹ⁻ télà kpɔ̃́ ᴹ⁻ tɔ̀fjókà xé/

[télà kpɔ̃́ tɔ̀fjókà xé]

tailor see tapioca this

A tailor found this tapioca. sxw-L0076-register tests-un.wav



Also, the determiner [lá] is realized with a surface L following these words, just as it is when it follows a noun of the /M.L/ tone pattern (see section 3.7). This is seen below.

(298) Nouns borrowed from English followed by determiner [lá]

a.	[bíjà là°]	the beer	sxw-L0103-borrowed words-un.wav
b.	[bɔ́lù là°]	the ball	sxw-L0104-borrowed words-un.wav
c.	[kábìtà là°]	the carpenter	sxw-L0106-borrowed words-un.wav

Borrowed nouns do not have the initial vowel that monomorphemic nouns in Saxwe normally have. Instead, they are assigned a left M- floating tone just like any other PW which fills the head slot of a NP but which does not have an initial vowel (see section 4.3). The presence of this left M- floating tone is detected by the fact that it triggers non-automatic downstep between the H tone of a borrowed noun and the H of the preceding TBU. This can be seen in (299).

(299) Evidence of the left M- floating tone

a.	/ᴹ⁻ é kpɔ̃́ ᴹ⁻ bíjà lá/	[é kpɔ̃́ ꜜbíjà là°]	He saw the beer. sxw-L0059-borrowed words-un.wav
b.	/ᴹ⁻ é kpɔ̃́ ᴹ⁻ bɔ́lù lá/	[é kpɔ̃́ ꜜbɔ́lù là°]	He saw the ball. sxw-L0061-borrowed words-un.wav
c.	/ᴹ⁻ é kpɔ̃́ ᴹ⁻ kábìtà lá/	[é kpɔ̃́ ꜜkábìtà là°]	He saw the carpenter. sxw-L0062-borrowed words-un.wav

A few frequently-used borrowed words that are lexically assigned H tone on a non-final syllable have M (rather than L) assigned to the adjacent TBU to the right. This means that the H is able to spread to the M TBU according to the rule of Tonal spread. Note, however, that a M tone can only be lexically assigned to a TBU of a borrowed word if the onset of the syllable contains a non-depressor consonant. The following are the isolation forms of these words.[81]

(300) Borrowed nouns—H on non-final syllable, M on following syllables

a.	/$^{\text{M-}}$ tʃɔ́tʃĩ̄/	[tʃɔ́tʃĩ̂]	church	sxw-L0013-borrowed words-un.wav
b.	/$^{\text{M-}}$ tʃĩ́tʃã̄/	[tʃĩ́tʃã̂]	teacher	sxw-L0004-borrowed words-un.wav
c.	/$^{\text{M-}}$ tĩ̀mã́tĩ̄/	[tĩ̀mã́tĩ̂]	tomato	sxw-L0042-borrowed words-un.wav

Tonal spread causes the H to be spread rightward. As a result of the association of the $L_{\%}$ IP boundary tone, there is a surface HL fall on the final TBU of the isolation forms of these words.[82]

There is no final surface HL contour when one of these words is found utterance-medially. Instead, the floating M (rendered floating because of Tonal spread) triggers non-automatic downstep when the TBU that follows one of these words is H.

(301) Evidence of the presence of M on nouns with H on non-final syllable

a.	/$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ tʃɔ́tʃĩ̄ lá/	[é kpɔ̃́ ↓tʃɔ́tʃĩ́ ↓lá]	He saw the church.
		sxw-L0064-borrowed words-un.wav	
b.	/$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ tʃĩ́tʃã̄ lá/	[é kpɔ̃́ ↓tʃĩ́tʃã́ ↓lá]	He saw the teacher.
		sxw-L0055-borrowed words-un.wav	
c.	/$^{\text{M-}}$ é kpɔ̃́ $^{\text{M-}}$ tĩ̀mã́tĩ̄ lá/	[é kpɔ̃́ tĩ̀mã́tĩ́ ↓lá]	He saw the tomato.
		sxw-L0089-borrowed words-un.wav	

There is a possibility that these words in (301) may have been borrowed earlier in the history of the language than those seen earlier in (296); the manner in which tone is assigned to these borrowed words in (301) reflects a two-way {H, Ø} contrast in which L is not an option to be lexically assigned to a word (see section 3.9). Another possibility is that these words arrived in Saxwe through another Gbe language and it is for this reason that their tonal assignment differs from that of words borrowed directly from Ghanaian or Nigerian English.

[81] The word 'teacher' is realized by some speakers as [tʃĩ́tʃã̀], indicating that for those speakers, L rather than M is lexically assigned to the second TBU. I have not observed the same interspeaker variation for the other two words listed here.

[82] There are two words that are realized by the primary language consultant I worked with without this final HL fall. They are /$^{\text{M}\omega}$ fláwā/ (surface form [fláwá]) 'flower', and /$^{\text{M}\omega}$ kplúlwī/ (surface form [kplúlwí]) 'pulley'. In a clause, a H which follows either of these words is downstepped—evidence that there is a M in the underlying lexical tone assigned to these words. One possible explanation for the lack of final fall in the isolation form is that these words may have been re-interpreted as being noun compounds with a right H_{ω} boundary.

So far the examples looked at have been words where primary stress in the source language (and therefore H tone in the target language) falls on a non-final syllable. When primary stress in the source language falls on the final syllable, the word in Saxwe is assigned a H tone associated to the TBU of the final syllable—following the same principle as with other borrowed words. In addition, it is assigned a floating M tone following this TBU. In this respect, it resembles the /M.H ^{M}/ tone pattern discussed in section 3.7.4.

The floating M at the word's right edge is indirectly responsible for creating a surface HL fall on the final syllable of the word when it is found in isolation.

(302) Borrowed nouns—H on final syllable, floating M following

a.	/$^{M-}$ sùklú ^{M}/	[sùklû]	school	sxw-L0007-borrowed words-un.wav
b.	/$^{M-}$ sìgá ^{M}/	[sìgâ]	cigarette	sxw-L0014-borrowed words-un.wav
c.	/$^{M-}$ bènȉglá ^{M}/	[bènȉglâ]	cemetery (burying ground)	sxw-L0018-borrowed words-un.wav

Because the rightmost tone is non-high, the $L_{\%}$ boundary associates to the final TBU of the word (see the rule of $L_{\%}$ association in (94)). The combination of having both a H tone and a $L_{\%}$ boundary associated to the same TBU creates the surface HL falling contour.

When these nouns are followed by a TBU that is underlyingly H, the floating M triggers non-automatic downstep between the H of the borrowed word and the following H.

(303) Evidence of the right floating M on nouns with syllable-final H

a.	/$^{M-}$ é kpɔ̃́ $^{M-}$ sùklú ^{M} lá/	[é kpɔ̃́ sùklú ↓lá] sxw-L0058-borrowed words-un.wav	He saw the school.
b.	/$^{M-}$ é kpɔ̃́ $^{M-}$ sìgá ^{M} lá/	[é kpɔ̃́ sìgá ↓lá] sxw-L0065-borrowed words-un.wav	He saw the cigarette.
c.	/$^{M-}$ é kpɔ̃́ $^{M-}$ bènȉglá ^{M} lá/	[é kpɔ̃́ bènȉglá ↓lá] sxw-L0069-borrowed words-un.wav	He saw the cemetery.

To summarize, it is clear that when words borrowed from English are incorporated into the tonal system of Saxwe, there is a preference for assigning to the underlying tone pattern of the borrowed word a non-high tone on the right edge—either a linked L, a linked M, or a floating M.[83]

[83] The exceptions I am aware of are: /$^{M\omega}$ klɛ̀zȉ́/ (surface form [klɛ̀zȉ̌]) from 'kerosene' and /$^{M\omega}$ mã̋ŋȕ̄gó/ (surface form [mã̋ŋ́↓gó]) from 'mango'.

There are some interesting cases where borrowings have been incorporated into larger PWs through compounding or derivation, and in these cases, the PW will be assigned a right H_{ω} boundary (section 4.1.2), and all postlexical operations will operate on the word as usual. For example, 'puffy sleeve' is /$^{M-}$ pɔ́fù-bɔ́ $^{H\omega}$/, which is a compounding of /$^{M-}$ pɔ́fù/ 'puff' and /ābɔ́/ 'arm'. Partial L spread (183) causes the surface realization of this compound to be [pɔ́fù-bɔ̌].

Another interesting example is a noun derived through reduplication from the borrowed verb /kísí/ 'kiss'. The reduplication prefix is employed to derive the nominal form /$^{M-}$ kí-kísí $^{H\omega}$/, with the surface output [kí-kísí] 'action of kissing'.

The topic of word borrowing in Saxwe merits a more detailed examination and analysis. Such a study could include borrowings from languages besides English and borrowings into categories of speech besides nouns.

4.8 The determiner [lá] and the relativizer [nã́]

The determiner [lá] and the relativizer [nã́] display a tonal peculiarity which I do not observe anywhere else in the data. Normally, an underlying H TBU with a sonorant onset has one of two possible surface realizations: (1) [LH] if the conditions for Partial L spread (106) are met at a certain point in the derivation; or (2) [H] elsewhere.

The determiner [lá] and the relativizer [nã́] each have four possible surface realizations: (1) non-falling [L°] utterance-finally when the morpheme follows a lexically-assigned L tone (with or without a floating H); (2) [L] utterance-medially when the morpheme follows a lexically-assigned L tone (with or without a floating H); (3) [LH] when the morpheme follows a lexically-assigned LH contour; and (4) [H] elsewhere.

The difference between the tonal behavior of the determiner [lá] and the tonal behavior of the verb /ɲɔ̃́/ 'be good' can be seen in (304) where the points of divergence in surface realizations are marked in bold.

(304) Comparing the H verb /ɲɔ̋/ 'be good' and the determiner [lá]

/M.H/	/ōsɔ́/	[ōsɔ́ ɲɔ̋]	[ōsɔ́ lá]
	horse	sxw-L0028-clause frames-un.wav	sxw-L0113-noun phrases-un.wav
/M.M/	/ōxɛ̄/	[ōxɛ̄ ɲɔ̋]	[ōxɛ̄ lá]
	bird	sxw-L0010-clause frames-un.wav	sxw-L0005-noun phrases-un.wav
/M.M ^{H}/	/ōsī ^{H}/	[ōsī ɲɔ̋]	[ōsī lá]
	wife	sxw-L0088-clause frames-un.wav	sxw-L0089-noun phrases-un.wav
/M.H ^{M}/	/ōklá ^{M}/	[ōklá ꜜɲɔ̋]	[ōklá ꜜlá]
	soul	sxw-L0130-clause frames-un.wav	sxw-L0105-noun phrases-un.wav
/M.LH/	/ōgbɔ̌/	[ōgbɔ̀ ɲɔ̌̋]	[ōgbɔ̀ lǎ]
	goat	sxw-L0058-clause frames-un.wav	sxw-L0017-noun phrases-un.wav
/M.L/	/ōdȁ/	**[ōdȁ ɲɔ̌̋]**	**[ōdȁ là°]**
	snake	sxw-L0052-clause frames-un.wav	sxw-L0029-noun phrases-un.wav
/M.L ^{H}/	/ōɦwè ^{H}/	**[ōɦwè ɲɔ̌̋]**	**[ōɦwè là°]**
	fish	sxw-L0094-clause frames-un.wav	sxw-L0077-noun phrases-un.wav
/L.H/	/òdʒú/	[ōdʒǔ ɲɔ̋]	[òdʒǔ lá]
	rain	sxw-L0112-clause frames-un.wav	sxw-L0121-noun phrases-un.wav

When the determiner [lá] and the verb /ɲɔ̋/ follow underlying H, M, or LH TBUs, they have identical surface realizations—either [H], [ꜜH], or [LH]. However, when the determiner [lá] follows an underlying L TBU (with or without a floating H), it is realized as non-falling [L°] utterance-finally. This is different from the verb /ɲɔ̋/, which is realized with a surface [LH] rise following an underlying L TBU because of Partial L spread (106).

Here in (305), the relativizer [ná̋] is utterance-medial. It is compared to the associative marker /wé/ and again, the points of divergence are marked in bold.

(305) Comparing the H associative marker /wé/ and the relativizer [nã̋]

		/… wé ōnṹ/ '...'s thing' … AM thing	**/… nã ᴹ⁻ kō kpɔ̃́/** '...that I saw' … REL 1SG see
/M.H/	/ōló/ crocodile	[ōló wé ó↓nṹ] sxw-L0003-associative construction-un.wav sxw-L0070-low spread tests-un.wav	[ōló nã̋ kó ↓kpɔ̃́]
/M.M/	/ōɲĩ̄/ cow	[ōɲĩ̄ wé ó↓nṹ] sxw-L0004-associative construction-un.wav sxw-L0052-low spread tests-un.wav	[ōɲĩ̄ nã̋ kó ↓kpɔ̃́]
/M.M ᴴ/	/ōnɔ̃̄ ᴴ/ wife	[ōnɔ̃̄ wé ó↓nṹ] sxw-L0075-low spread tests-un.wav sxw-L0071-low spread tests-un.wav	[ōnɔ̃̄ nã̋ kó ↓kpɔ̃́]
/M.H ᴹ/	/ōklá ᴹ/ soul	[ōklá ↓wé ó↓nṹ] sxw-L0076-low spread tests-un.wav sxw-L0072-low spread tests-un.wav	[ōklá ↓nã̋ kó ↓kpɔ̃́]
/M.LH/	/ōvũ̌/ dog	[ōvũ̏ wě ó↓nṹ] sxw-L0002-associative construction-un.wav sxw-L0048-low spread tests-un.wav	[ōvũ̏ nã̌ kó ↓kpɔ̃́]
/M.L/	/ōdã̀/ snake	**[ōdã̏ wě** ó↓nṹ] sxw-L0001-associative construction-un.wav sxw-L0047-low spread tests-un.wav	**[ōdã̏ nã̏** kò kpɔ̃́]
/M.L ᴴ/	/ōɦwè ᴴ/ fish	**[ōɦwè wě** ó↓nṹ] sxw-L0077-low spread tests-un.wav sxw-L0073-low spread tests-un.wav	**[ōɦwè nã̏** kò kpɔ̃́]
/L.H/	/òdʒú/ rain	[òdʒǔ wé ó↓nṹ] sxw-L0078-low spread tests-un.wav sxw-L0074-low spread tests-un.wav	[òdʒǔ nã̋ kó ↓kpɔ̃́]

Like the determiner [lá], the relativizer [nã̋] is realized [L] following an underlying L TBU (with or without a floating H). This is different from the associative marker /wé/, which is realized with a surface [LH] rise following an underlying L TBU (again because of Partial L spread).

Assigning an underlying tone to these two function words is problematic. If the function word is assumed to be underlyingly H, it becomes hard to explain why it is realized [L] afer an underlying L tone. If the function word is assumed to be underlyingly L, it becomes hard to explain why it is realized H after an underlying H or M tone. If the function word is assumed to be underlyingly LH, it becomes hard to explain why it is realized [H] after an underlying M tone. The data indicate that there must be something unusual about the lexical assignment of tone to these function words.

Clearly the surface tone of these function words is closely tied to the tone of the preceding element. For this reason, I start with the assumption that both these function words, [lá] and [nɑ̃́], are encliticized to the preceding PW. Any tonal interaction between these enclitics and the PW to which they are cliticized is a lexical interaction.

The working hypothesis I have is that these particular function words are underlyingly assigned an unassociated H tone—in other words, a floating H. However, before this floating H can associate to the TBU of the function word, there is a process of tone copying that takes place in the lexical stage of the phonology, like the tone copying that occurs with the reduplication prefix in verbal reduplication (section 4.4.3). A single tone is copied from the immediately preceding syllable, and only linked tones are copied. Following the copy of tone, the floating H is permitted to associate to the function word if and only if the TBU of this function word is linked to M tone. (This is reminiscent of the postlexical rule of Grammatical tone docking A (102), which states that a floating grammatical tone is only permitted to dock rightward if the TBU is M.) The lexical association of this floating H delinks the M tone that was assigned to the function word by tone copy. These hypothesized lexical processes are shown in (306). The final form entering the postlexical stage of the derivation is bolded.

(306) Hypothetical lexical processes involved with determiner /la ^{H}/

			1st - copy tone to clitic	2nd - floating H association
/M.H/	horse	/ōsɔ́=la ^{H}/	**ōsɔ́=lá**	--
/M.M/	bird	/ōxɛ̄=la ^{H}/	ōxɛ̄=lā ^{H}	**ōxɛ̄=lá**
/M.M ^{H}/	wife	/ōsī ^{H} =la ^{H}/	ōsī ^{H} =lā ^{H}	**ōsī ^{H} =lá**
/M.H ^{M}/	soul	/ōklá ^{M} =la ^{H}/	**ōklá ^{M} =lá**	--
/M.LH/	goat	/ōgbɔ̌=la ^{H}/	**ōgbɔ̌=lá**	--
/M.L/	snake	/ōdɔ̀=la ^{H}/	**ōdɔ̀=là** ^{H}	--
/M.L ^{H}/	fish	/ōɦwè ^{H} =la ^{H}/	**ōɦwè ^{H} =là** ^{H}	--
/L.H/	rain	/òdʒú=la ^{H}/	**òdʒú=lá**	--

For ease of reading, I have left out in the rightward columns in (306) the floating H when it appears to the right of a TBU already associated to H tone. In cases where it appears to the right of a L TBU, this floating H prevents L$_{\%}$ association in the postlexical derivation.

Interestingly, the determiner [lá] displays the same tonal behavior regardless of the category of word which precedes it. We can see this below where it is cliticized to the verb of the relative clause.

(307) /ōɲī̄ xéní́ sɔ́́=la H/
[ōɲī̄ xéní́ **sɔ́́** **lá**/
cow REL leave DET
the cow that left sxw-L0079-low spread tests-un.wav

(308) /ōɲī̄ xéní́ gbɔ̀̀=la H/
[ōɲī̄ xéní́ **gbɔ̀̀** **là**˚/
cow REL return DET
the cow that returned sxw-L0081-low spread tests-un.wav

However it is accounted for, there is no denying that the tonal behavior of these function words is exceptional in Saxwe. It would be worth exploring in other Gbe languages whether the cognates of these morphemes also display exceptional tonal behavior.[84]

Note that while I believe that the determiner /la H/ has a floating H lexically assigned to it, in this study, I have in some examples given the underlying form of the determiner as /lá/ in derivations which show only postlexical operations. I have done this in situations where I know that at the end of the lexical stage, the determiner would have H associated to it. This is done in order to prevent having to give an explanation of the exceptional tonal behavior of /la H/ in every instance where my examples include this morpheme.

4.9 Ideophones and tone

Ideophones are words that often have unusual phonological properties. They may sound in some way like the concept being communicated. They tend to be challenging to categorize with respect to word classes (Ameka, 2001). Ideophones may be more common in narrative discourse than in other genres (Payne, 2012).

In Gbe languages, ideophones are not confined to a specific grammatical category, nor do they represent a distinct grammatical category; the same ideophonic form may function either as an adverb or as an adjective (Ameka, 2001). In Saxwe, a prototype (or central member) of the ideophonic word would have the following phonological properties: (1) all of the vowels in the word share the same features; (2) the word may be lengthened for pragmatic effect, or alternatively, part or all of the word may be repeated for effect; (3) there is only one underlying tone for the word and this tone is either H or L. Of course, not all words that might be labeled as ideophones display all of these properties.

In addition, there is a correlation between the tone of an ideophone and the semantics of the word. Words that denote reduced amplitude, smallness, closeness, immediacy, or absence have a strong tendency to be H. Words that denote increased

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[84] As a side remark, it is possible that the determiner [lá], which marks discourse specificity (see section 1.8.1) and the relativizer [nɛ̃́] are in some way related historically.

amplitude, largeness, distance, longevity, or volume have a strong tendency to be L. Examples of each tone category are given in (309) and (310).

(309) H ideophones - often connected with reduced quantity

a.	/kété-kété/	small	sxw-L0002-Ideophones-un.wav
b.	/plɔ́-plɔ́-plɔ́/	spotless	sxw-L0005-Ideophones-un.wav
c.	/tróló/	now, just recently, fast	sxw-L0007-Ideophones-un.wav
d.	/tróló-ló/	now, just recently, fast	sxw-L0022-Ideophones-un.wav
e.	/tróló-tróló/	now, just recently, fast	sxw-L0008-Ideophones-un.wav
f.	/pɛ́-pɛ́-pɛ́/	exactly	sxw-L0010-Ideophones-un.wav
g.	/pɛ́ɛ́/	exactly	sxw-L0017-Ideophones-un.wav
h.	/tʃɛ̃́-tʃɛ̃́-tʃɛ̃́/	silently	sxw-L0011-Ideophones-un.wav
i.	/kɛ́tʃɛ́-kɛ́tʃɛ́/	describes walking with feet that are shackled	sxw-L0012-Ideophones-un.wav
j.	/sé-sé-sé/	emptied	sxw-L0013-Ideophones-un.wav
k.	/blé-blé-blé/	fast	sxw-L0021-Ideophones-un.wav
l.	/bléwṹ/	quickly	sxw-L0024-Ideophones-un.wav
m.	/fí-fí/	right now	sxw-L0025-Ideophones-un.wav
n.	/gbá-gbá-gbá/	a lot	sxw-L0033-Ideophones-un.wav
o.	/tó-tó-tó/	silently	sxw-L0035-Ideophones-un.wav
p.	/xwíí/	silently	sxw-L0038-Ideophones-un.wav

(310) L ideophones - often connected with increased quantity

a.	/ɦlìdì-dì/	with heaviness	sxw-L0009-Ideophones-un.wav
b.	/jɛ̀ɛ̀/	unintelligent	sxw-L0015-Ideophones-un.wav
c.	/tɛ̀gbɛ̀ɛ̀/	always	sxw-L0018-Ideophones-un.wav
d.	/tɛ̀gbɛ̀ɛ̀-tɛ̀gbɛ̀ɛ̀/	always, forever	sxw-L0019-Ideophones-un.wav
e.	/blɛ̀wùù/	slowly	sxw-L0023-Ideophones-un.wav
f.	/dã̀-dã̀-dã̀/	necessarily	sxw-L0029-Ideophones-un.wav
g.	/gbèɖè/	never	sxw-L0030-Ideophones-un.wav
h.	/dʒì-dʒìì/	slowly	sxw-L0031-Ideophones-un.wav
i.	/gbɔ̀kɔ̀ɔ̀/	without haste	sxw-L0032-Ideophones-un.wav
j.	/gbà-gbà-gbà/	with force	sxw-L0034-Ideophones-un.wav
k.	/glòbòtò-tòò/	round	sxw-L0037-Ideophones-un.wav

The correlation between tone and semantics is not completely clear in every instance. For example, /gbá-gbá-gbá/ of (309)n means 'a lot', but does not have L tone, as one might expect. Taking another example, it is not clear why /jɛ̀ɛ̀/ 'unintelligent' of (310)b has L tone.

Despite these outlier cases, the general trend holds. Words that denote reduced amplitude, smallness, closeness, immediacy, or absence have a strong tendency to be H, while words that denote increased amplitude, largeness, distance, longevity, or volume have a strong tendency to be L. In pairings of opposites, for example, the reduced amplitude option is H and the increased amplitude option is L. Some examples of this are given in (311).

(311) Ideophone opposites

a.	/bléwű/	quickly	sxw-L0024-Ideophones-un.wav
	/blɛ̀wùù/	slowly	sxw-L0023-Ideophones-un.wav
b.	/tróló/	now, just recently, fast	sxw-L0007-Ideophones-un.wav
	/tɛ̀gbɛ̀ɛ̀/	always	sxw-L0018-Ideophones-un.wav

Note from examples given in (309) through (311) that although the H ideophones often contain voiceless obstruents and the L ideophones often contain voiced obstruents, this is not always the case, and the reverse can hold true.

So far, I have looked mostly at ideophones that function as adjectives or adverbs. There are some words that function as nouns in Saxwe that seem to be of ideophonic origin. Of the ones I am aware of, there may be either H or L tone (or both) assigned to these words.

(312) Nouns possibly of ideophonic origin

a.	/$^{M-}$ gɛ̀kɛ́/	bicycle	sxw-L0011-other nouns-un.wav
b.	/$^{M-}$ kpákpá/	duck	sxw-L0012-other nouns-un.wav
c.	/$^{M-}$ gòklò/	chicken	sxw-L0013-other nouns-un.wav

Note that because these ideophonic words function as nouns, we see the presence of the left M- floating tone (see section 4.3).

Ideophones present an interesting example of monomorphemic words in Saxwe that are polysyllabic without the presence of an initial vowel. In section 3.7, I discuss the fact that monomorphemic nouns in Saxwe (with the exception of borrowed words and pronouns) are constrained to be minimally bisyllabic. This is usually ensured by the presence of an initial vowel preceding the C(C)V-shaped syllable. Here in these ideophonic forms, we see that a monomorphemic noun can be polysyllabic without this initial vowel.

4.10 Conclusions

The phonological word is an important entity in the Saxwe tone system. Given the multitude of word-formation and lexicon-building strategies that exist in Saxwe, tone plays a significant role in many of these strategies.

In this chapter, we see that structurally-driven boundary tone at the word-level is one of the means by which tone is used to identify categories of words that have certain structures in common. The right H_ω boundary tone helps to identify PWs that share a particular prosodic structure that involves recursivity at the level of the PW (section 4.1).

There is also a left floating M- tone which marks a word that is functioning as the head of a noun phrase (sections 4.3 and 4.4). This floating M- tone is present wherever there is no initial vowel on the noun.

Tone plays a role in distinguishing between two types of reduplication that exist in Saxwe—the kind that involves a prefix and the copying of tone from the stem, and the kind that does not involve a prefix but is simply a copying of the word with the insertion of a floating M between copies (sections 4.4.3 and 4.5).

If we take the case of the pronominal 1SG and 3SG suffixes that are affixed to the verb (section 4.6), we see that these grammatical morphemes have a high degree of segmental underspecification and that M tone is crucially one of the few things that is specified about these morphemes. The study of these pronominal suffixes also provides the clearest evidence for the claim that the mora, rather than the syllable, is the TBU in Saxwe.

Tone is often assigned in relatively consistent ways to certain types of words. For example, tone is assigned to borrowed words with relation to stress in the language of origin, with stress being reinterpreted as H tone in Saxwe (section 4.7). In the case of two encliticized function words (the determiner [la] and the preposition [nã]), it is a lexical process of tone copy which accounts for much of the surface consistency between the tone of the function word and the tone of the preceding element (section 4.8). In ideophones, tone is often correlated with the meaning conveyed by the ideophone (section 4.9), and H or L are the two options for tone assigned to the ideophone.

In this chapter, I have focused on tone as it relates to word-level structures. I turn in chapter 5 to structures at the intonational phrase level, looking at tonal boundaries that operate on phrases rather than words. I also examine tone which marks a particular syntactic meaning without any associated segmental information (labeled as grammatical tone).

5 Grammatical tone and intonational boundary tone

In this chapter, I look at tonal phenomena beyond the word level, which include two broad areas of study. The first is grammatical tone, or tone which, without the addition of a segmental component, serves to mark meaningful grammatical distinctions in Saxwe. The second is boundary tone that is generated at the level of the intonational phrase. The outline of this chapter is as follows. Section 5.1 examines the imperfective construction, which involves two morphemes, one of which is a preverbal floating M. In section 5.2, I discuss the fact that unmarked negation also has two morphemes, one of which is a clause-final L. Section 5.3 discusses the negation of present imperfective events as a means of providing context for the discussion in section 5.4 of the negation of future events, which involves a floating H marking irrealis modality. In section 5.5, I show that the prospective marker also includes the floating H marking irrealis. In section 5.6, I examine YNQ formation, which involves a clause-final L.

The next section, 5.7, begins a discussion of intonation by describing the way that fronted topics are marked by a floating L topic marker in addition to a right edge $H_{\%}$ intonational boundary. In section 5.8, I describe the fact that certain IPs that include a syntactic gap have a $H_{\%}$ intonational boundary rather than the default $L_{\%}$ intonational boundary. Section 5.9 continues the discussion of intonational boundaries by looking at the correspondences between IPs and syntactic clauses. Finally, in section 5.10, I offer some conclusions regarding the two topics of grammatical tone and intonational boundaries in Saxwe.

5.1 Imperfective aspect

In Saxwe, the majority of TAM markers are preverbal auxiliaries. These auxiliaries normally consist of a segmental element that is linked underlyingly to H, M, or L tone.

The following are some examples of preverbal TAM markers in Saxwe. These include the future marker /nã̄/, the jussive marker /nĩ́/, and the anterior marker /ò/.

(313)	/kájí	nã̄	sɔ̃́/
	[kájí	nã́	↓sɔ̃́]
	Kayi	FUT	leave

Kayi will leave. sxw-L0416-auxiliaries-un.wav

(314) /kájí nɪ̋ sɔ̋/
[kájí nɪ̋ sɔ̋]
Kayi JUSS leave
Kayi should leave. sxw-L0419-auxiliaries-un.wav

(315) /kájí ò sɔ̋/
[kájí ò sɔ̋]
Kayi ANT leave
Kayi has left. sxw-L0414-auxiliaries-un.wav

The postlexical tone rules formalized in chapter 3 operate on these grammatical morphemes in the same way that they operate on nouns, verbs, or any other element in the language. The list of these tone rules is repeated here. I have also added lexical tone phenomena that are discussed in chapter 4.

(316) Operations that generate surface tone patterns in Saxwe

Lexical operations (unordered)
Default left M- floating tone on nouns without an initial vowel (section 4.3)
Generation of the right H_{ω} boundary (207)

Postlexical operations (ordered)
$L_{\%}$ association (94)
Nominal floating H deletion (151)
Contour simplification A (159) and B (160)
Grammatical tone docking A and B (102)[85]
Partial L spread (106)
Tonal spread (72)

Instead of taking the form of a single morpheme, imperfective aspect in Saxwe has bipartite marking which consists of two morphemes: a floating M tone in a preverbal position as well as the marker /nɔ̃̄/—which also has M tone—in a post-argument position in the clause. This marker /nɔ̃̄/ follows the verb and any argument of the verb in the clause, but it precedes an adjunct (section 5.3). Examples of these two markers are seen in (317), where forms marked in bold reveal the tonal changes triggered by the floating M.

[85] The ordering of Grammatical tone docking with respect to other postlexical rules is discussed in section 5.4.

(317) Imperfective aspect compared to the unmarked verb

a.	/sɔ̃́/ 'leave'	[é sɔ̃́]	He left.
		[é ↓sɔ̃́ nɔ̃̂]	He is leaving. sxw-L0109-auxiliaries-un
b.	/sē/ 'hear'	[é sê]	He heard.
		[é sé nɔ̃̂]	He is hearing. sxw-L0110-auxiliaries-un
c.	/ɲɔ̃́/ 'be good'	[é ɲɔ̃́]	He is good.
		[é ↓ɲɔ̃́ nɔ̃̂]	He is becoming good. sxw-L0111-auxiliaries-un
d.	/lɔ̃̄/ 'weave'	[é lɔ̃̂]	He wove.
		[é lɔ̃́ nɔ̃̂]	He is weaving. sxw-L0112-auxiliaries-un
e.	/vǎ/ 'come'	[é vá]	He came.
		[é và nɔ̃]	He is coming. sxw-L0115-auxiliaries-un
f.	/gbɔ̃̀/ 'return'	[é gbɔ̃̀]	He returned.
		[é gbɔ̃̀ nɔ̃̀]	He is returning. sxw-L0113-auxiliaries-un

As we see in (317), marking of the imperfective aspect includes the use of the marker /nɔ̃̄/ following the verb (as there is no object argument in these clauses). Since this marker has underlying M tone, its TBU is subject to having either H or L tone spread onto it, depending on whether there is H or L earlier in the utterance. In its post-argument position, the imperfective marker /nɔ̃̄/ ends with a final falling or downgliding pitch due to the association of the $L_{\%}$ boundary.

We see also in (317) that between the subject and the verb in the imperfective aspect, there is evidence of a floating M tone which we find no corresponding evidence of between the subject and the verb in the unmarked case. This floating M causes downstep between the first two H surface tones in the two clauses [é ↓sɔ̃́ nɔ̃̂] 'he is leaving' of (317)a and [é ↓ɲɔ̃́ nɔ̃̂] 'he is becoming good' of (317)c—both of which have underlying Hs linked to both the subject and to the verb. Moreover, in [é và nɔ̃] 'he is coming' of (317)e, the underlying LH contour on /vǎ/ is simplified by delinking the H rather than by deleting the L. This differs from [é vá] 'he came', where the L is deleted. The floating M is the conditioning environment for both the triggering of non-automatic downstep and the type of Contour simplification observed.

The preverbal floating M is likely the vestige of a preverbal marker that had a segmental dimension at one time in the language's history. In several other Gbe languages, imperfective aspect is marked by a construction that involves SOV word order and two morphemes—one before the verb (and object if one is present), and one following the verb (Aboh, 2004).[86] For example, in Gen, the preverbal marker is [lè] and the postverbal marker is [ɔ̀] (p. 36).

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[86] Some Gbe researchers label this as progressive aspect. In Saxwe, progressive aspect—which involves an added emphasis on the ongoing nature of a state or event—is marked by a

In (318), we see the floating M (symbolized as M) positioned between the subject and verb.

(318)	/M- é	M	sɔ̄́	nɔ̿/
	[é		↓sɔ̄́	nɔ̄̂]
	3SG	IPFV	leave	IPFV
	He is leaving.			
	sxw-L0109-auxiliaries-un.wav			

The following is the derivation of this utterance.

(319)		IPFV		IPFV	
	/M- é	M	sɔ̄́	nɔ̿/	Output from the lexical stage
	é	M	sɔ̄́	nɔ̄̀	L% association
	--				Nominal floating H deletion
	--				Contour simplification (A&B)
	--				Grammatical tone docking (A&B)
	--				Partial L spread
	é	M	sɔ̄́	nɔ̄̂	Tonal spread
	[é		↓sɔ̄́	nɔ̄̂]	Surface

The floating M which marks the imperfective triggers non-automatic downstep between the H of /é/ '3 SG' and the H of /sɔ̄́/ 'leave' during the phonetic implementation. Note that this floating M does not dock; only H or L floating grammatical tones dock during as a result of Grammatical tone docking operations (327).

In (320), we have the derivation of (317)e [é và nɔ̄̀] 'he is coming'.

(320)		IPFV		IPFV	
	/M- é	M	vǎ	nɔ̿/	Output from the lexical stage
	M- é	M	vǎ	nɔ̄̀	L% association
	--				Nominal floating H deletion
	M- é	M	và H	nɔ̄̀	Contour simplification (A&B)
	--				Grammatical tone docking (A&B)
	--				Partial L spread
	--				Tonal spread
	[é		và H	nɔ̄̀]	Surface

The floating M in (320) is responsible for the fact that during the application of the rules of Contour simplification, the underlying LH contour on the verb /vǎ/ 'come' is simplified by delinking the H rather than by delinking the L. Note

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preverbal marker /ló/ in addition to the post-argument imperfective /nɔ̿/.

that this delinked H is not a grammatical tone and because of this, it does not dock to a TBU as a result of the operations of Grammatical tone docking. The floating H does, however, prevent the spread of L tone, with the result that the imperfective marker /nɔ̄̄/ here is realized on the surface with a ML fall.

As is seen in sections 5.3, 5.4, and 5.5, imperfective marking co-occurs with other types of TAM marking, including future negation. Before looking at these instances of TAM co-occurrence, however, I turn to the examination of default negation in Saxwe as it too involves a floating tonal morpheme.

5.2 Default negation

As with imperfective marking, default clausal negation involves two morphemes.[87] Unlike with imperfective aspect, in default negation it is the preverbal morpheme which has a segmental component and the clause-final morpheme which does not. The preverbal negation marker is /ɔ̀̃/ and the clause-final morpheme is a floating L tone.[88] These two morphemes are seen in (322).

(321) /ōló sɔ̃́/
[ōló sɔ̃́]
3SG leave
The crocodile left.
sxw-L0023-clause frames-un.wav

(322) /ōló ɔ̀̃ sɔ̃́ L /
[ōló ɔ̀̃ sɔ̃̂]
3SG NEG leave NEG
The crocodile did not leave.
sxw-L0013-Negation-un.wav

The L floating tone is likely the historical vestige of a marker that did at some point have a segmental component. This analysis is supported by the fact that in other Gbe languages, there is bipartite negation marking as well, with both parts having a segmental dimension. For example, in Gen, the marker [mú] appears preverbally and the marker [ò] appears clause-finally (Aboh, 2004, p. 47).

The following are examples of negation where the verb is followed by a direct object and the determiner [lá].

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[87] There are several kinds of negation in Saxwe, including additive negation, constituent negation, and negation in word-formation processes; this is the marking for default clausal negation.

[88] The prohibitive construction (which could alternatively be labeled as a negative imperative) also makes use of this clause-final floating L. In that construction, there is a preverbal prohibition marker /kâ/ and a clause-final floating L of negation.

(323) Negation—verb located clause-medially

a.	/kpɔ̋/ 'see'	[ōló ɔ̏ kpɔ̋ ó↓tɪ̋ lâ]	The crocodile did not see the stick. sxw-L0219-Negation-un.wav
b.	/sē/ 'hear'	[ōló ɔ̏ sè òtɪ̋ lâ]	The crocodile did not hear the stick. sxw-L0220-Negation-un.wav
c.	/wɛ̋/ 'break'	[ōló ɔ̏ w̃ɛ̋ ó↓tɪ̋ lâ]	The crocodile did not break the stick. sxw-L0221-Negation-un.wav
d.	/ɖʊ̄/ 'eat'	[ōló ɔ̏ ɖʊ̀ òtɪ̋ lâ]	The crocodile did not eat the stick. sxw-L0222-Negation-un.wav
e.	/gbɛ̌/ 'refuse'	[ōló ɔ̏ gbɛ̌ ó↓tɪ̋ lâ]	The crocodile did not refuse the stick. sxw-L0223-Negation-un.wav
f.	/ɦɔ̏/ 'pull up'	[ōló ɔ̏ ɦɔ̏ òtɪ̋ lâ]	The crocodile did not pull up the stick. sxw-L0224-Negation-un.wav

In these examples in (323), we see that the morpheme /ɔ̏/ always appears before the verb, and the clause-final determiner [lá] ends with a surface [HL] contour in every utterance.

We can also look at examples of default negation in clauses that do not contain a direct object.

(324) Negation—verb located clause-finally

a.	/sɔ̋/ 'leave'	[ōló ɔ̏ sɔ̂]	The crocodile did not leave. sxw-L0013-Negation-un.wav
b.	/sē/ 'hear'	[ōló ɔ̏ sè]	The crocodile did not hear. sxw-L0014-Negation-un.wav
c.	/ɲɔ̋/ 'be good'	[ōló ɔ̏ ɲɔ̂]	A crocodile is not good. sxw-L0015-Negation-un.wav
d.	/lē/ 'be present'	[ōló ɔ̏ lè]	A crocodile is not present. sxw-L0016-Negation-un.wav
e.	/gbɛ̌/ 'refuse'	[ōló ɔ̏ gbɛ̂]	The crocodile did not refuse. sxw-L0017-Negation-un.wav
f.	/gbɔ̏/ 'return'	[ōló ɔ̏ gbɔ̏]	The crocodile did not return. sxw-L0018-Negation-un.wav

In (324), we see that the final syllable of every clause ends either with final L tone or as a surface [HL] contour.

Given what is summarized about tonal operations in (316), most of what is seen in (323) and (324) is straightforward. There are two utterances in these data that deserve further examination, and these are recopied below. Both have to do with what happens when the negation marker /ɔ̏/ is followed by a verb that has a lexically assigned /LH/ tone pattern.

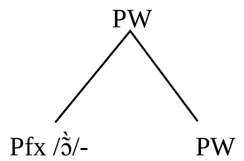
(325) Negation—verb with /LH/ tone pattern

a.	/gbɛ̌/ 'refuse'	[ōló ɔ̏ **gbɛ̌** ó↓tɪ́ lâ]	The crocodile did not refuse the stick. sxw-L0223-Negation-un.wav
b.	/gbɛ̌/ 'refuse'	[ōló ɔ̏ **gbɛ̂**]	The crocodile did not refuse. sxw-L0017-Negation-un.wav

In (325)a, the verb /gbɛ̌/ 'refuse' is realized with a surface LH contour. This is of note because in conformity with the rule of Contour simplification B (160), an underlying LH which follows a L would normally be simplified by delinking the H. Here, however, the H is not delinked.

The explanation for this observation is that the negation marker /ɔ̏/ is treated from a phonological point of view as a prefix to the verb. As such, it has the following prosodic structure.

(326) Prosodic structure involving negation marker /ɔ̏/



What this means is that there are nested right edge PW brackets in this structure (summarized as $]_{PW}]_{PW}$). As a result, the right H_ω PW boundary described in section 4.1.2 is generated at the right edge of this combination of /ɔ̏/ negation marker and verb, just as there is a H_ω PW boundary at the right edge of nouns derived through the affixation of a redupliction prefix to a verb (section 4.4.3).[89]

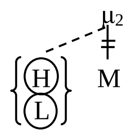
Returning to the form in (325)a, we see that an OCP-related constraint prevents the delinking of a H in the presence of this H_ω PW boundary. Therefore, there is no delinking of the H of the underlying LH contour on the verb /gbɛ̌/ 'refuse' in (325)a or b.

[89] There is an interesting aspect of interspeaker variability regarding the phonological prefixing of certain elements to the verb instead of treating them as separate PWs the way the habitual /nɔ̄̄/ and future /nā̄/ auxiliaries are treated. All speakers I consulted prefix the negation marker /ɔ̏/ to the verb. In addition, some also prefix the anterior marker /ò/ to the verb while others do not.

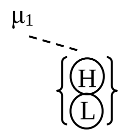
Bearing this H_ω boundary in mind, we can look at the derivations of several of the utterances from (323) and (324). Before doing so however, I review here the rules A and B of Grammatical tone docking, first seen in (102).

In Saxwe, grammatical floating tones which are H or L differ from grammatical floating tones which are M in that they dock to a TBU if they are able. The following describes Grammatical tone docking in Saxwe.

(327) Grammatical tone docking A



Grammatical tone docking B



These rules of grammatical docking are ordered, with rule A applying before rule B. These rules state that a grammatical floating H or L will first dock rightward to a TBU that bears M tone. If this does not occur (because the following TBU bears H or L, or because there is no following TBU), then a grammatical floating H or L will dock leftward if there is a TBU available. In the case of the L of negation, the floating tone docks leftward to the final TBU of the clause.

I take first the example of [ōló ɔ̃̀ w̃ɛ̃̌ ó↓tí̃ lâ] 'the crocodile did not break the stick' from (323)c to show how the surface form of this utterance is obtained. In this derivation, we see the preverbal /ɔ̃̀/ as well as the clause-final floating L of negation (represented by the symbol ^{L}). The right H_ω boundary assigned during the lexical stage is also included.

(328)

	NEG				NEG	
/ōló	ɔ̏-	wɛ̋ Hω	ōti̋	lá	L/	Output from the lexical stage
--						$L_{\%}$ association[90]
--						Nominal floating H deletion
--						Contour simplification (A&B)
ōló	ɔ̏	wɛ̋ Hω	ōti̋	lâ		Grammat. tone docking (A&B)
ōló	ɔ̏	wɛ̌ Hω	ōti̋	lâ		Partial L spread
ōló	ɔ̏	wɛ̌ Hω	ó M ti̋	lâ		Tonal spread
[ōló	ɔ̏	w̃ɛ̌	ó↓ti̋	lâ]		Surface

Let us take now the example [ōló ɔ̏ gbɛ̌ ó↓ti̋ lâ] 'the crocodile did not refuse the stick' from (325)a. The following is the derivation of this clause.

(329)

	NEG				NEG	
/ōló	ɔ̏-	gbɛ̌ Hω	ōti̋	lá	L/	Output from the lexical stage
--						$L_{\%}$ association
--						Nominal floating H deletion
--						Contour simplification (A&B)
ōló	ɔ̏	gbɛ̌ Hω	ōti̋	lâ		Grammat. tone docking (A&B)
--						Partial L spread
ōló	ɔ̏	gbɛ̌ Hω	ó M ti̋	lâ		Tonal spread
[ōló	ɔ̏	gbɛ̌	ó↓ti̋	lâ]		Surface

Here we see that the underlying LH contour of /gbɛ̌/ 'refuse' is not simplified during the application of the rules of Contour simplification. Simplification of the contour here would create a floating H in a context where there is already a H_{ω} boundary tone, a situation against which there is a constraint in keeping with the OCP (see also sections 4.1.2, 4.4.2, and 4.4.3).

I return now to the example from (325)b, [ōló ɔ̏ gbɛ̂] 'the crocodile did not refuse'. The surface HL contour on [gbɛ̂] 'refuse' is interesting, given that the underlying tone of /gbɛ̌/ is a LH sequence. The following is the derivation of this utterance.

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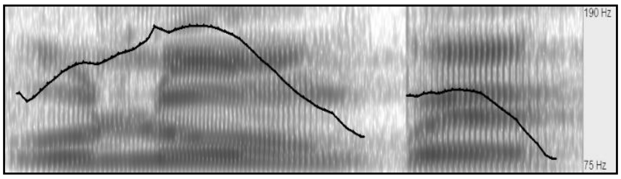
[90] In this and other derivations involving negation, it is unclear whether the $L_{\%}$ boundary associates to the final TBU as direct result of the presence of the floating L or not. Since $L_{\%}$ association is sensitive to the presence of nominal floating H tones as well as word-level H_{ω} boundaries, it would be consistent to imagine that it might be sensitive to the presence of floating Ls as well. It is unclear whether it really matters, since the L of negation will be associated to the final TBU in any case.

(330)

	NEG		NEG	
/ōló	ɔ̄̀-	gbɛ̌ Hω	L/	Output from the lexical stage
--				L% association
--				Nominal floating H deletion
--				Contour simplification (A&B)
ōló	ɔ̄̀	gbɛ̌̂		Grammatical tone docking (A&B)
--				Partial L spread
--				Tonal spread
[ōló	ɔ̄̀	gbɛ̂]		Surface

Once again, the underlying contour of /gbɛ̌/ 'refuse' is not simplified during the application of the rules of Contour simplification. Because the TBU of this verb is the last one of the clause, the floating L of negation docks to it, creating a theoretical LHL sequence on the one TBU. However, we do not hear a LHL in the phonetic implementation; because of the relative difficulty of modulating pitch both up and down over the time span of a single mora, only the surface [HL] is heard.[91] As seen in the pitch trace of this utterance in (331), the surface HL contour on [gbɛ̂] maintains a brief stable H level, with perhaps a slight upward drift, before heading down towards a downgliding L pitch height.

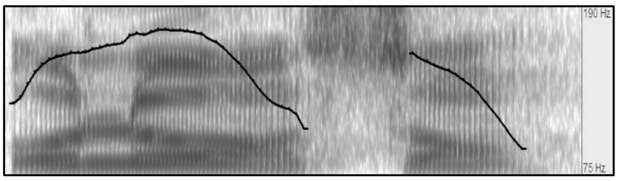
(331) [ōló ɔ̄̀ gbɛ̂]



ō- ló ɔ̄̀ gbɛ̂

A difference can be observed in the final [HL] surface contour of (331) and that of (332), which is a pitch trace of (324)a [ōló ɔ̄̀ sɔ̂] 'the crocodile did not leave'.

(332) [ōló ɔ̄̀ sɔ̂]



ō- ló ɔ̄̀ sɔ̂

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[91] It is also possible that there is a constraint against having three tones linked to the same TBU, and that as a result, the leftmost tone is delinked just prior to phonetic implementation.

Here in (332), the drop in pitch begins immediately in the articulation of the vowel, although it is hard to know how much of this difference can be attributed to the difference of three tones *vs*. two tones linked to a TBU in the output from the phonology, and how much can be attributed to the surface effects of a voiced obstruent *vs*. a voiceless obstruent on tone.

So far we have seen examples of negation in grammatical constructions where no overt TAM marking is present. I turn in the next sections to negation in clauses where there is TAM marking.

5.3 Negation of present imperfective events

This section explores what happens when clauses that are in a present imperfective framework are marked for clausal negation. Imperfective marking, as described in section 5.1, is bipartite and involves a preverbal floating M as well as the post-argument marker /nɔ̄̄/. Clausal negation, as described in section 5.2, is also bipartite and involves the preverbal marker /ɔ̀̀/ as well as a clause-final floating L. In both cases of bipartite marking, there is an element before the verb and an element after the verb. The question then is how these markers are ordered relative to each other.

We see in this section and in section 5.4 that the imperfective morphemes are ordered closer to the verb (both in their positions before and after the verb) than the negation morphemes. The ordering of the morphemes that follow the verb can be seen in (333), where an adjunct appears between the imperfective marker and the clause-final L of negation.

(333)	/$^{\text{M-}}$ kōfí	ɔ̀̀	$^{\text{M}}$	ɖū $^{\text{H}\omega}$	ōnú́	nɔ̄̄	fí	$^{\text{L}}$ /
	[kōfí	ɔ̀̀		ɖù	nú́	nɔ̄́	↓fî	]
	Kofi	NEG	IPFV	eat	thing	IPFV	now	NEG

Kofi is not (still) eating now.
sxw-L0421-auxiliaries-un.wav

The following is the paradigm of verbs marked both for negation and for imperfective aspect.

(334) Negation of present imperfective events

a.	/sɔ̃́/ 'leave'	[ōló ɔ̃̀ sɔ̃́ nɔ̃̂]	The crocodile is not leaving. sxw-L0085-Negation-un.wav
b.	/sē/ 'hear'	[ōló ɔ̃̀ sè nɔ̃̀]	The crocodile is not hearing. sxw-L0086-Negation-un.wav
c.	/ɲɔ̃́/ 'be good'	[ōló ɔ̃̀ ɲɔ̃̌ nɔ̃̂]	The crocodile is not becoming good. sxw-L0087-Negation-un.wav
d.	/jī/ 'go'	[ōló ɔ̃̀ jì nɔ̃̀]	The crocodile is not going. sxw-L0088-Negation-un.wav
e.	/gbɛ̌/ 'refuse'	[ōló ɔ̃̀ gbɛ̌ nɔ̃̂]	The crocodile is not refusing. sxw-L0089-Negation-un.wav
f.	/gbɔ̃̀/ 'return'	[ōló ɔ̃̀ gbɔ̃̀ nɔ̃̀]	The crocodile is not returning. sxw-L0090-Negation-un.wav

Although the floating M of the imperfective is located between the negation marker /ɔ̃̀/ and the verb, these morphemes are still treated as though they comprise one PW; we can see evidence of the presence of the H_ω boundary tone to the right of the verb. The following is the example that provides the best evidence of this H_ω boundary, repeated from (334)e.

(335)	/ōló	ɔ̃̀	M	gbɛ̌ Hω	nɔ̃̄	L /
	[ōló	ɔ̃̀		gbɛ̌	nɔ̃̂	]
	crocodile	NEG	IPFV	refuse	IPFV	NEG

The crocodile is not refusing.
sxw-L0089-Negation-un.wav

The H_ω boundary tone, together with the constraint that prevents the creation of a floating H adjacent to a H_ω boundary, is what explains the failure of the underlying LH contour on /gbɛ̌/ 'refuse' to be simplified in (335). The following is the derivation of that utterance.

(336)		NEG	IPFV			IPFV	NEG	
	/ōló	ɔ̃̀-	M	gbɛ̌	Hω	nɔ̃̄	L/	Output from the lexical stage
	ōló	ɔ̃̀	M	gbɛ̌	Hω	nɔ̃̄̀	L	$L_{\%}$ association
	--							Nominal floating H deletion
	--							Contour simplification (A&B)
	ōló	ɔ̃̀	M	gbɛ̌	Hω	nɔ̃̄̀		Grammat. tone docking (A&B)
	--							Partial L spread
	ōló	ɔ̃̀	M	gbɛ̌	Hω	nɔ̃̂		Tonal spread
	[ōló	ɔ̃̀		gbɛ̌		nɔ̃̂]		Surface

The ordering of the preverbal markers for negation and for the imperfective becomes more evident as we examine the negation of future events. I move now to that situation, which involves the addition of a fifth grammatical morpheme to the four discussed here.

5.4 Negation of future events with irrealis H tone

The negation of future events, just like the negation of present imperfective events, employs imperfective marking.[92] What distinguishes a future negative event from a present negative event is not the future marker /nã̄/, but rather a floating H tone that could be labeled as an irrealis marker.[93] This H tone is located between the negation marker [ɔ̃̀] and the verb. It docks rightward to a TBU that bears M tone. If this TBU is not M, the floating H will instead dock leftward.

The following are data which show the paradigm of verbs describing a negative future event.

(337) Negation of future events

a.	/fɔ̃́/ 'awaken'	[ōsɔ́ **ɔ̃̌** ↓**fɔ̃́** nɔ̃̂]	The horse will not awaken. sxw-L0145-Negation-un.wav
b.	/sē/ 'hear'	[ōsɔ́ **ɔ̃̀** **sé** nɔ̃̂]	The horse will not hear. sxw-L0146-Negation-un.wav
c.	/ɲɔ̃́/ 'be good'	[ōsɔ́ **ɔ̃̌** ↓**ɲɔ̃́** nɔ̃̂]	The horse will not become good. sxw-L0147-Negation-un.wav
d.	/jī/ 'go'	[ōsɔ́ **ɔ̃̀** **jí** nɔ̃̂]	The horse will not go. sxw-L0148-Negation-un.wav
e.	/gbɛ̌/ 'refuse'	[ōsɔ́ **ɔ̃̌** **gbɛ̀** nɔ̃̄]	The horse will not refuse. sxw-L0149-Negation-un.wav
f.	/gbɔ̃̀/ 'return'	[ōsɔ́ **ɔ̃̌** **gbɔ̃̀** nɔ̃̀]	The horse will not return. sxw-L0150-Negation-un.wav

This can be compared to utterances describing events that are negated in a present imperfective framework. The following examples are copied from section 5.3.

[92] The implication is that in the Saxwe TAM system, future negative events are perceived as unbounded (Comrie, 1976).

[93] For the moment, I use this label as a working hypothesis; whether this is the best label for this floating tone is yet to be determined.

(338) Negation of present imperfective events

a.	/sɔ̄́/ 'leave'	[ōló **ɔ̄̀ sɔ̄́** nɔ̄̂]	The crocodile is not leaving. sxw-L0085-Negation-un.wav
b.	/sē/ 'hear'	[ōló **ɔ̄̀ sè** nɔ̄̀]	The crocodile is not hearing. sxw-L0086-Negation-un.wav
c.	/ɲɔ̄́/ 'be good'	[ōló **ɔ̄̀ ɲɔ̄̌** nɔ̄̂]	The crocodile is not becoming good. sxw-L0087-Negation-un.wav
d.	/jī/ 'go'	[ōló **ɔ̄̀ jì** nɔ̄̀]	The crocodile is not going. sxw-L0088-Negation-un.wav
e.	/gbɛ̆/ 'refuse'	[ōló **ɔ̄̀ gbɛ̌** nɔ̄̂]	The crocodile is not refusing. sxw-L0089-Negation-un.wav
f.	/gbɔ̄̀/ 'return'	[ōló **ɔ̄̀ gbɔ̄̀** nɔ̄̀]	The crocodile is not returning. sxw-L0090-Negation-un.wav

The differences between the forms in (337) and (338) are two-fold. First, in the negative future clauses of (337), there is a floating H marking irrealis aspect. Second, there is no H_{ω} boundary at the right edge of the verb in the negative future.

The floating H marking irrealis aspect associates to a TBU in the manner described by the ordered rules of Grammatical tone docking A & B, given in (327). These rules of tone docking are ordered, stating that a grammatical floating H or L will first dock rightward to a TBU that bears M tone. If this does not occur (because the following TBU bears H or L, or because there is no following TBU), then a grammatical floating H or L will dock leftward if there is a TBU available.

The following is the derivation of (337)b, [ōsɔ́ ɔ̄̀ sé nɔ̄̂] 'the horse will not hear'. In this derivation, we see that the floating H of irrealis modality precedes the floating M of imperfective aspect in the output from the lexical stage, which in turn precedes a M verb.

(339)		NEG	IRR	IPFV		IPFV	NEG	
	/ōsɔ́	ɔ̄̀	H	M	sē	nɔ̄̄	L/	Output from the lexical stage
	ōsɔ́	ɔ̄̀	H	M	sē	nɔ̄̃	L	$L_{\%}$ association
	--							Nominal floating H deletion
	--							Contour simplific. (A&B)
	ōsɔ́	ɔ̄̀		M	sé	nɔ̄̃		Grammat. tone dock. (A&B)
	--							Partial L spread
	ōsɔ́	ɔ̄̀		M	sé	nɔ̄̂		Tonal spread
	[ōsɔ́	ɔ̄̀			sé	nɔ̄̂]		Surface

The floating H marking irrealis docks rightward to the available M TBU of the verb /sē/ 'hear'. This is possible despite the intervening presence of the floating M of the imperfective; there are no lines of association to be crossed. Once the H of irrealis is docked, it is spread rightward by the operation Tonal spread, giving the surface form [ōsɔ́ ɔ̃̀ sé nɔ̃̂]. This, then, gives us some information about the ordering of rules. It is clear that Grammatical tone docking must be ordered before Tonal spread because the grammatical H tone must dock before it can spread rightward from the verb.

We turn now to cases where the TBU following the H of irrealis has either H or L tone assigned to it. In these cases, rightward docking is not possible (327). This being true, the floating H is associated leftward to the TBU of the negation marker /ɔ̃̀/. This is seen in the utterance below, [ōsɔ́ ɔ̃̌ ↓fɔ̃́ nɔ̃̂] 'the horse will not awaken'. Here, the H verb /fɔ̃́/ 'awaken' is preceded by the negation marker which is realized with a surface [LH] rise.

(340)

	NEG	IRR	IPFV		IPFV	NEG	
/ōsɔ́	ɔ̃̀	H	M	fɔ̃́	nɔ̃̄	L/	Output from lexical stage
ōsɔ́	ɔ̃̀	H	M	fɔ̃́	nɔ̃̄̀	L	L% association
--							Nominal floating H deletion
--							Contour simplific. (A&B)
ōsɔ́	ɔ̃̌		M	fɔ̃́	nɔ̃̄̀		Grammat. tone dock. (A&B)
--							Partial L spread
ōsɔ́	ɔ̃̌		M	fɔ̃́	nɔ̃̂		Tonal spread
[ōsɔ́	ɔ̃̌			↓fɔ̃́	nɔ̃̂]		Surface

In (340), the floating H docks leftward to the negation marker /ɔ̃̀/.[94] In the output from the phonology, there is a floating M marking imperfective aspect between the H docked to the negation marker and the H of the verb. This floating M triggers non-automatic downstep and the verb is realized with a downstepped H. Here we see clearly that the floating M of imperfective marking is ordered closer to the verb than the negation marker /ɔ̃̀/.

We have already seen that the operations Grammatical tone docking A and B must be ordered before Tonal spread. In (340), we see that Grammatical tone docking A and B must be ordered after Contour simplification. Otherwise, the contour created because of the docking of the irrealis H tone would be simplified and yield an incorrect surface form. This is shown in (341), where the derivational operations are incorrectly ordered.

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[94] The surface LH rising pitch on a form like [ɔ̃̌] which has a lexically-assigned L tone and a docked grammatical H tone is realized with some variation in the phonetic implementation depending on the tone which precedes. My general observation is that following a surface H, the H pitch of the LH rise is attained relatively late in the duration of the vowel, but that following a surface M or L, the H pitch of the LH rise is attained relatively early in the duration of the vowel. This is a topic that could be studied further.

(341)		NEG	IRR	IPFV		IPFV	NEG	
	/ōsɔ́	ɔ̏̀	H	M	fɔ̏́	nɔ̏̄	L/	Output from lexical stage
	ōsɔ́	ɔ̏̀	H	M	fɔ̏́	nɔ̏̀	L	L% association
	--							Nom. floating H deletion
	ōsɔ́	ɔ̏̌		M	fɔ̏́	nɔ̏̀		Gramm. tone dock. (A&B)
	ōsɔ́	ɔ̏́		M	fɔ̏́	nɔ̏̀		Contour simplific. (A&B)
	--							Partial L spread
	ōsɔ́	ɔ̏́		M	fɔ̏́	nɔ̏̂		Tonal spread
	*[ōsɔ́	ɔ̏́			↓fɔ̏́	nɔ̏̂]		Surface

In addition to the presence of the floating H of irrealis, the second thing that distinguishes negative future events from negative present imperfective events is that in the former context, there is no evidence of a H_{ω} boundary on the right edge of the verb. This leads us to the conclusion that once the floating H of irrealis intervenes between the negation marker /ɔ̏̀/ and the verb, the negation marker is no longer able to be prefixed to the verb.[95]

In the absence of a H_{ω} boundary, the H of the underlying LH tone pattern of a verb such as /gbɛ̌/ 'refuse' is delinked when it follows the M tone of the imperfective. This is seen below.

(342) Negation of future events – no right H_{ω} boundary on verb

/gbɛ̌/ 'refuse' [ōsɔ́ ɔ̏̌ gbɛ̀ nɔ̏̀] The horse will not refuse.
sxw-L0149-Negation-un.wav

The following is the derivation of [ōsɔ́ ɔ̏̌ gbɛ̀ nɔ̏̀] 'the horse will not refuse'.

(343)		NEG	IRR	IPFV		IPFV	NEG	
	/ōsɔ́	ɔ̏̀	H	M	gbɛ̌	nɔ̏̄	L/	Output from lexical stage
	ōsɔ́	ɔ̏̀	H	M	gbɛ̌	nɔ̏̀	L	L% association
	--							Nom. floating H deletion
	ōsɔ́	ɔ̏̀	H	M	gbɛ̀ H	nɔ̏̀		Contour simplific. (A&B)
	ōsɔ́	ɔ̏̌		M	gbɛ̀ H	nɔ̏̀		Gramm. tone dock. (A&B)
	--							Partial L spread
	--							Tonal spread
	[ōsɔ́	ɔ̏̌			gbɛ̀	nɔ̏̀]		Surface

In (343), the floating H docks leftward onto the negation marker /ɔ̏̀/ because the TBU to the right does not have M tone. Again we see in (343) that the rules of Contour simplification must be applied before the rules of Grammatical tone

[95] One might ask whether it is prefixed to the irrealis marker in this case. There is no way to answer this, as there is no way to detect a H_{ω} boundary adjacent to a surface H tone.

docking. Were this not the case, the rising contour on the negation marker created as a result of tone docking would not be realized as such at the surface level.

In addition, we see that the underlying contour of /gbɛ̌/ is simplified by delinking the H. This is due to the conditioning presence of the floating M tone of the imperfective. The delinked H from the verb /gbɛ̌/ is what prevents spread of L tone to the imperfective marker /nɔ̏̄/. As a result, this latter imperfective marker is realized utterance-finally with a surface ML falling tone.

Were there a H_{ω} boundary to the right of the verb, the H of /gbɛ̌/ would not be permitted to be delinked, as such an action would constitute a violation of the constraint against adjacent unattached Hs.

There are other morphemes that can appear between the negation marker /ɔ̏/ and the verb. For example, in (344), the additional preverbal marker that intervenes between the two is the repetitive marker /mɔ̏/ which marks an event that is (or is not in this case) re-occurring.

(344)	/M- é	ɔ̏	mɔ̏	H	M	gbɛ̌	nɔ̏̄	L/
	[é	ɔ̏	mɔ̏̌			gbɛ̀	nɔ̏̄	]
	3SG	NEG	REPET	IRR	IPFV	refuse	IPFV	NEG

He will not refuse again.
sxw-L0387-auxiliaries-un.wav

Here in (344), the repetitive marker comes between the negation marker and the floating H marking irrealis modality.[96]

There is also a morpheme that can appear between the floating H of irrealis modality and the floating M of imperfective aspect.[97] In (345) and (346), we see what I label as the outcome marker in this position. This marker, which has the form /dǒ/, marks an expected, achieved, or potential outcome (overlapping with the semantic notions of purpose and result).

(345)	/ M- jē H	ɔ̏	mɔ̏	H	dǒ	M	vǎ	nɔ̏̄	L/
	[jē	ɔ̏	mɔ̏̌		dó		và	nɔ̏̄	]
	3PL	NEG	REPET	IRR	OUTC	IPFV	come	IPFV	NEG

As a result, they will not come again.
sxw-L0412-auxiliaries-un.wav

[96] Another morpheme that appears in this position is /vǎ/, which literally means 'come' but functions in this position to mark an event that will eventually happen. When the floating H docks leftward onto this marker /vǎ/, it surfaces as [vá]. The repetitive marker /mɔ̏/ and the marker /vǎ/ can co-occur, in which case the repetitive marker is ordered first.

[97] There may be multiple morphemes that can appear in this position; I am aware of the one.

(346)

/ $^{\text{M-}}$ jē $^{\text{H}}$	ɔ̃̀	mɔ̃̀	$^{\text{H}}$	dǒ	$^{\text{M}}$	kpɔ̃́	nɔ̃̄	$^{\text{L}}$/
[jē	ɔ̃̀	mɔ̃̌		dó		↓kpɔ̃́	nɔ̃̂	]
3PL	NEG	REPET	IRR	OUTC	IPFV	see	IPFV	NEG

As a result, they will not see [it] again.
sxw-L0411-auxiliaries-un.wav

In both (345) and (346), the H of irrealis docks leftward onto the repetitive marker /mɔ̃̀/. The outcome morpheme /dǒ/ which follows the repetitive marker has its contour simplified by deleting the L. The verb /vǎ/ 'come' which follows /dǒ/ in (345) is simplified in a manner that is conditioned by the floating M of the imperfective. In (346), the floating M triggers non-automatic downstep on the H verb /kpɔ̃́/ 'see'.

These tonal alternations seen in clauses expressing future negation, and the underlying structures proposed to account for these alternations, are fairly complex. However, the complexity proposed in this analysis is borne out by the fact that there is another type of syntactic construction that mirrors many of the tonal structures and alternations seen in future negation. This structure is the topic of section 5.5.

5.5 The prospective

In Saxwe, there is a morpheme /kà/ which I label as the prospective. This is a marker of modality that is used to communicate either a desire or the imminent occurence of an event. For example, (347)a, [ōló kǎ ↓sɔ̃́ nɔ̃̂]. could be glossed either as 'the crocodile wants to leave' or 'the crocodile is about to leave'.

The tonal alternations seen for the prospective mirror the tonal alternations seen for the future negative. The following are examples of this.

(347) Prospective events

a.	/sɔ̃́/ 'leave'	[ōsɔ́ **kǎ ↓sɔ̃́** nɔ̃̂]	The horse wants to leave. sxw-L0268-auxiliaries-un.wav
b.	/sē/ 'hear'	[ōsɔ́ **kà sé** nɔ̃̂]	The horse wants to hear. sxw-L0269-auxiliaries-un.wav
c.	/ɲɔ̃́/ 'be good'	[ōsɔ́ **kǎ ↓ɲɔ̃́** nɔ̃̂]	The horse wants to become good. sxw-L0270-auxiliaries-un.wav
d.	/jī/ 'go'	[ōsɔ́ **kà jí** nɔ̃̂]	The horse wants to go. sxw-L0271-auxiliaries-un.wav
e.	/gbɛ̌/ 'refuse'	[ōsɔ́ **kǎ gbɛ̀** nɔ̃̏]	The horse wants to refuse. sxw-L0272-auxiliaries-un.wav
f.	/gbɔ̃̀/ 'return'	[ōsɔ́ **kǎ gbɔ̃̀** nɔ̃̀]	The horse wants to return. sxw-L0272-auxiliaries-un.wav

In analyzing the prospective, we see that it too is accompanied by a floating grammatical H and bipartite imperfective marking.[98] I assume as a working hypothesis that the floating H in this case is the same morpheme that is used in the future negative construction—in both cases marking irrealis modality. Here again, we see that in keeping with the rules of Grammatical tone docking, this floating H associates rightward if the TBU which follows is M and leftward otherwise.

In (348) the floating H associates rightward and is then spread to the end of the utterance.

(348)	/ōsɔ́	kà	H	M	sē	nɔ̃̄/
	[ōsɔ́	kà			sé	nɔ̃̂]
	horse	PROSP	IRR	IPFV	hear	IPFV
	The horse wants to hear.					
	sxw-L0269-auxiliaries-un.wav					

In (349), the floating H associates leftward. The floating M triggers non-automatic downstep of the H tone of the verb /ɲɔ̃́/ 'be good'.

(349)	/ōsɔ́	kà	H	M	ɲɔ̃́	nɔ̃̄/
	[ōsɔ́	kǎ			↓ɲɔ̃́	nɔ̃̂]
	horse	PROSP	IRR	IPFV	be.good	IPFV
	The horse wants to become good.					
	sxw-L0270-auxiliaries-un.wav					

In (350), the verb /gbɛ̌/ 'refuse' undergoes contour simplification in a manner which is conditioned by the floating M that precedes it. The floating H of the prospective docks leftward.

(350)	/ōsɔ́	kà	H	M	gbɛ̌	nɔ̃̄/
	[ōsɔ́	kǎ			gbɛ̀	nɔ̃̄]
	horse	PROSP	IRR	IPFV	refuse	IPFV
	The horse wants to refuse.					
	sxw-L0272-auxiliaries-un.wav					

The examples in this section demonstrate the parallels between the future negative and the prospective constructions. The areas of semantic overlap for these two constructions and the corresponding areas of overlap in tonal phenomena strengthen the case for claiming that both make use of a bipartite marking for imperfective aspect as well as a floating tone which marks irrealis modality.

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[98] Like with negative future events, this implies that an event that is desired or about to occur is understood as unbounded.

5.6 Yes-no questions

Yes-no questions (YNQ) are marked in Saxwe by an IP-final L tone and a slight lengthening of the final syllable of the IP. In the following pairs, the first utterance is declarative and the second is a YNQ. In (351)b, the surface [HL] fall utterance-finally helps to distinguish the question from the declarative clause.

(351) a. /$^{M-}$ kōfí sɔ̃́/
[kōfí sɔ̃́]
Kofi leave
Kofi left.
sxw-L0075-YNquestions-un.wav

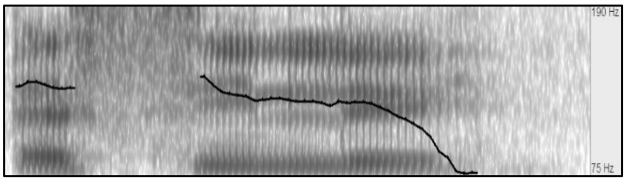
b. /$^{M-}$ kōfí sɔ̃́ ^{L} /
[kōfí sɔ̃̂:]
Kofi leave YNQ
Did Kofi leave?
sxw-L0076-YNquestions-un.wav

(352) a. /ɛ̄sĩ̄ lē/
[ɛ̄sĩ̄ lḕ]
water be.present
There is water.
sxw-L0077-YNquestions-un.wav

b. /ɛ̄sĩ̄ lē ^{L} /
[ɛ̄sĩ̄ lḕ:]
water be.present YNQ
Is there water?
sxw-L0078-YNquestions-un.wav

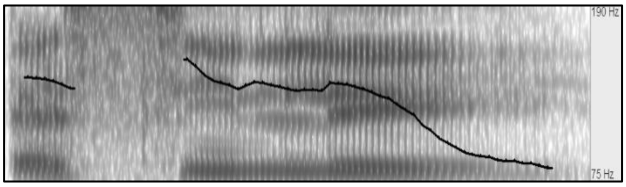
When a declarative clause ends with a surface fall to L or downgliding L because of the association of the right edge $L_{\%}$ IP boundary (section 3.5), the only auditory means by which its corresponding YNQ is differentiated from the declarative clause is by the lengthening of the last TBU of the YNQ, accompanied sometimes by a slight raising of pitch F_0 IP-initially. This is the case in (352)b. The following pitch traces from the utterances in (352) both cover a timespan of 0.70 seconds. The declarative clause is shown in (353), while the YNQ is shown in (354).

(353) Declarative – [ɛ̄sĩ̄ lɛ̂] 'there is water'



ɛ̄- sĩ̄ lɛ̂

(354) YNQ – [ɛ̄sĩ̄ lɛ̂:] 'is there water?'



ɛ̄- sĩ̄ lɛ̂:

The duration of the final vowel in the YNQ of (354) is longer than that of the corresponding declarative clause of (353).

We have seen in the analyses of imperfective aspect (section 5.1) and negation (section 5.2) that grammatical morphemes which in other Gbe languages have a segmental dimension are sometimes represented in Saxwe by a floating tone—a remnant on the tonal tier of a morpheme that historically had both segmental and tonal dimensions. This is again the case for the YNQ marker. In Fon, for example, the YNQ marker is an utterance-final [à] (Aboh, 2004, p. 30).

For YNQs in Saxwe, the marker is an IP-final floating L that docks leftward to the final TBU of the IP in accordance with rule B of Grammatical tone docking (327). The presence of this floating L does not explain why there is lengthening on the final vowel. This lengthening appears to be a concomitant prosodic characteristic of YNQs which is in addition to the L YNQ morpheme (just as other languages can have concomitant intonation and rhythm or tempo-related prosodic means of distinguishing a question).

There is some overlap in the marking of YNQs and the marking of negation in Saxwe. As discussed in section 5.2, the negative construction includes (as part of its bipartite marking) a L tone at the right edge of the negated clause. We have just seen that the YNQ marker is a L tone at the right edge of the IP. This situation can present potential confusion in distinguishing a clause marked for negation from a clause marked for negation and marked additionally as a YNQ.

There are two strategies used to distinguish the negative YNQ from the negative declarative clause. One possibility is that the floating L that normally serves as the YNQ marker can be preceded by /wɛ̄/, a focus marker that is otherwise used in marking constituent focus and clause-level focus. This is accompanied by a slight lengthening of the last vowel—the prosodic marking of a YNQ. The following is an example of the use of the /wɛ̄/ morpheme.

(355)	/$^{\text{M-}}$ kōfí	ɔ̄̀	sɔ̄́	wɛ̄	$^{\text{L}}$	$^{\text{L}}$ /
	[kōfí	ɔ̄̀	sɔ́	wɛ̂:]		
	Kofi	NEG	leave	FOC	NEG	YNQ
	Did Kofi not leave?					
	sxw-L0092-YNquestions-un.wav					

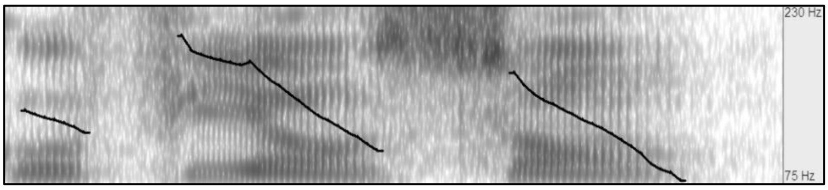
The other possibility is that for the negative YNQ, there are simply prosodic-level distinguishing factors, including a lengthening of the last vowel accompanied by a widening of the pitch F_0 range of the utterance—with pitch levels starting clause-initially at a slightly elevated F_0 compared to what is seen in the negative statement. The negative YNQ and negative declarative statement can be seen below.

(356)	/$^{\text{M-}}$ kōfí	ɔ̄̀	sɔ̄́	$^{\text{L/}}$
	[kōfí	ɔ̄̀	sɔ̂]	
	Kofi	NEG	leave	NEG
	Kofi did not leave.			
	sxw-L0082-YNquestions-un.wav			

(357)	/$^{\text{M-}}$ kōfí	ɔ̄̀	sɔ̄́	$^{\text{L}}$	$^{\text{L}}$ /
	[kōfí	ɔ̄̀	sɔ̂:]		
	Kofi	NEG	leave	NEG	YNQ
	Did Kofi not leave?				
	sxw-L0083-YNquestions-un.wav				

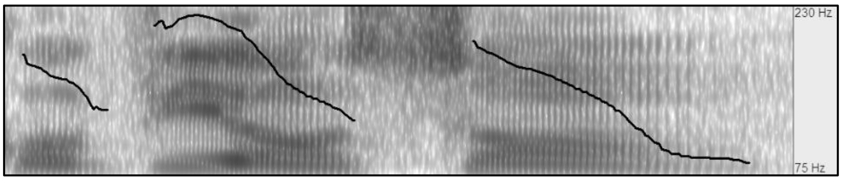
Both pitch traces shown below cover a time span of 0.80 seconds. The lengthening of the IP-final syllable can be seen in (359). In addition, we see that the H tone of this YNQ is raised quite a bit higher in F_0 than the H tone of the negative declarative clause.

(358) Negative declarative – [kōfí ɔ̀ sɔ̂] 'Kofi did not leave'



kō- fí ɔ̀ sɔ̂

(359) Negative YNQ – [kōfí ɔ̀ sɔ̂:] 'Did Kofi not leave?'



kō- fí ɔ̀ sɔ̂:

In many languages (particularly non-tonal languages), the pitch patterns associated specifically with YNQs can be attributed to intonational boundary tones. In this section, I have attributed the IP-final lowering seen in YNQs to a tonal morpheme accompanied by prosodic lengthening and a widening of the pitch range. The decision between what can be attributed to a tonal morpheme and what can be attributed to boundary tones is a topic that arises again in section 5.7, which looks at fronted topics.

5.7 Fronted topics

In Saxwe, there is a group of elements that appear in a fronted position before the subject and whose right boundaries are marked by a common distinctive pitch pattern. These include: pragmatic topics in fronted topicalization constructions, adverbs, temporal subordinate clauses, conditional clauses, and conjunctions. These are all categorized together under the general heading of 'topics' by Aboh (2004), who states that Gbe languages sometimes have specific morphemes—labeled as 'topic markers'—to mark the right edge of these topics. For example, Aboh identifies the topic marker in Gun as [yà]. He also notes that the presence of these topic markers is accompanied by 'comma intonation' (p. 51).

In Saxwe, there is no segmental morpheme which is a topic marker. Rather, there is a lowering and subsequent leveling or raising of pitch F_0 at the right edge of these fronted elements, as well as a pronounced lengthening of the rightmost syllable of the fronted element.

I analyze these pitch phenomena as being due to a right floating L topic marker followed by a $H_{\%}$ IP boundary. This combination of a lexically specified tone and an edge tone associated to a boundary is suggested as a possibility in Ladd (1996, p. 151).

The utterance in (360) includes a fronted topic, which is /ōsɔ́/ 'horse'. This is realized with a lengthened second syllable and a surface [HLH] contour.

(360)	/ōsɔ́	$^{\text{L}}$	$^{\text{H\%}}$ /
	[ōsɔ̃:]		
	horse	TOP	

/$^{\text{M-}}$ é	lē	ɖī	ōɦũ̌	ɦá/
[é	lé	ɖí	óɦũ̀	ɦǎ]
3SG	be	resemble	car	approximate

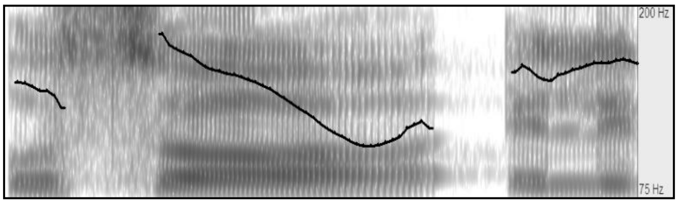
/nã́	$^{\text{M-}}$ mĩ́	lē	égbé/
[nã́	↓mĩ́	lé	↓égbé]
to	1PL	at	this.day

The horse, it was like a car is to us today.

sxw-T0128-texts-un.wav

The pitch trace for the first three words of this utterance is shown in (361).

(361) Pitch trace: [ōsɔ̃: é lé...]



ō- sɔ̃: é lé ...

Note the length of the last syllable of [ōsɔ̃:] 'horse' (underlying form /ōsɔ́/). The vowel in this syllable is significantly longer than the other vowels shown. Note also the pitch modulation of [ōsɔ̃:]. The lowering and subsequent slight upglide of pitch that occurs on the last syllable of this word is distinctive and can be recognized as different from the lowering that might occur at the right edge of an utterance because of the association of the right $L_{\%}$ IP boundary—an association which should not occur anyway in this environment, since /ōsɔ́/ ends with a H tone. This movement of pitch is attributed to the presence of a right floating L topic marker morpheme followed by a right $H_{\%}$ IP boundary.

This analysis is based on two arguments. First, there is the fact that other Gbe languages have a segmentally-represented morpheme that marks topics; it makes sense that the L here would be the lexical cognate of those markers.

Second, there must be an explanation for the pitch modulation of the last syllable of these topicalization structures, which always involves a leveling or slight upglide of pitch on a final L pitch level within the IP. This leveling or slight upglide of pitch indicates that the default $L_{\%}$ boundary is not associated to the final TBU of these structures. Instead, there is a right $H_{\%}$ IP boundary on these topics.

Cross-linguistically, a $H_{\%}$ IP boundary tends to be associated with non-finality or incompleteness, whereas a $L_{\%}$ IP boundary tends to be associated with completion (Ladd, 1996, p. 113). These fronted elements in a topicalized construction are obligatorily non-final within the utterance, so this presence of a $H_{\%}$ boundary in this position is consistent with this cross-linguistic tendency.

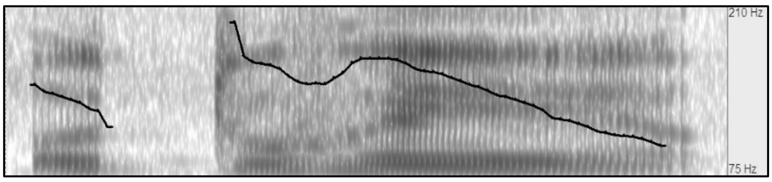
Upglide of pitch at this edge is not always seen following the L of the topic marker; more often, there is a pitch at the right edge of the fronted topic that is lowered initially and then simply levels off rather than falling to the bottom of a speaker's F_0 range as would be seen when a $L_{\%}$ IP boundary is linked to the final TBU. This is the 'comma intonation' referred to earlier (Aboh, 2004) and can be seen in (362) and (363), where the final F_0 ends at a frequency which is high enough above the speaker's lowest levels of pitch realization (just above 75 Hz) that the fronted topic sounds non-final.

(362)	/ōtú	xé	L	H% /
	[ōtú	xê°:		
	gun	DEM	TOP	

/ M- é=ɔ̃̀	ɲĩ́	ōtú	àdǒdwě	L /
[ɔ̃̂	ɲĩ́	ó↓tú	àdòdwê	
3SG:NEG	be	car	genuine	NEG

This gun, it is not a genuine gun.
sxw-L0023-other clauses-un.wav

(363) Pitch trace: [ōtú xê°: ...]



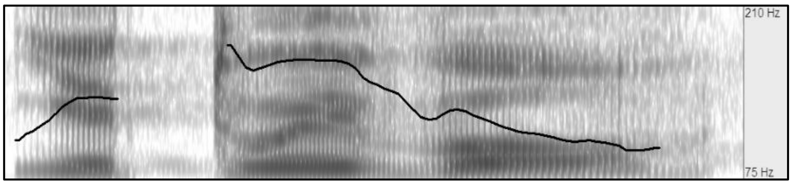
ō- tú xê°:

If the TBU of the last syllable of the topic bears L tone, the pitch F_0 will be leveled over a longer time period. This can be seen in (365), a pitch trace of the topicalized subordinate clause in (364).

(364) /M- jē H tó-V̄ vɔ̀ L H% /
[jē twé: vɔ̀°:]
3PL pound:3SG COMPL TOP

/M- jē H nā̄ fú-V̄/
[jē nā̄ fwî:]
3PL FUT winnow:3SG
When they have pounded it, they will winnow it.
sxw-T0027-texts-un.wav

(365) Pitch trace: [jē twé: vɔ̀°: ...]



jē twé: vɔ̀°:

What all of these cases have in common is that the final realization of pitch on the last syllable of the topicalized element is in the L pitch range and there is either a leveling or slight upglide of pitch F_0 observed for this L surface tone. This fact, as well as the pronounced lengthening, cues the listener to expect that the utterance will continue on this topic.

The $H_{\%}$ boundary can serve to make it clear that a clause that otherwise bears no indication of being a dependent clause is in fact a topic, and is therefore in a syntactically dependent relationship with the following clause. This can be seen in (366).

(366) / M- é nā̄ sō āwɔ̃̄-mɔ̃́ lá L H% /
[é nā́ só áw̃ɔ̃́-↓mɔ̃́ lâ°:]
3SG FUT bisect asphalt-path DEF TOP

/ M- é=ɔ̃̀ kpɔ̃́ ɖùsí/
[ɔ̃̂ kpɔ̃́ ɖùsí]
3SG:NEG see right

/ M- é=ɔ̃̀ kpɔ̃́ āmjɔ̃̄ H L /
[ɔ̃̂ kpɔ̃́ ámjɔ̃̂]
3SG:NEG see left NEG
When he was going to cross that paved road, he didn't look right and he didn't look left.
sxw-T0095-texts-un.wav, sxw-T0104-texts-un.wav, sxw-T0105-texts-un.wav

The dependent clause in (366) has no morpheme of subordination and, apart from the L topic marker and H$_{\%}$ boundary, is grammatically acceptable as an independent clause. It is the L topic marker and H$_{\%}$ boundary, along with the accompanying prosodic lengthening, that serves to indicate that from a semantic point of view, this clause is subordinate to the following one.

The L topic marker does not exist at the right edge of every syntactically fronted element in Saxwe. For example, a focused element in a focalization construction is not followed by this tonal morpheme, even though it too precedes the subject. In (367), the adverb /fífí/ 'now' is not immediately followed by any kind of tonal morpheme or tonal boundary.

(367)	/fífí	wɛ̄	$^{M-}$jē ^{H}	vǎ/
	[fífí	wɛ́	jé	và^{R}]
	now	FOC	3PL	come

They came [just] NOW.
sxw-L0017-NP boundary tests-un.wav

In (367), where there is no L topic marker or H$_{\%}$ boundary, the H from the adverb /fífí/ 'now' spreads to the focus marker and then on to the following pronoun.

In Saxwe, IP boundaries limit the domain of Tonal spread (section 5.9). Where there is a H$_{\%}$ boundary at the edge of a topic, there is no Tonal spread across this boundary. For example, in (368), where there is a H$_{\%}$ boundary, we see that there is no L spread from the completive marker /vɔ̀/ to the following pronoun.

(368)	/$^{M-}$jē ^{H}	tó-V̄	vɔ̀	^{L}	$^{H\%}$ /
	[jē	twé:	vɔ̀°:]		
	3PL	pound:3SG	COMPL	TOP	

/$^{M-}$jē ^{H}	nā̄	fú-V̄/
[jē	nā̄	fwî:]
3PL	FUT	winnow:3SG

When they have pounded it, they will winnow it.
sxw-T0027-texts-un.wav

To the right of the H$_{\%}$ boundary, the pitch realized for the following underlying M TBU is a surface M; there is no spread of L across this boundary.

In the Saxwe tone system, there are two right edge IP boundaries: the default right L$_{\%}$ IP boundary (section 3.5) and the H$_{\%}$ boundary discussed here which is associated with non-finality. Note that unlike the L$_{\%}$ IP boundary, the H$_{\%}$ IP boundary does not associate to a TBU, but is instead a mechanism to explain the fact that in certain syntactic contexts (like a topic-marking construction) which involve an element of non-finality, there is a failure of the final pitch F_0 to exhibit the lowering or downglide that would be expected otherwise at the right edge of an IP. In section 5.9, I show another syntactic context where the $H_{\%}$ IP boundary exists.

5.8 $H_{\%}$ boundary and leftward syntactic displacement

In Saxwe, leftward syntactic displacement (often in the context of a relativization or focus strategy) may cause the final clause in an utterance to contain a syntactic gap. When this happens in the context of an assertion, a $H_{\%}$ boundary becomes assigned to the right edge of the IP.

This phenomenon is seen by comparing (369), where the utterance ends with the verb /lē/ 'be.present/be.at' and there is no syntactic gap, with (370) and (371), where there is a syntactic gap. In each case the utterance ends with the same verb; in (369) there is a surface [HL] fall of pitch F_0, but in (370) and (371) there is no such fall.

(369) /ōxá lá lē $^{L\%}$ /
[ōxá lá lê]
broom DEF be.present
That broom is present [somewhere]. sxw-L0021-final fall tests-un.wav

(370) / $^{M-}$ kōfí kpɔ̃́ $^{M-}$ fí nã́ ōxá lá lē Ø $^{H\%}$ /
[kōfí kpɔ̃́ ↓fí nã́ ó↓xá lá lé]
Kofi see place REL broom DEF be.at
Kofi saw where the broom was. sxw-L0024-final fall tests-un.wav

(371) /blɛ́ $^{M-}$ é lē Ø $^{H\%}$ /
[blɛ́ ↓é lé]
there 3SG be.at
There it is. sxw-L0021-left boundary tests-un.wav

The gaps in (370) and (371) are both due to the leftward displacement of a syntactic element. In (370), the gap is in the restricting clause of a relative clause construction. In (371), the adverb /blɛ́/ 'there' has been moved leftward from its normal position after the locative verb. Associated to the right edge of both of these IPs is a $H_{\%}$ IP boundary.

We see another example of the tonal effect of a syntactic gap in the comparison of (372) and (373). The latter utterance has a gap in the restricting clause of the relative clause construction, and this gap appears at the right edge of the utterance.

(372) /$^{M-}$é sē $^{L\%}$/
[é sê]
3SG hear
He heard. sxw-L0014-final fall tests-un.wav

(373) /$^{M-}$é jí ōwā́ nā́ ōnū́ nā́ $^{M-}$é sē Ø $^{H\%}$/
[é jí ↓wā́ nā́ ↓nū́ nā́ ↓é sé]
3SG like (lit. receive odor) of thing REL 3SG hear
He liked the thing he heard. sxw-L0013-final fall tests-un.wav

In (372), there is a surface [HL] falling pitch as a result of $L_{\%}$ association, and in (373), there is an absence of this surface falling pitch as a result of the presence of the alternative $H_{\%}$ IP boundary. The syntactic gap at the right edge of the restricting clause in (373) conditions the presence of the $H_{\%}$ boundary.

We see this same $H_{\%}$ IP boundary in the contrastive focus construction in (374).

(374) /ōɲī̄ wɛ̄ $^{M-}$é sē Ø $^{H\%}$/
[ōɲī̄ wɛ̄ é sé]
cow FOC 3SG hear
He heard a COW [not something else]. sxw-L0134-focus markers-un.wav

The syntactic gap need not be at the right edge of the utterance for the $H_{\%}$ IP boundary to be observed. In (376), it is the subject which has been relativized and is absent in the restricting clause.

(375) /ōlā̄ xé ^{L} $^{H\%}$ $^{M-}$é ɲɔ̄̄ $^{L\%}$/
[ōlā̄ xê°: é ɲɔ̂]
meat DEM TOP 3SG be.rotten
This meat, it is rotten. sxw-L0039-final fall tests-un.wav

(376) /$^{M-}$kō kpɔ́́ ōlā̄ xéní́ Ø ɲɔ̄̄ $^{H\%}$/
[kō kpɔ́́ ólā́ ↓xéní́ ɲɔ́́]
1SG see meat REL be.rotten
I saw the meat that is rotten. sxw-L0040-final fall tests-un.wav

In (376) the syntactic gap is not at the right edge of the utterance, but there is still no final [HL] fall on the right edge of this utterance despite its underlying /M/ TBU. This is an indication that the syntactic gap of the relative clause has conditioned a $H_{\%}$ boundary rather than a $L_{\%}$ boundary.

We see this again in (377), where the imperfective marker /nɔ̄̄/ follows the syntactic gap in the relative clause.

(377) /$^{M-}$ kō	ɲɔ̄́	ɛ̄mɛ̄̄	nā́	$^{M-}$ jē ^{H}	^{M}	kā̄	Ø	nɔ̄̄ $^{H\%}$ /
[kō	ɲɔ̄́	ɛ́mɛ̄́	↓nā́	jé		kā́		nɔ̄́]
1SG	know	person	REL	3PL	IPFV	look.for		IPFV

I know the person they are looking for. sxw-L0038-final fall tests-un.wav

There is no surface [HL] fall at the end of the imperfective marker /nɔ̄̄/, as one would expect to see in a clause which has the default $L_{\%}$ IP boundary at its right edge.

Interestingly, in focus constructions where the subject is in focus, we also see evidence of the $H_{\%}$ boundary.

(378) / ōlā̄	mɛ̄̄	wɛ̄	Ø?	ɲɔ̄̄ $^{H\%}$ /
[ōlā̄	mɛ̄̄	wɛ̄		ɲɔ̄̄]
meat	DEM	FOC		be.rotten

THAT MEAT [and not some other] is rotten. sxw-L0045-final fall tests-un.wav

Here the presence of the $H_{\%}$ boundary seems to indicate that there is a syntactic gap in the rightmost clause. This raises a question of whether this is a focalization construction or rather a cleft construction (with the translation "It is THAT MEAT that is rotten").[99]

An analysis that posits the two possibilities of either a $H_{\%}$ boundary or a $L_{\%}$ boundary on IPs finds some support in other tonal studies, such as that of Kinande, which according to Hyman (1990) has two IP boundary tones. In that language, a L IP boundary tone marks a completed assertion; a noun in its citation form is a completed assertion, as is a simple clause. A question, however, is not a completed assertion and it gets the alternative H IP boundary tone.

This brings up the issue of what happens in Saxwe with questions. Interestingly, in Saxwe, a question has a $L_{\%}$ boundary rather than a $H_{\%}$ IP boundary associated to its right edge. This is true even when the rightmost clause of the question includes a syntactic gap. This means that the presence of a syntactic gap alone is not sufficient for predicting the absence of final pitch fall in Saxwe. Note the surface [HL] falling pitches at the right edge of the utterances in (379) and (380).[100]

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[99] Linguists studying the different Gbe variants are of differing opinions as to whether these are cleft constructions (comprised of two clauses) or focalization constructions (comprised of one single clause) (Ameka, 1992; Lefebvre & Brousseau, 2002).

[100] Unlike with yes-no questions, a WH question does not have a final floating L tone marker. For instance, we can take the case of the verb /sɔ̄́/ 'leave'. The question "where did he leave from" is [bō lɛ́ ↓é sɔ̄́] with a final surface H—a realization one would not have if there were a final floating L, but one would expect from a final H TBU in the presence of a $L_{\%}$ boundary

(379)

/bɔ̄	lɛ́	$^{\text{M-}}$é	lē	Ø $^{\text{L\%}}$/
[bɔ̄	lɛ́	↓é	lê]	
where?	FOC	3SG	be.at	

Where is it? sxw-L0006-questions-un.wav

(380)

/$^{\text{M-}}$ lōbwé	nɛ̃̄mṹ	lɛ́	$^{\text{M-}}$é	xɔ̄	Ø $^{\text{L\%}}$/
[lōbwé	nɛ̃́↓mṹ	lɛ́	↓é	xɔ̂]	
orange	how.many?	FOC	3SG	buy	

How many oranges did he buy? sxw-L0006-questions-un.wav

We can see the difference between the IP boundary tones assigned to the two following utterances, both of which have a syntactic gap in the object position.

(381)

/ɛ̄-lɛ́	$^{\text{M-}}$jē $^{\text{H}}$	bɔ̄	Ø $^{\text{L\%}}$/
[ɛ̄-lɛ́	jé	bɔ̂	
what?- FOC	3PL	gather	

What did they gather? sxw-L0051-final fall tests-un.wav

(382)

/nã̄ké	wɛ̄	$^{\text{M-}}$jē $^{\text{H}}$	bɔ̄	Ø $^{\text{H\%}}$/
[nã̄ké	wɛ́	jé	bɔ́	
firewood	FOC	3PL	gather	

They gathered FIREWOOD [not something else]. sxw-L0052-final fall tests-un.wav

The difference between these two clauses is that a H$_{\%}$ IP boundary is assigned to the assertion which contains a syntactic gap (382), while the default L$_{\%}$ boundary is assigned to the question which contains a syntactic gap (381).

If we consider that the H$_{\%}$ IP boundary is most commonly associated with non-finality or incompleteness (Ladd, 1996), this raises the issue of whether a question which has a syntactic gap is considered complete for the reason that the syntactic gap is a necessary and expected feature of WH questions. Conversely, in the context of an assertion, a syntactic gap flags a clause as incomplete. It is as if the H$_{\%}$ IP boundary serves to highlight the relationship between the information in the incomplete clause and the element that has been displaced out of that clause and therefore comes earlier in the utterance.

Before closing, I note that there is some variation among speakers with regard to the H$_{\%}$ IP boundary. All the speakers I observed have this boundary on assertions where the syntactic gap is on the far right edge of the utterance. However, the further away from the right edge of the utterance the gap is located, the more of a possibility that some speakers will employ the default L$_{\%}$ boundary rather than the H$_{\%}$ boundary. I have represented here the data obtained from my primary language

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since L$_{\%}$ association would be prevented by the presence of the H.

consultant. This is a topic that deserves further study. It would also be useful to do a comparison of what happens across Gbe languages in similar syntactic structures.

I turn now to another topic having to do with IP boundaries before summarizing the findings of this chapter.

5.9 Correspondences between IPs and syntactic structures

In section 3.5, I discuss the $L_{\%}$ boundary tone which, by default, exists on the right edge of every IP. The rule of $L_{\%}$ association states that the $L_{\%}$ IP boundary tone will become associated to the final TBU of the IP if the final tone of the IP is a non-H tone (either M or L). In addition to being sensitive to tones that are lexically associated to a TBU, this operation of $L_{\%}$ association is sensitive to floating tones and boundary tones.

I do not generally mark the default $L_{\%}$ boundary in underlying forms because its presence is assumed unless noted otherwise and because its association to a TBU (when the environment is right for this to occur) is indicated during the application of the rule of $L_{\%}$ association. Here in this section and the following, however, I mark its presence exhaustively because its presence is related to the topic of study.

In the prototypical case, the IP corresponds with a syntactic clause. However, there is not necessarily a one-to-one correspondence between the IP and the syntactic clause. This lack of one-to-one correspondence is the topic of this section.

The IP can be defined in different ways. Linguists focus on various criteria to define the IP, including the mapping of syntax to phonology, semantic considerations, prosodic cues, and tonal phenomena, particularly that which is boundary-related (Ladd, 2001).

In Saxwe, a phonologically-driven definition for the IP is that it is the domain in which tone will spread (section 3.2). This being the case, tonal spread can be a litmus test for determining where the boundaries of an IP lie. This definition is not, in the majority of cases, at odds with semantic and syntactic criteria; generally, tone spreads within predictable syntactic units and within domains of semantic interpretation. However, there are some IP boundaries that cannot be predicted based purely on syntactic and semantic considerations.

In an utterance composed of two fairly short coordinate clauses that share the same subject, the IP may encompass both clauses. This is seen in (383).

(383)	/$^{M-}$é	fɔ̃́	bō	sɔ́	ōnṹ	lá $^{L\%}$/
	[é	fɔ̃́	bó	↓sɔ́	ó↓nṹ	lá]
	3SG	awaken	CONJ	take	thing	DEF

He awoke and took the thing.
sxw-L0001-clause connectives-un.wav

The clearest indication that (383) represents a single IP is that H tone spreads from the verb /fɔ̃́/ 'awaken' to the following conjunction marker /bō/ and the M tone delinked from this conjunction marker triggers non-automatic downstep of the following H on the verb /sɔ́/ 'take'.

In an utterance that includes multiple independent syntactic clauses, the situation can be more complex. This is seen in the following utterance.

(384)	/kòfí	fɔ̃́	bō	fṹ	wṹmɛ̃̄ $^{L\%}$/
	[kòfí	fɔ̃́	bó	↓fṹ	ŋ́ʷmɛ̃̂]
	Kofi	awaken	CONJ	splash	face
	/bō	dǒ	ōgbè	nã	ōtɔ́ $^{L\%}$/
	[bō	dò	ògbè	nã̀	òtɔ́]
	CONJ	put	speech	to	father
	/bō	lɛ̄	ɛ̄sĩ̄ $^{L\%}$/		
	[bō	lɛ̄	ɛ̄sĩ̄̀…]		
	CONJ	sprinkle	water		

Kofi awoke, and splashed his face, and greeted his father, and showered...
sxw-L0001-multi-clause utterances-un.wav

In (384), we have four syntactic clauses and three IPs. The right edge of the first IP is found after the second syntactic clause rather than after the first. The evidence for this is in the fact that H tone is spread to the first conjunction /bō/ and it is realized H; otherwise the tone on /bō/ would be realized M.

At the end of the first IP (the second syntactic clause), there is a right edge $L_{\%}$ boundary. This boundary tone associates to the final TBU of the IP, creating a surface [HL] falling contour.

At the beginning of the second IP (the third syntactic clause), the conjunction /bō/ is realized M; there is no tonal spread across the first IP's right boundary. At the right edge of the second IP, the $L_{\%}$ boundary does not become associated to the final TBU because of the presence of a H tone on the final TBU of /ōtɔ́/. This being the case, there is no final falling pitch at the end of this IP. We can infer, however, that there is an IP boundary between [ōtɔ́] and the conjunction /bō/ of the third IP because we see that /bō/ (the first TBU of the third IP) is realized M rather than H.

So far, the examples given have been clauses in coordination that share a same subject. When two clauses in coordination have different subjects, the two clauses can no longer be encompassed by a single IP. An example of this is seen in (385), where the subject of the second clause is followed by the coordinating conjunction.[101]

(385)	/ $^{\text{M-}}$ kōfí	xɔ̄	ōtú $^{\text{L\%}}$ /
	[kòfí	xɔ́	ó$^{\downarrow}$tú]
	Kofi	buy	gun

/ōtɔ́	bō	xɔ̄	ōlǐ̃ $^{\text{L\%}}$ /
[ōtɔ́	bó	xɔ́	ólì̃$^{\text{R}}$]
father	CONJ	buy	hoe

Kofi bought a gun and his father bought a hoe.
sxw-L0024-other clauses-un.wav

Here, the right edge $L_{\%}$ boundary of of the first IP does not associate to the final TBU of IP because of the presence of a H tone on this TBU. However, this boundary prevents Tonal spread, and the initial underlying M of the second IP is realized at the surface level as M rather than H.

Another example of this is given in (386), an excerpt from a procedural text about cultivating beans.

(386)	/...$^{\text{M-}}$ é	bā	xú $^{\text{L\%}}$ /
	[é	bá	$^{\downarrow}$xú]
	3SG	CONJ[102]	dry

/ $^{\text{M-}}$ jē $^{\text{H}}$	bā	bɛ́-V̄ $^{\text{L\%}}$ /
[jē	bā	bɛ̂:]
3SG	CONJ	gather-3SG

... and it will dry, and they will gather it.
sxw-T0033-texts-un.wav

Here again we see that there is no H spread from the last TBU of the first IP to the initial TBU of the second IP.

We see in this section that the mapping of IPs to syntactic structures is not always a one-to-one affair. Prototypically, every syntactic clause is mapped as a separate IP, but it is possible that two coordinate clauses may be encompassed by a

[101] This same ordering of the subject and the coordinating conjuction is seen in Yoruba but not, to my knowledge, in the Gbe variants that have been documented thus far.

[102] The conjunction /bā/ is used only in a future or habitual framework where the subject of the clause is different from that of the previous clause.

single IP. This is most likely to be the case if: (1) the two clauses share the same subject; (2) the first clause does not contain a direct object; and (3) the second clause does not repeat the subject.

5.10 Conclusions

This chapter deals with a number of topics related to grammatical tone and intonational boundaries—both of which are observed at the clause and text levels rather than at the word level. While grammatical tone and intonational boundaries may seem at first glance to be quite distinct, we see that in Saxwe, the decision regarding which pitch-related phenomena to attribute to grammatical tone and which to attribute to an intonational boundary is not necessarily a simple one. In this study I adopt the explicitly phonological approach to intonation (Bruce, 1977; Ladd, 1996; Pierrehumbert, 1980; Pierrehumbert & Beckman, 1988) whereby intonational pitch across an utterance can be attributed to tones that are related either to local prominences (or lexically-assigned tone in the case of tonal languages) or to boundaries.

Assuming this phonological approach to intonation, an utterance-final grammatical floating tone will produce different surface realizations from a tonally identical intonational boundary only if its association to a TBU is governed differently. This means that a floating tonal morpheme on the edge of an IP can be difficult to distinguish from a intonational boundary tone. One guiding principle in this study is that a boundary tone tends to be structurally-driven and is therefore assigned in the presence of certain structural conditions (whether phonological or morphosyntactic) that are generalizable—such as the presence of a syntactic gap in the final clause of an assertion or the fronting of a constituent. This is different from a floating tone which marks a particular semantic distinction such as negation or irrealis modality. Yes-no questions present the hardest case for deciding whether they are represented by an intonational boundary tone or a tonal morpheme. In a selection of African tonal languages summarized by Downing and Rialland (2017b), pitch-lowering trends at the edge of the IP (combined with register raising or expansion in some cases) are seen to be commonly associated with yes-no questions, and this is most frequently labeled as intonational tone. There is some reason, however, to posit the notion of a floating L morpheme marking yes-no questions in Saxwe, and this is discussed below.

In sections 5.1 through 5.7, we see that Saxwe has a number of grammatical morphemes that are represented by a floating tone. Many of these grammatical floating tones have cognates in other Gbe languages that have a segmental component. The following is a summary of some of these cognates. The Saxwe and Aja data come from my own field notes and the rest come from Aboh (2004).

(387) Tonal morphemes in Saxwe compared to their Gbe cognates
(Aboh, 2004, pp. 30, 34, 36, 43–47)

imperfective aspect	lè … ɔ̀	Gen	Note: for all languages except Saxwe, imperfective aspect involves SOV word order; the first of these markers precedes the object and the second follows the verb
	tò … / ^{L} /	Gun	
	ɖò … wɛ̀	Fon	
	lè … ḿ	Ewe	
	lè … kɔ̀	Aja	
	/ ^{M} / … nɔ̃̄	Saxwe	
clausal negation	má (preverbal)	Gun	
	má (preverbal) *or* ǎ (clause-final)	Fon	
	mú … ò	Gen	Note: for Gen, Ewe, Aja, and Saxwe, the first marker is preverbal and the second is clause-final
	mē … ō	Ewe	
	dé … ò	Aja	
	ɔ̃̀ … / ^{L} /	Saxwe	
yes-no questions	à	Fon	Note: all of these markers are clause-final
	/ ^{L} /	Gun	
	/ ^{L} /	Adan	
	à	Aja	
	/ ^{L} /	Saxwe	
fronted topics	yà	Gun	Note: all of these markers follow the fronted topic
	lá	Ewe	
	ɔ̀	Aja	
	/ ^{L} /	Saxwe	

We see in this summary that the Gbe varieties differ along a spectrum as to whether all of their markers have a segmental dimension or whether there is a mix of those markers that have a segmental dimension plus those that are purely autosegmental.

If we consider that the differences between these Gbe varieties reflect historic sound changes, there are two ways of looking at the matter. If the direction of sound change is toward loss of segmental information, then Saxwe would be considered to be on the innovative end of the spectrum (with Gun perhaps next), because so many of these morphemes that have a segmental dimension in the other

Gbe varieties are simply autosegmental in Saxwe. On the other hand, if the direction of sound change is toward assigning segmental information to autosegmental morphemes, Saxwe would be considered to be on the conservative end of the spectrum.

A similar trend can be seen when we compare the marking of negative future events. As far as I am aware, Saxwe is the only Gbe variety that does not employ a combination of future and negation markers for this purpose, but instead has a floating H tone (marking irrealis modality) that distinguishes negative future events from negative present imperfective events (section 5.4).

In this chapter, we see that there are two possible IP boundaries: a default $L_{\%}$ IP boundary and an alternative $H_{\%}$ IP boundary. Section 5.8 describes the fact that an assertion which contains a syntactic gap in its final clause is assigned a $H_{\%}$ boundary. This $H_{\%}$ IP boundary is generally associated with non-finality or incompleteness and may serve to flag the connection between the incomplete information within the clause and the displaced element that precedes it in the utterance.

In this respect the $H_{\%}$ IP boundary bears some similarity to the H_{ω} PW boundary if we consider that the H_{ω} boundary may serve to flag the connection between a PW and a preceding element (such as a prefix or a noun in a noun compound) when the two function together in a nested structure of recursive PWs (section 4.1). We could say that the innermost right PW is no longer complete in itself, but is completed—yielding a new lexical sense—by the element that precedes. In both cases, then, there is an incompleteness about the rightmost unit (whether it is a clause or a PW), and the information missing in this rightmost unit is completed by an element that precedes it in the utterance. The H boundary alerts the listener to this reality.

This same $H_{\%}$ boundary is also assigned to a topic in a fronted topicalization construction (section 5.7). These topics are clearly non-final and it is perhaps because of this that they too are assigned the $H_{\%}$ boundary.

A $H_{\%}$ boundary co-occurring with a fronted constituent is not unusual in African tone languages (Downing & Rialland, 2017b). Here in Saxwe, the $H_{\%}$ IP boundary does not associate to a TBU, but prevents IP-final falling or downgliding pitch. This is slightly different from the default $L_{\%}$ IP boundary which does associate to a TBU if the final tone in the IP is non-high.

The correspondence between IPs and syntactic clauses is explored in section 5.9, where it is shown that there is some variability in the correspondence between IPs and syntactic clauses; it is not always a one-to-one relationship.

In this study of Saxwe tone, chapter 3 provides the groundwork for understanding the Saxwe tonal system, including: (1) an analysis of underlying tones in Saxwe; (2) monomorphemic noun and verb tone patterns; and (3) many of the postlexical tone rules. Chapter 4 looks at word-level tonal phenomena in Saxwe, including the floating M- tone and the H_{ω} PW boundary. In that chapter, I also describe a number of ways in which tone is assigned in various word-formation or lexicon-building strategies in Saxwe. The present chapter rounds out the analysis of the Saxwe tonal system by looking further at tonal issues having largely to do with grammatical tone and tonal boundaries. These chapters together provide a general overview of Saxwe tone in its various roles and dimensions.

I turn now to chapter 6, which examines Saxwe tone system in light of a feature model of tone, before continuing with details regarding the phonetic implementation of tone in Saxwe followed by final conclusions.

6 The features of H, M, and L

This chapter discusses how the atomic units H, M, and L described thus far can more profitably be understood by assigning tonal features to these units. Although it has been questioned whether there is value in a universal feature model for tone (Clements et al., 2010; Hyman, 2010), I argue in this chapter that a feature model of tone is very useful in explaining the assymetries that exist in the Saxwe tonal system. This chapter also serves as a preface to chapter 7, in which the details of the phonetic implementation of tone are examined in light of this feature model of Saxwe tone.

6.1 Background – the Two-Feature model and underspecification

The predominant feature model for tone is that of Yip (1980, 1989) and Clements (1981), often referred to as the Two-Feature Model. In this model, the TBU dominates a prosodic level that describes register, described as either [+upper] or [-upper]. Each of [+upper] and [-upper] is in turn subdivided into [+raised] and [-raised] (the latter terminology introduced by Pulleyblank (1986)). This results in four hierarchically related tone levels.

(388)

[+upper]	[+raised]
	[-raised]
[-upper]	[+raised]
	[-raised]

Tone designations such as H, M, and L are assigned positions with repect to this hierarchy. Different sets of labels have been given to these four levels: {high, mid, lower mid, and low} (Hyman, 2011a), and {super-high, high, mid, and low} (Clements et al., 2010; Odden, 2010).

(389)

		Hyman (2011a)	Clements et. al. (2010) Odden (2010)
[+upper]	[+raised]	H	super H
	[-raised]	M	H
[-upper]	[+raised]	lower M	M
	[-raised]	L	L

In a three-tone system, there could theoretically be two ways to characterize the M tone. As seen in (389), M could be either [+upper] [-raised], or [-upper] [+raised]—depending perhaps on whether M is seen as having more in common with H or L (Hyman, 2010).

Pulleyblank (1986), using the Two-Feature Model for tone, assigns the features shown in (390) to Yoruba phonetic heights H, M and L. These three phonetic heights are analyzed as being underlying H, Ø, and L. Only the features specified in the first column of (390) are pre-assigned to H and L underlyingly.[103] If no feature is assigned to a given TBU, it is toneless. Default rules supply the features [-upper] and [+raised]. To summarize, for Yoruba H, M and L phonetic heights, H and L are considered to be underspecified, and M is considered to be unspecified.

(390)		**Underlying**	**After application of default rules**
	H	[+upper]	[+upper, +raised]
	M	Ø	[-upper, +raised]
	L	[-raised]	[-upper, -raised]

The arguments for claiming that there is 'tonelessness' in Yoruba include the following (Pulleyblank, 1988, 2004).

1. A [M] vowel is easily elided in certain contexts in Yoruba and loss of the vowel does not entail phonetic perturbations to the adjacent H or L tones.
2. The tonal height [M] is associated with optionally epenthetic initial vowels on nouns (and the epenthesis of these vowels presumably does not entail phonetic perturbations to adjacent H and and L tones).
3. There are OCP effects observed with certain H and L affixes, but not with M affixes.
4. Lexical tonal contours in Yoruba do not involve M.

The decision regarding whether to consider that a language's tonal system includes TBUs unspecified for tone is a complex one. Hyman (2001a) and Hyman (2011a) provide several criteria for considering this issue. In general, surface tones may be underlyingly unspecified if they are inactive phonologically. This can be manifested in several ways. For example:

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[103] In a subsequent analysis, Pulleyblank (2004) argues against the underspecification account, explaining the asymmetries in tonal behavior instead in terms of markedness and OT-framed constraints.

1. Unspecified tones should not be manipulated in phonological rules such as rules of tone spread, tone shift or tone dissimilation.
2. Morphological rules should not assign a tone which is underlyingly unspecified.
3. Surface tones which are underlyingly unspecified should not appear in tonal contours.
4. A tone which is underlyingly unspecified should not be present as a floating tone.
5. Generally, only tones that are specified underlyingly would have constraints on their position within a prosodic unit.

Given the background of the case for Yoruba, we can turn to the question of how Saxwe tone can be explained using the Two-Feature model and the theory of underspecification.

6.2 Saxwe and the Two-Feature model

There are two questions that need to be answered in a discussion of how to describe Saxwe tone in terms of features. First, there is the question of whether there is a true M in Saxwe, or whether there are instead toneless TBUs. Second, there is the question of which feature combinations might make up the three surface tonal heights H, M, and L, and how these features are specified underlyingly.

I address first the issue of whether there are toneless TBUs in Saxwe. I believe that the most simple and clearly justifiable position one can take is that there is an underlying M. The reasons for this position are given in the paragraphs below. However, I believe that it would also be possible to make a case for there being toneless TBUs in Saxwe, and I give later in this section a brief description of how the analysis of tone might look if this position were taken.

6.2.1 The case for a M analysis

The first argument in favor of a M analysis is that when there is elision of a vowel bearing M tone, any following tones behave in ways which indicate that the M tone is still present as a floating tone (section 4.2). In Yoruba, underlying /rí igbá/ or [rí] + [īgbá] 'see calabash' becomes [rígbá] (Pulleyblank, 1986, p. 109). In a similar context in Saxwe, despite the loss of a word-initial M vowel, there will still be the triggering of non-automatic downstep on a following H TBU (example (391)b) or the simplification of a following underlying LH contour in a manner that delinks the H (example (391)d)—both of which indicate that the M tone is present even though the vowel is elided.

(391)	a.	/kplā́ ōnū́/	→	[kplā́ óꜜnū́]	learn something
				or	(lit. learn thing)
	b.		→	[kplā́ ꜜnū́]	
	c.	/kplā́ ōdā̌/	→	[kplā́ ódā̀^{R}]	learn a job
				or	(lit. learn work)
	d.		→	[kplā́ dā̀^{R}]	

By way of comparison, we see that in morphological word formation where a M vowel is elided word-internally and there is simultaneous deletion of the tone as well as the vowel, non-automatic downstep is not triggered on a following H (example (392)b) and a following underlying LH contour is not simplified in a manner that delinks the H, but rather in a manner that delinks the L (example (392)d).

(392)	a.	/kplā́ ōnū́/	→	[kplā́ ꜜnū́]	learn something
					(lit. learn thing)
	b.	/āɖí/ + /ōfū́/ $^{H\omega}$	→	[āɖí-fū́]	soapsuds
					(lit. soap fur)
	c.	/kplā́ ōdā̌/	→	[kplā́ dā̀^{R}]	learn a job
					(lit. learn work)
	d.	/ōló/ + /ōvǐ/ $^{H\omega}$	→	[ōló-ví]	baby crocodile
					(lit. crocodile child)

So this is the first argument in favor of M—the fact that a M vowel may be elided either (a) in a way that indicates that the M tone is left floating, or alternatively, (b) in a way that indicates that the M is elided along with the vowel. In the former case, the floating M tone is the single mechanism responsible for two types of tonal phenomena: the triggering of non-automatic downstep and the simplification of an underlying LH contour such that the H tone (rather than the L tone) is delinked. In an analysis that employs tonelessness rather than a M tone, achieving a simple mechanism that explains all of these variations is slightly more complicated. This is explored in section 6.2.2, which addresses also the issues raised in the paragraphs which follow.

The second argument is that there are a few lexical floating M tones which are not word-initial and which are not synchronically the result of the elision of a vowel, although this may have been their origin in a diachronic process (section 3.7.4). Utterance-finally, the presence of the floating M provides the correct environment for the default $L_{\%}$ IP boundary to associate to the right edge of the IP (example (393)a). The evidence of the presence of the floating M tone IP-medially is that following these words, H tones are downstepped (example (393)b) and underlying LH contours are simplified by delinking the H (example (393)c).

(393)	/ōklá ^{M}/	[ōklâ]	soul sxw-L0018-VCV nouns-soul-un.wav
	/ōklá ^{M} sɔ̃́/	[ōklá $^{\downarrow}$sɔ̃́]	The soul left. sxw-L0131-clause frames-un.wav
	/ōklá ^{M} vǎ/	[ōklá và^{R}]	The soul came. sxw-L0132-clause frames-un.wav

A third argument in favor of a M analysis is that there is a floating M- tone found at the left edge of any word that has the syntactic role of being the head of a noun phrase (section 4.3) and that does not already have an initial vowel. This M- floating tone is likely a vestigial remnant of a historic noun class-marking system, present on all nouns which are realized without one of the initial vowels /a/, /ɛ/, or /o/—either (a) because they never had an initial vowel, or (b) because the initial vowel has been elided through diachronic processes, or (c) because the initial vowel is elided in synchronic processes (sections 4.4.1 and 4.4.2). Because these initial vowels are normally linked to M tone in Saxwe, it is reasonable to consider that when these initial vowels are elided in synchronic or diachronic sound changes, the tone that is left behind as a floating tone would be M rather than L.

The left floating M- tone on nouns functions in the tonal system just like any other floating M tone, and is the mechanism that triggers two things: the downstep of H tone and the simplification of underlying LH contours by delinking the H. We see it in the following example which involves a noun-noun compound.

(394)	/$^{M-}$jē ^{H}	kpɔ̃́	**$^{M-}$fí-zɔ̀ $^{H\omega}$**	lē	blɛ́/
	[jē	kpɔ̃́	**$^{\downarrow}$fí-zɔ̀**	lè	blɛ́/
	3PL	see	ashes-smoke	at	there

They saw dust there. sxw-L0019-other clauses-un.wav

The floating M- tone is also present on nominalizations of various kinds, including nouns derived from verbs, as demonstrated in (395) (section 4.4.3).

(395)	/$^{M-}$é	kpɔ̃́	**$^{M-}$tí-tá $^{H\omega}$**	lá/
	[é	kpɔ̃́	**$^{\downarrow}$tí-tá**	lá]
	3SG	see	RED-draw	DEF

He saw the [one] drawn. sxw-L0077-verb reduplication-un.wav

This floating tone precedes words of other lexical categories that may fill the syntactic role of head of a noun phrase, as the demonstrative does in (397).

(396)	/$^{M-}$jē ^{H}	kpɔ̃́	ōtú	xé/
	[jē	kpɔ̃́	ó$^{\downarrow}$tú	xé/
	3PL	see	gun	DEM

They saw this gun. sxw-L0002-NP boundary tests-un.wav

(397) /$^{\text{M-}}$ jē $^{\text{H}}$ kpɔ̃́ $^{\textbf{M-}}$ **xé**/
[jē kpɔ̃́ ↓**xé**/
3PL see DEM
They saw this [one]. sxw-L0003-NP boundary tests-un.wav

A fourth argument for the M analysis is that there are first and third singular object suffixes that are affixed to verbs in Saxwe and that are represented by a M tone linked to a vowel slot on the segmental tier whose features are underspecified (section 4.6). The 1SG pronominal suffix, for example, is a M suffix specified only as being [back]. The M component of this affix is important, as its presence is the mechanism responsible for three tonal phenomena. The first of these phenomena is that IP-finally, the M tone provides the correct environment for the right $L_{\%}$ IP boundary to associate to the TBU of an underlyingly H verb, creating a surface [HL] pitch fall. This is seen in (398).

(398) /$^{\text{M-}}$ é **kó=V̄**[back]/
[é **kô:**]
3SG laugh=1SG
He laughed at me. sxw-L0044-verb plus pronoun-un.wav

When the verb is not utterance-final, as in (399), the M tone triggers either (a) non-automatic downstep on a following H, as shown in (399), or (b) the simplification of a following LH TBU such that the H is delinked.

(399) /$^{\text{M-}}$ é kó=V̄[back] fí/
[é kó: ↓fí]
3SG laugh=1SG now
He laughed at me just now. sxw-L0070-verb plus pronoun-un.wav

A fifth argument in favor of the M analysis is the existence of the grammatical floating M tone that marks imperfective aspect (section 5.1). This floating M may have originated diachronically from the elision of a segmental preverbal auxiliary identical in form to the post-argument imperfective auxiliary which accompanies it. (To my knowledge, Saxwe is unique among the Gbe varieties in having this post-argument marker.) In looking at imperfective preverbal auxiliaries in other Gbe varieties and the post-argument marker in Saxwe, it seems reasonable to assume that a cognate of these in Saxwe would have had M tone prior to the loss of segmental information.

The imperfective floating M tone is the mechanism which triggers two familiar processes: the downstep of following H tones (example (401)) and the simplification of following underlying LH contours by delinking the H (example (403)).

(400)	/$^{\text{M-}}$ é	sɔ̃́/		
	[é	sɔ̃́]		
	3SG	leave		
	He left.			

(401)	/$^{\text{M-}}$ é	$^{\text{M}}$	sɔ̃́	nɔ̃̄/
	[é		↓sɔ̃́	nɔ̃̂]
	3SG	**IPFV**	leave	IPFV
	He is leaving.			
	sxw-L0109-auxiliaries-un.wav			

(402)	/$^{\text{M-}}$ é	vǎ/		
	[é	vá]		
	3SG	come		
	He came.			

(403)	/$^{\text{M-}}$ é	$^{\text{M}}$	vǎ	nɔ̃̄/
	[é		và	nɔ̃̀]
	3SG	**IPFV**	leave	IPFV
	He is coming.			
	sxw-L0115-auxiliaries-un.wav			

A sixth argument in favor of the M analysis is that fact that there is a floating M at the right edge of many words borrowed from English (section 4.7)—those that do not have a L tone at their right edge. Words which have stress on the final syllable in English are borrowed into Saxwe as having H tone on the final vowel, followed by a floating M tone.

(404)	a.	/$^{\text{M-}}$ sùklú $^{\text{M}}$/	[sùklû]	school	sxw-L0007-borrowed words-un
	b.	/$^{\text{M-}}$ sìgá $^{\text{M}}$/	[sìgâ]	cigarette	sxw-L0014-borrowed words-un

Because the rightmost floating tone is non-high, the default right $L_{\%}$ boundary associates to the final TBU of the word in isolation as described by the rule of $L_{\%}$ association in (94). The combination of having both a H tone and a $L_{\%}$ boundary associated to the same TBU creates the surface [HL] falling pitch.

In addition to being the mechanism that provides the correct environment for the association of the default right $L_{\%}$ boundary IP-finally, the floating M tone on the right edge of borrowed words is the mechanism that triggers the downstep of a following H tone and the simplification of underlying LH contours by delinking the H.

(405) Evidence of the right floating M on borrowed nouns

/$^{M-}$ é kpɔ̃́ $^{M-}$ sùklú ^{M} lá/	[é kpɔ̃́ sùklú $^{\downarrow}$lá] sxw-L0058-borrowed words-un	He saw the school.

In all of the arguments discussed up to this point, there are three tonal processes (IP-final association of the $L_{\%}$ boundary, non-automatic downstep of H, and the simplification of an underlying LH contour by delinking the H) that all have a single mechanism (the floating M tone) which is responsible for enabling them to occur. In some of these contexts, we see that the floating M tone could be seen as the result of the historical loss of segmental information that was once linked to M tone. A toneless analysis will likely be unable to account for all of these processes in all of these various contexts by a single mechanism. This is explored further in section 6.2.2. First, however, I present two more arguments in favor of the /H, M, L/ analysis.

A further argument in favor of the M analysis is the fact that IP-finally we find both a level [M] surface realization as well as a falling [ML] surface realization. This difference in surface realizations reflects a phonemic reality, which is the presence of a floating H. This could be a lexical floating H tone which is found on some noun tone patterns (sections 3.7.3 and 3.7.7) or the PW boundary H_{ω} tone which is found in constructions like noun-noun compounds which involve a right edge nested $]_{PW}]_{PW}$ structure (section 4.1.2).

The following examples show the difference between the IP-final [M] and [ML] surface realizations at the right edge of the IP when we have different underlying tone patterns. The noun /āmã̄ ^{H}/ 'leaf' has a lexical floating H tone at its right edge that prevents the association of the default $L_{\%}$ IP boundary, whereas the noun /ōxɛ̄/ 'bird' has no floating tone. The phonetic details of the implementation of these noun tone patterns are examined more fully in section 7.5.

(406) Utterances containing the /M.M/ and /M.M ^{H}/ noun tone patterns

a.	/$^{M-}$ ō xɔ̄ ōxɛ̄/	[ō xɔ̄ ōxɛ̄̀]	You bought a bird.	sxw-L0208-clause frames-un.wav
b.	/$^{M-}$ ō xɔ̄ āmã̄ ^{H}/	[ō xɔ̄ āmã̄°]	You bought leaves.	sxw-L0252-clause frames-un.wav

In the examples below, we see the difference between the IP-final [M] and [ML] surface realizations even though the same lexical form appears at the right edge of two different utterances. The lack of [ML] surface realization in (406)b is due to the presence of the boundary H_{ω} tone which prevents the association of the default $L_{\%}$ IP boundary (section 4.1.2).

(407) Compounds ending with a /M.M/ noun

a.	/ōkā̄/	cord	[ōkā̄]	cord
		sxw-L0259-VCV nouns-rope, cord-un.wav		
b.	/ālī̄/ + /ōkā̄/ $^{H\omega}$	waist+cord	[ālī̄-kā̄°]	belt
		sxw-L0063-polymorphemic nouns-un.wav		

The fact that M tone is realized IP-finally both with and without a final lowering of pitch as a reflection of phonemic contrasts shows that this lowering of pitch (the [ML] surface realization) is not simply a phonetic phenomenon. The lack of association of an IP-final $L_{\%}$ boundary is influenced by a floating H tone. If one adopts a toneless analysis, one might need to account for why H tone is found lexically floating at the end of a word that has no underlying tones associated to it. One might also need to explain why the association of a $L_{\%}$ boundary to an utterance of toneless TBUs results in a phonetic implementation where there is a [M] realization throughout the utterance up to and including the first part of the realization of the final vowel. The details of the phonetic implementation of M tone utterances are explored more fully in section 7.2.

A final argument in favor of the M analysis is that there are floating L and H tones that signal grammatical differences without the aid of segmental-level information, and these differ in behavior from the grammatical floating M tone. The floating L tones include the negation marker and the imperative (sections 3.6 and 5.2) and the floating H tone marks irrealis modality (section 5.4). Unlike the grammatical floating M tone of the imperfective, these floating L and H tones become associated to a TBU according to the rules of Grammatical tone docking (327)—docking preferentially to the right if the environment permits this, and otherwise to the left. A toneless analysis will need to account for these differences in another manner, and this is explored in section 6.2.2.

As we consider whether what is labeled as M in all of these examples could instead be an unspecified tone, we should recall from section 6.1 that according to Hyman (2001a) and Hyman (2011a), a tone which is underlyingly unspecified should not be present as a floating tone. Moreover, unspecified tones should not be manipulated in phonological rules, nor should morphological rules assign a tone which is underlyingly unspecified.

In the examples given in this section, M in Saxwe is frequently present as a floating tone. This is sometimes the result of a process of synchronic elision. Moreover, there are contrastive cases where either: (1) vowel elision processes include elision of the M tone (at a medial position in noun compounds, for example), or (2) vowel elision processes leave behind a floating M tone. The fact that this contrast can be made is a strong argument against an unspecified analysis.

There are other examples of floating M tones in this section. A floating M can result from diachronic processes of elision, such as in the case of the imperfective which is marked in part by a floating M in the preverbal position. The floating M- tone is found to the left of a noun when there is no initial vowel. There is also a right floating M on words borrowed from English which do not have a final L.[104] So the types of floating M tones in Saxwe are varied.

We also see that the rules that govern contour simplification as well as the rule that predicts the association of the right $L_{\%}$ IP boundary to the final TBU of an utterance are all sensitive to the conditioning presence or absence of M. This is true whether this M is present as a floating tone or as a tone prelinked to a TBU. This means that M is referenced as a conditioning factor in phonological rules, although it is not itself spread or otherwise manipulated.

Morphological processes should not assign a tone which is underlyingly unspecified. The first and third singular object suffixes in Saxwe are composed of an underspecified vowel with an associated M tone. The presence of this pronominal suffix is perceptible in some cases only because of the effect of the M tone in either: (1) triggering non-automatic downstep, or (2) causing simplification of LH contours to proceed by delinking the H, or (3) permitting the association of the right $L_{\%}$ IP boundary if the suffix is utterance-final.

To summarize, three kinds of tonal interactions are explained in Saxwe by positing the presence of an underlying M, whether linked or floating: (1) the triggering of the non-automatic downstep of H in situations where the M is found between Hs, (2) the simplification of any underlying LH contour which follows the M in such a way that the H tone of the LH countour is delinked, and (3) the association of the right edge $L_{\%}$ boundary in situations where M is the final tone in the IP.

These interactions can be observed in a variety of situations. They are observed most commonly when M tone is underlyingly linked to the TBU of a syllable, but they are also observed in the following cases where a floating M is needed: (1) to the left of any word functioning as a noun which does not have an initial vowel in its lexical form or its surface form, (2) to the right of nouns which have the /M.H ^{M}/ tonal pattern, (3) to the right of borrowed nouns which have surface H on the final TBU, (4) to the right of the verb when 1SG and 3SG pronominal affixes are suffixed, and (5) to the left of a verb which describes an event in the imperfective aspect. These contexts are varied and encompass a variety of lexical word categories, forms that are both monomorphemic and polymorphemic, both lexical and grammatical considerations, and differing placement of the M tone as to whether it appears to the left or to the right of a specific morpheme.

The M analysis is the most straightforward analysis of the middle tonal height in the Saxwe tone system because it permits with a single mechanism to

[104] Words borrowed from other languages were not studied, so I am unable to make any kind of statement about their tonal properties.

explain multiple tonal phenomena, and because its existence is supported by diachronic observations, contrastive comparison with tones that are clearly L, and the phonetic implementation data. However, the toneless analysis is possible given certain assumptions, and I explore those in the following section.

6.2.2 The alternative toneless analysis

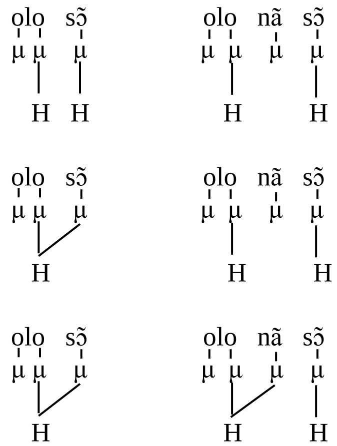
The fact that L or H spreads so readily to an adjacent M in Saxwe (section 3.2) could be seen as an indicator that the TBU which has as its phonetic realization M is, to speak anthropomorphically, 'needy' in the sense that it has no features or identity of its own. Thus Saxwe could be said to have a three-way /H, Ø, L/ distinction.

Such an analysis would have to provide a new manner of accounting for the tonal observations described in section 6.2.1. Let us consider a theoretical model in which default feature assignment does not happen within the phonological component. Instead, M is the phonetic height assigned to a TBU which, at the output from the phonology, is not linked to either H or L. A TBU may be realized H or L because of underlying tonal assignment or because of Tonal spread.

In such a system, one must have a means of distinguishing between Hs which are adjacent underlyingly from the beginning of the derivation (between which there is no non-automatic downstep) and Hs which are adjacent only because of Tonal spread (between which there is non-automatic downstep). In such a system, the trigger for non-automatic downstep would not be a floating M tone. Instead, non-automatic downstep would be triggered by the presence of adjacent unmerged Hs in the output from the phonology (Odden, 1982). For this to be the case in Saxwe, an ordered rule of H fusion would be necessary, taking effect before the operation of Tonal spread.

We can show this in the derivations of /oló sɔ̃́/ 'a crocodile left' and /oló na sɔ̃́/ 'a crocodile will leave', whose underlying forms are written here in keeping with a toneless analysis. The following would be the derivations.

(408)



a. Underlying forms

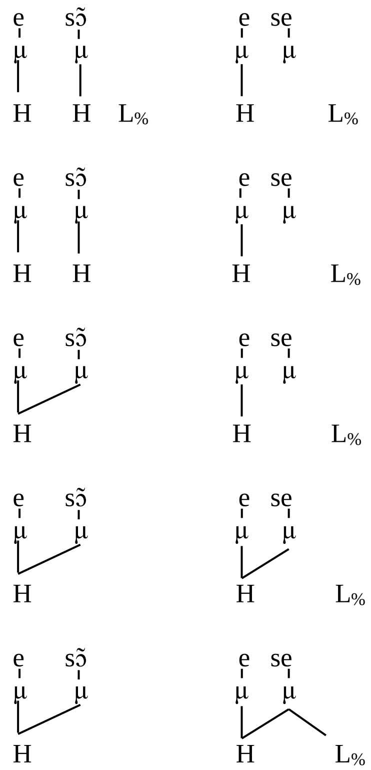
b. H fusion

c. Tonal spread

The resulting surface realizations are [ōló sɔ̃́] 'a crocodile left' and [ōló nã́ ꜜsɔ̃́] 'a crocodile will leave'. In this analysis, it is because of the ordering of H fusion and Tonal spread that non-automatic downstep only occurs at a boundary where there are two surface Hs which were not both H underlyingly. Non-automatic downstep of H is explained as a phonetic lowering of F_0 triggered by adjacent unmerged Hs present on the tonal tier at the output from the phonology.

One would also have to account for the difference between an utterance-final H which displays no utterance-final pitch F_0 fall, and an utterance-final H which is only H because of Tonal spread and which is realized with an utterance-final pitch fall because of interaction with the final $L_{\%}$ IP boundary. One possible way to accomplish this would be to delete the right $L_{\%}$ boundary tone when it immediately follows an underlying H. This would be ordered prior to Tonal spread. Then any $L_{\%}$ boundary still present later in the derivation would be associated prior to the output from the phonology. We can see this illustrated below with the sentences /é sɔ̃́/ 'he left' and /é se/ 'he heard'.

(409)



a. Underlying forms

b. $L_{\%}$ deletion

c. Tonal fusion

d. Tonal spread

e. $L_{\%}$ association

The resulting surface realizations of the two underlying forms are [é sɔ̃́] 'he left', and [é sê] 'he heard'. Only the latter has the utterance-final surface [HL] fall because for this utterance, the $L_{\%}$ boundary is not deleted earlier in the derivation, whereas it is deleted in the case of the underlying /é sɔ̃́/. This analysis assumes that deletion of a boundary tone is a theoretical possibility—or that there is some alternative way to account for the association of the boundary tone being dependent on tonal specification (or its absence) prior to Tonal spread.

Given this background, we can look at how one would explain the tonal interactions that occur at places where, using the M analysis, we would posit the presence of a floating M: (1) to the left of any word functioning as a noun which does not have an initial vowel in its lexical form or its surface form, (2) to the right of nouns which have the /M.H ^{M}/ tonal pattern, (3) to the right of borrowed nouns which have surface H on the final TBU, (4) to the right of the verb when 1SG and 3SG pronominal affixes are suffixed, and (5) to the left of a verb which describes an event in the imperfective aspect.

We can re-examine the analysis of the data in (410), where underlying forms are given here in keeping with the toneless analysis. Here, a vowel segment is lost in a synchronic process of vowel elision in fast speech.

(410)	a.	/kplã́ onṹ/	→	[kplã́ ó↓nṹ]	learn something
				or	(lit. learn thing)
	b.		→	[kplã́ ↓nṹ]	
	c.	/kplã́ odã̌/	→	[kplã́ ódã̀^{R}]	learn a job
				or	(lit. learn work)
	d.		→	[kplã́ dã̀^{R}]	

In (410)a, if Tonal fusion is ordered before Tonal spread, this results in having adjacent unmerged Hs in the output from the phonology. This triggers downstep in the phonetic implementation. In (410)c, Contour simplification would be formulated as two ordered rules stating that an underlying LH contour is simplified by deleting the L whenever the contour immediately follows a H TBU; following this, the contour is simplified by delinking the H.

One would still need to account for: (1) the fact that there is downstep in (410)b despite the elision of the toneless vowel [o], and (2) the fact that the LH contour in (410)d is simplified by delinking the H despite the elision of the toneless vowel [o]. To account for these, one might have to either: (1) order Tonal fusion before the process of vowel elision, or (2) employ the notion of a floating toneless TBU. This toneless TBU would be a residual autosegmental anchor for tone left behind after elision of the segmental vowel. Its presence would prevent the fusion of Hs in (410)b and would condition the delinking of H in (410)d. This would be a fairly abstract notion.

Another possible mechanism to account for the observations in (410)b and (410)d would be to posit a phonological boundary inserted to the left of the noun—somewhat like the M- floating tone but not tonal in nature, simply a hindrance to tonal interactions. This phonological boundary would both prevent the fusion of tones and also condition the simplification of a following underlying LH contour such that the H was delinked, regardless of the tonal specification of what preceded the boundary. The prevention of tonal fusion at this type of boundary seems phonologically justifiable, while the simplification of an underlying LH contour in this particular way at this boundary seems less phonologically justifiable.

The notion of such a barrier would help to explain why complex nouns and other words which function as a noun interact with previous tones in manners similar to what we see in (410)b and (410)d even when they do not have an initial vowel.

However, there is still the problem of explaining the failure for the Hs to merge in sentences such as (411), where there is downstep of H to the right of the 3SG suffix; or in (412), where there is downstep of the H tone of the verb in the imperfective aspect; or in (413), where there is downstep of H to the right of the noun /oklá ^{Ø}/ 'soul'.

(411) /$^{\text{M-}}$ é kó=V[back] fí/
[é kó: ↓fí]
3SG laugh=1SG now
He laughed at me just now. sxw-L0070-verb plus pronoun-un.wav

(412) /$^{\text{M-}}$ é ^{Ø} sɔ̃́ nɔ̃/
[é ↓sɔ̃́ nɔ̃̂]
3SG IPFV leave IPFV
He is leaving. sxw-L0109-auxiliaries-un.wav

(413) /oklá ^{Ø} sɔ̃́/ [ōklá ↓sɔ̃́] A soul left. sxw-L0131-clause frames-un.wav

To explain these cases, one would have to invoke such possibilities as: (1) further phonological boundaries (some of which would seem arbitrary), or (2) a large number of floating toneless TBUs inserted because of lexical or morphosyntactic reasons, or (3) floating L tones which do not associate to a TBU in these contexts, but which do associate to TBUs in other contexts—since the floating Ls of negation and the imperative do associate to TBUs.[105]

There could be a categorical decision made that for every floating M tone that I invoke in this study, a floating L tone would be used instead. This would prevent having to posit the existence of floating M tone, which is typologically rare. There would be several disadvantages to this solution. First, one would have to disregard the diachronic evidence that certain of these floating tones have developed from the loss of syllables which, from comparison with their cognates in other Gbe varieties, would have had M rather than L tone associated to the TBU of the syllable.

Second, one would have multiple paths by which identical tonal phenomena were conditioned. Where segmental information was present, and the tone was neither H nor L, it would be the non-specification of tone on the TBU that would indirectly (in some cases by preventing Tonal fusion) condition effects such as the downstep of H, the association of the $L_{\%}$ IP boundary tone, and the simplification of an underlying LH contour such that H is delinked. However, where

[105] It is true that the floating Ls of the imperative and the negation marker occur on the edges of the IP and this might help in making a distinction between floating grammatical Ls which do associate to TBUs and those which do not. However, there are indications that this reflects instead a tendency for the language to avoid having grammatical Ls lexically floating within the IP. There is a preverbal auxiliary marking prohibition which occurs IP-internally and this auxiliary /kâ/ has a HL contour in its lexical underlying form – surfacing always as [HL]. This is an extremely rare tonal assignment on a single TBU (the only other case I am aware of is another preverbal auxiliary /bô/ which marks deontic modality) and may reflect a historic incorporation of the L of negation into an auxiliary form which was formerly H.

segmental-level information was not present and the same tonal phenomena were observed, it might then be a floating L tone which would condition these phenomena. And furthermore, if the notion of phrasal boundaries were also invoked (such as at the left edge of the noun phrase), then this would be a third path that would lead to these same tonal phenomena.

Any combination of these mechanisms introduces complexities into the analysis of the Saxwe tone system and weakens the motivation for the phonological phenomena that are observed. These complexities make the toneless analysis a less desirable alternative to the M analysis. The simplification of the inventory of Saxwe tones by the removal of M does not sufficiently counterbalance the theoretical complexity that would be introduced. It is my conclusion, therefore, that the M analysis is preferable to the toneless analysis.

6.2.3 The features of H, M, and L

Although the M tonal height is not an unspecified TBU, there are clearly asymmetries in the Saxwe tonal system. I believe these asymmetries are best explained when we consider the three atomic tones {H, M, L} in light of the Two-Feature model of tone. In my analysis, all three tones are underspecified underlyingly, but none is absolutely underspecified; all three tones have some underlying featural specification. The following are the surface and underlyingly features of tones in Saxwe.[106]

(414)

		Surface	**Underlying**
	H	[+upper, -raised]	[+upper]
	M	[-upper, +raised]	[+raised]
	L	[-upper, -raised]	[-raised]

The following feature fill-in rules apply before the application of tonal rules within the phonology. Here and in all other tonal rules in this chapter, [U] refers to the feature [upper] and [R] refers to the feature [raised].

[106] The description of surface features here is the same as the description in Pulleyblank (1986) of the tone features of Yoruba after default fill-in rules apply.

(415) Feature fill-in rules

$$\mu \quad \rightarrow \quad \begin{array}{c} \mu \\ | \\ [\text{-U}] \end{array}$$

$$\mu \quad \rightarrow \quad \begin{array}{c} \mu \\ | \\ [\text{-R}] \end{array}$$

These feature fill-in rules state that a TBU unspecified for the feature [upper] will receive a default specification of [-upper]. A TBU unspecified for the feature [raised] will receive a default specification of [-raised].

Inherent in the Two-Feature model of tone is the notion that these features define natural classes of tone (Pulleyblank, 1986; Yip, 2002). In Saxwe, there is much support within the data for the understanding that M and L form a natural class (the class of [-upper] tones) distinct from H ([+upper]).

Preceding a discussion of how M and L form a natural class, it is useful to consider the evolution of the Saxwe tone system. Those who have written about Saxwe history (Kpinso, 2006; Metinhoue, 2006; Pazzi, 1979) claim that there was a historical migration of the Saxwe ancestors from a Yoruboid-speaking area to a Gbe-speaking area (section 1.1). Bearing this in mind, it is likely that the Saxwe system evolved through contact between a three-way {H, Ø, L} system like that of Yoruba (Akinlabi, 1985; Pulleyblank, 1986) where consonant-tone interaction was absent, and a two-way {H, Ø} system like that of Ewe (Ansre, 1961; Clements, 1978; Stahlke, 1971) in which depressor consonants were responsible for a third, surface L tonal height. The discussion of how a two-tone system like Ewe would have been restructured into a phonemic three-tone system is covered in section 3.9. There we see that the historical development of the Saxwe tone system helps to explain why L tone in Saxwe most commonly follows a depressor consonant, why there are relatively few underlying H tones following a depressor consonant, and why there are never underlying M tones following a depressor consonant—the latter fact an indication that there is a neutralization of the contrast between M and L in the environment following a depressor consonant. (In these summary statements, depressor consonants are defined as the set of voiced obstruents excluding /b/ and /ɖ/.)

Looking at this development in terms of features, we can imagine that the Gbe influence on the current Saxwe tone system represented a simple [+upper] *vs.* [-upper] distinction, with phonetic M and L being surface realizations of the [-upper] trait. The Yoruboid influence was responsible for L having the status of a tone in its own right in the current three-tone system. Thus the feature [+/-raised] became necessary to subdivide the [-upper] register.

In short, H has likely been a contrastive tone longer than L has and is, in the current tone system, the unique tone within the [+upper] register and thus specified underlyingly only as [+upper]. This distinctiveness of H helps to explain some of the asymmetries that group the two [-upper] tones together in ways that oppose them to the single [+upper] tone. These include asymmetries within the phonology, asymmetries in distribution, asymmetries in the phonetic realization of the output from the phonology, asymmetries in the distribution of boundary tones, and asymmetries in sensitivity to OCP violations. In the following paragraphs, I consider each of these kinds of asymmetries.

First, there are phonological rules which make reference to a H *vs.* non-high distinction ([+upper] *vs.* [-upper]), while there are no rules which make reference to a L *vs.* non-low distinction. For example, the rules of Contour simplification and the rule of $L_{\%}$ association both make H *vs.* non-high distinctions. These phonological rules are reformulated in light of a Two-Feature model of tone in section 6.2.5.

Second, there are asymmetries in the distribution of the three tones. For example, the initial vowel of monomorphemic nouns is either L or M, both [-upper], but not H (section 3.7). As another example of distributional asymmetries, we see that words that are borrowed from English are phonologized as having H on the stressed syllable in the language of origin, but either L or M on the other syllables—both of which are [-upper] (section 4.5). What influences the assignment of L (the most frequent assignment) or M in a given case is not clear and may be related to the date or path of borrowing, but we see for example that for the principal language consultant for this study, 'teacher' is phonologized as /tʃítʃā/ (realized [tʃítʃâ]), and 'tailor' is phonologized as /télà/ (realized [télà]).[107] In all these cases, we see that in certain positions, the distribution of sounds is limited to the two [-upper] tones.

One asymmetry observed in the phonetic implementation is that if there is unequal distribution of the three tones {H, M, L} within the F_0 range of a speaker, it is the two [-upper] tones which are closer in F_0 to each other. For the speakers tested in chapter 7, the difference in F_0 between [+raised] and [-raised] within the [-upper] register is either smaller than or equal to the difference in F_0 between [+upper] and [-upper]. The difference in F_0 between [+raised] and [-raised] is never greater than the difference in F_0 between [+upper] and [-upper].

In addition, we see in chapter 7 that in the phonetic implementation, downstep—whether automatic or non-automatic—is only triggered when there is alternation between the values [+upper] and [-upper]. Stated in terms of atomic tones, downstep is only triggered by having a floating M or surface L between Hs; it is not triggered by having a floating M between Ls.

[107] There is, however, interspeaker variation on this matter; some Saxwe speakers have 'teacher' phonologized as /tʃítʃà/ (realized [tʃítʃà]).

Looking at boundary tones, we see that IP boundary tones are $H_{\%}$ or $L_{\%}$ (sections 3.5, and 5.8), which differ in their values for [upper]; we do not see two [-upper] alternatives.

A final asymmetry is in the OCP sensitivity to potential violations. There is a sensitivity to OCP violations regarding H (or [+upper]) tone—a sensitivity that does not exist in the same way for the [-upper] tones. Floating Hs and the H_{ω} phonological phrase boundary are sensitive to OCP violations; the constraint against having two unassociated Hs on the tonal prevents the delinking of H that would otherwise occur as described by rule B of Contour simplification (see sections 4.4.2, 4.4.3, and 5.2). In contrast with this, there is no constraint preventing the presence of two unassociated [-upper] tones on the tonal tier.

All of these asymmetries show that the [+/-upper] distinction is the primary featural distinction in Saxwe tone processes, and that M and L tone are often treated similarly in phonological processes in contrast with the way H is treated. These asymmetries also help us to draw some conclusions about the relative markedness of the features of Saxwe; this is the topic of the next section.

6.2.4 Markedness and tonal features

Jiang-King (1996) proposes a tonal hierarchy whereby {[+upper] > [-raised]}, or (in her terms) [+upper] is more sonorous than [-raised]. Pulleyblank (2004) applies this to the three-tone system of Yoruba and disusses the hierarchy in terms of markedness, drawing the conclusion that H, which is [+upper, +raised], is the most marked tone; L, being [-upper, -raised] is the next in the hierarchy of markedness; and M, which has neither of the values [+upper] nor [-raised] is the least marked tone. The term 'markedness' used by Pulleyblank refers to the notion that a phonological change in the language will favor the output of the more marked element in a ranking of constraints, thus a "markedness as faithfulness" understanding, in the language of Optimality Theory (Pulleyblank, 2004).

The {H > L > M}—or {[+U] > [-R] > [+R]}—tonal hierarchy holds true as well when discussing tonal markedness in Saxwe. However, it must be clarified how markedness is understood here. There is debate about whether markedness is universally predictive or whether it is language-specific, as well as whether it is part of innate phonology or not (Blevins, 2004; de Lacy, 2006; Hume, 2003). Moreover, there is relatively little discussion in the literature which focuses on tonal markedness. This topic could be addressed in much greater length. For the purposes of this study, I confine myself to giving here a brief summary of the understanding of markedness that is assumed for Saxwe. In Saxwe, markedness cannot be tied structurally to having more extensive underlying feature specification, since all three tones are to an equal extent unspecified. Instead, tonal markedness is language-specific and develops through phonetically-driven sound changes over time and in the course of language contact. Increased markedness is related to perception; there is a higher perceptibility of the more marked tone in the phonetic output. One contributing factor to greater perception is that the more marked tone is more likely to be favored in the output of phonological rules. Another contributing factor is that the more marked tone is more likely to be preserved in the more infrequent or restrictive prosodic structures.

Some of the data supporting the {[+U] > [-R] > [+R]} hierarchy of markedness are discussed in section 6.2.3 and are repeated here. For example, we see that H is the most marked tone from the fact that there is sensitivity to OCP violations regarding adjacent floating and boundary [+upper] tones—a sensitivity that does not exist for the [-upper] tones. To illustrate this, we see that in compounding processes, the delinking of H from an underlying LH contour will be prevented when there is a H_{ω} boundary present at the right edge of the compound (section 4.1.2).

In addition, the phonologically weak initial vowel of monomorphemic nouns—a vowel which is easily elided in fast speech and which in lexical compounding processes is obligatorily elided word-medially—contains the less marked [-upper] tones, but not the more marked [+upper] tone (sections 3.7, 4.2, and 4.4).

Furthermore, in rules A and B of Contour simplification, a delinked [+upper] tone remains floating on the autosegmental tier while the linked [-upper] tone is deleted (sections 3.6.4 and 3.7.5). Later in the derivation, this floating [+upper] tone blocks Tonal spread and therefore its presence does have a perceptible effect in the phonetic output.

More evidence comes from the asymmetry in the types of tones that are found as floating tones in the inventory of monomorphemic noun tone patterns. The inventory includes /M.M ^{H}/ and /M.L ^{H}/ as minority tone patterns. There are no floating Ls in monomorphemic noun tone patterns, and while the tone pattern /M.H ^{M}/ exists, there are only two examples of words of this pattern in my corpus.

We also see in the phonetic implementation that downstep (whether automatic or non-automatic) is a relevant aspect of the realization of H tone, but not of L tone (section 7.3). This means that in the phonetic implementation, the perceptibility of the [+upper] tone is heightened relative to the [-upper] tones.

Again having to do with the phonetic implementation, when there is unequal distribution of the three tones {H, M, L} within the F_0 range of a speaker, it is the two [-upper] tones which are closer in F_0 to each other. For the speakers tested in chapter 7, the difference in F_0 between [+raised] and [-raised] within the [-upper] register is either smaller than or equal to the difference in F_0 between [+upper] and [-upper]. Here again, assuming that markedness is related to increased perceptibility, we see that [+upper] is the most marked tone.

So far we have seen support for [+upper] being the most marked tone in the language. However, there are also reasons to argue that the second half of the {[+U] > [-R] > [+R]} hierarchy holds true. For example, in nouns and verbs, underlying contours composed of two tones linked to a single TBU in Saxwe contain a [+upper] and [-raised] tone, but not a [+raised] tone (sections 3.7.5 and 5.5). Here is a case where [+upper] and [-raised] values are favored to the exclusion of [+raised] in a restrictive prosodic structure.

In addition, there are rules which prioritize the realization of [+upper] and [-raised] over the realization of [+raised], such as the rule of Tonal spread (72) which spreads H and L tone onto a M TBU, and the rule of Grammatical tone docking (327) which links a floating grammatical H or L rightward to an available M TBU (linking leftward elsewhere). In both of these rules, the output of [+upper] and [-raised] features are favored over the [+raised] feature.

Given this understanding of Saxwe tone in terms of features and the relative markedness of these features, I proceed in section 6.2.5 to a reformulation of Saxwe tone rules.

6.2.5 Reformulation of tone rules in terms of features

In this section, the six postlexical phonological tone rules described in the previous chapters of this study are reformulated in light of the Two-Feature model of tone. Here, these tones rules are given in the order they occur in the phonology.

Note that because there are rules which reference [-upper], this feature—which is not specified underlyingly for any tone—must be filled in by default fill-in rules before derivational rules apply. At the same time, [+upper] tones also get the default feature assignment [-raised]. This is shown in section 6.2.3.

The first rule is that of right edge $L_{\%}$ association. A feature model of tone nicely captures the generalization that the right edge $L_{\%}$ boundary (discussed in section 6.2.6 and symbolized here as the $[\text{-U}]_{\%}$ boundary) links to the final TBU of an IP when a tone of the class of [-upper] tones—either associated to a TBU or floating—is found on the right edge of the IP.

(416) $L_{\%}$ (or $[\text{-U}]_{\%}$) association $\mu\ ]_{IP}$

[-U] $[\text{-U}]_{\%}$

The next rule is a mechanism to explain the fact that the /M.L ^{H}/ and /M.M ^{H}/ noun tone patterns differ from the /M.L/ and /M.M/ noun tone patterns only in that the floating H prevents $L_{\%}$ association at the right edge of the IP. There is no other role played by these floating Hs later in the phonology and, in fact, it is important that they *not* be present later in the phonology.

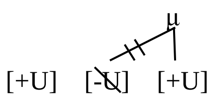
(417) Nominal floating H (or [+U]) deletion

$[+U] \rightarrow Ø$

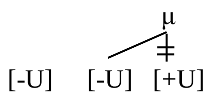
One might argue that this rule does not support the notion that [+upper] is the most marked value for tone. However, the motivation for this rule appears to be the preservation of the contrastive identity of the underlying /M.LH/ pattern, a pattern which is more common and less subject to interspeaker variability than the /M.L ^{H}/ pattern (section 7.5). Speaking in anthropomorphic terms, the field of floating H tones on nouns is being cleared so that the floating H tone resulting from the simplification of the /M.LH/ pattern can serve as a recovery mechanism for identifying this latter tone pattern. The [+upper] tone of the underlying /M.LH/ pattern is preserved throughout the phonology at the expense of that of the underlying /M.L ^{H}/ pattern.

The next rule, perhaps not coincidentally, describes the simplification of an underlying LH TBU in a /M.LH/ noun or a /LH/ verb. Here again, the [+/-upper] feature distinction helps to elegantly capture what is happening.

(418) Contour simplification A



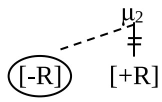
Contour simplification B



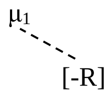
This might be seen as a kind of assimilation; a TBU that has both [+upper] and [-upper] values associated with it assimilates to the preceding TBU by delinking the value (of the two) which is not identical to that which precedes. Where we see the difference in the two rules of Contour simplification is in the fact that when [-upper] is delinked, it is immediately deleted, whereas when [+upper] is delinked, it remains present as a floating element on the autosegmental tier.

The next two-part tonal process shows evidence of the tonal hierarchy within the phonological rules. Here, in the rules of Grammatical tone docking, the more marked [-raised] values (one of which is [+upper] and one of which is [-upper]) will first dock rightward and delink the less marked [+raised] value. Otherwise, if this does not happen (because the condition is not favorable), docking will occur leftward. There are two points to note here. First, a [+raised] value is dispreferred in the output when opposed to a [-raised] value. Second, there is no mechanism for a floating [+raised] tone to dock to a TBU; if present in the input to the phonology as a floating tone, it will remain as a floating tone.

(419) Grammatical tone docking A - ordered first

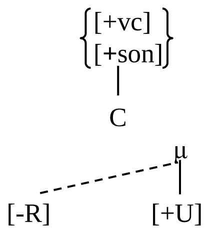


Grammatical tone docking B



The rule of Partial L spread is reformulated in (420) using feature notation. We see in chapter 7 that peak delay (or F_0 target achievement delay—a term I use to cover both delay in attaining a H target as well delay in attaining a L target) is fairly common in Saxwe. The rule of Partial L spread is a phonologization of this tendency. When an underlyingly voiced consonant (a voiced obstruent) or a sonorant appears between a [-raised] tone and a [+upper] tone, there is a spread of the [-raised] tone onto the following TBU.[108]

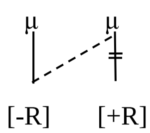
(420) Partial L (or [-R]) spread



The [+sonorant] feature is specifically noted in this rule because we do not know the ordering of this rule relative to the default voicing of sonorants.

The final rule which is reformulated in terms of tonal features is the rule of Tonal spread. This rule is iterative. In this rule, the more marked [-raised] tones spread onto a TBU which is [+raised], delinking this latter tone.

(421) Tonal spread (iterative)



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[108] Note that although it is not specified in this rule that the [-raised] tone is [-upper], it is not important to the formulation of this rule; in the event that the [-raised] tone is [+upper], we would have adjacent H tones and the issue of spread would be moot.

Note that as with the rules of Grammatical tone docking, we see in this rule of Tonal spread that a [+raised] value, if present to the right of either of the other two more marked tones, is dispreferred in favor of a [-raised] value. The practical result of this rule of Tonal spread is that there are far fewer surface realizations of the unmarked underlying [+raised] tone than there are of the other two more marked tones. Thus the most unmarked tone in Saxwe is not the most common tone at the surface level.

Now that the derivational rules of Saxwe have been reformulated in terms of tonal features, I turn finally to a discussion of boundary tones and floating tones when examined in terms of features rather than atomic units.

6.2.6 Boundary tones, floating tones, and features

If we consider the distribution of boundary tones, we see that there is a [+upper] PW boundary tone (H_{ω}) and there is a [+upper] and a [-raised] IP boundary tone ($H_{\%}$ and $L_{\%}$). These are described in sections 4.1, 4.3, 3.5, and 5.8.

Neither the H_{ω} PW boundary nor the $H_{\%}$ IP boundary (both [+upper]) ever associate to a TBU. Rather, they are mechanisms by which downglide and downward pitch fall are arrested or avoided in environments where they would otherwise be observed. This is different from the $L_{\%}$ IP boundary ([-raised]) which does associate to a TBU and has a direct effect on pitch levels by lowering the level of pitch F_0 toward the end of the duration of the TBU.

If we compare this with floating tones, we see some similarities and some differences. Lexical floating Hs ([+upper]) resemble [+upper] boundary tones in that they do not associate with TBUs but have an indirect effect on pitch levels by their role in the absence of pitch lowering (sections 3.7.3 and 3.7.7). Contrary to this, the grammatical floating H of irrealis modality ([+upper]) will associate to a TBU and thereby plays a direct effect on pitch levels by raising the level of pitch F_0 (sections 5.4 and 5.5).

The left M- floating tone on nouns, lexical floating Ms and the floating M of imperfective aspect (all of which are [+raised]) all have an indirect role in pitch levels by conditioning Contour simplification to effect a particular result and triggering non-automatic downstep in the phonetic implementation. In addition, these floating tones have an indirect effect on pitch levels by conditioning the association of the [-raised] boundary when in an IP-final position (sections 3.7.4 and 5.1).

Grammatical floating Ls marking imperative modality and negation, as well as the intonational $L_{\%}$ of yes-no questions (all [-raised]) have a direct lowering effect on pitch F_0 levels, similar to the direct lowering effect of the [-raised] default $L_{\%}$ boundary when it associates to a TBU (sections 3.6, 5.2, and 5.6).

A generalization that can be made, then, is that [+raised] floating tones do not associate to TBUs and therefore have an indirect effect on phonetic implementation. Conversely, [-raised] boundary tones and floating tones can associate to TBUs. Because of this, they play a direct role in lowering the level of pitch F_0 in the phonetic implementation.

6.3 Summary: an accounting of H, M and L using features

In this chapter, I address first the question of whether there is a true M in Saxwe, or whether there are instead toneless TBUs. I argue that the most felicitous position one can take is that that there is an underlying M. This is based on an examination of the many varied contexts where M appears in the language, and the possibilities of how an alternative analysis might present itself.

The next issue addressed is whether the Two-Feature model of tone can be fruitfully applied to the Saxwe tone system. I conclude that the Two-Feature model of tone effectively explains many of the asymmetries that exist when one compares the atomic tones H, M and L. Most importantly, the Two-Feature model of tone predicts that the primary distinction made is the [+/-upper] distinction. The [-upper] tones (M and L) often function as a natural class in opposition to H. In addition, we see that the [-raised] tones (H and L) also sometimes function as a natural class. The Two-Feature model correctly predicts that H and M will not function as a natural class with regard to tonal phenomena.

After describing the underlying features of Saxwe {H, M, L} in light of an underspecification model, these features are discussed in terms of their position in a tonal hierarchy of markedness. I note that the hierarchy {[+U] > [-R] > [+R]} (Jiang-King, 1996) is one that holds true for Saxwe. Following this is a reformulation of the phonological rules from previous chapters using feature notation. Finally, I note some generalizations that can be made about boundary tones and floating tones when these are described in terms of tonal features.

Having looked at the theoretical underpinnings of the Saxwe tone system, it becomes useful to examine things from the final end of the workings of the system. Chapter 7 studies the phonetic implementation of tone in light of the theory discussed here.

7 The phonetic implementation of tone

This chapter examines the specifics of how tone is realized by four Saxwe speakers of similar age and linguistic background. While there are many similarities in the phonetic output of these four speakers, there are also some notable differences, particularly in utterances that push the limits of what might occur in natural speech—such as in lengthy iterative H–M and H–L sequences. Observations are summarized in each section and are discussed more globally in the concluding section of this chapter.

The following is the outline of this chapter. Section 7.1 gives a summary of the methods and instruments used to obtain and analyze the data discussed in this chapter. In section 7.2, baselines for all-H, all-M, and all-L utterances are established. Section 7.3 examines the question of whether there is iterative automatic and non-automatic downstep of H, as well as whether there is iterative automatic downstep of L. In the course of answering this question, we observe the anticipatory raising of H before successive L–H sequences. Section 7.4 looks at the phonetic implementation of L tones in successive L–M sequences and demonstrates the fact that there is no non-automatic lowering of L tone. In the course of examining this question, we also see evidence of anticipatory lowering of L before H.

Turning from multi-word utterances to individual words, section 7.5 looks at the phonetic realization of the most common tone patterns of V.C(C)V nouns. Finally, section 7.6 concludes with a summary of the details of the phonetic implementation of tone in Saxwe.

7.1 Methodology

The data discussed in this chapter were recorded in the Houeyogbe township of the country of Benin in May 2017. These data collection sessions followed a significant amount of analysis that had been done on recordings made previously in 2015 (section 1.3). Based on information I had about the underlying tone of words from data notes and a database in Fieldworks Language Explorer (FLEx) (SIL International, 2011), a preliminary list of the groups of words and sentences to be recorded was prepared before the recording sessions.

In the Houeyogbe township, I worked with Patrice Videgnon and Godefroy Sossou, both of whom had had some basic linguistic training, to finalize the list of words and sentences so that they would reflect the particular sequences of tones desired. In each section of this chapter, the words or sentences tested are described in more detail.

The recordings were done on a Marantz PMD 660 solid state recorder using an external Shure SM10A headworn, unidirectional dynamic microphone. The recordings were done in a cement-walled room with a front door open and a quiet fan running in the background. The recorder was set at a 44,100 Hz sampling rate.

The first recordings were made of André Taïve, a 43-year old male from Adrome. Taïve (hereafter speaker AT) had considerable experience in radio recording, and had worked with me on previous recordings done in 2015. Following this, recordings were done with three other individuals—Nicolas Gbemasse, a 45-year old male from Tohon; Kouessi Sossou, a 51-year old male from Kpovidji; and Béatrice Lokossou, a 45-year old female from Houeyogbe (hereafter speakers NG, KS, and BL). In all, there were three males and one female. These individuals were selected specifically because they were mature adults who were literate in Saxwe, and they had grown up and spent most of their adult years in the Houeyogbe township.

For all of the recordings which were not of himself, speaker AT explained the process and addressed any issues that arose. I operated the recording equipment in all cases.

The process for recording was the following. For each topic of testing, the words or sentences prepared for that topic were printed on individual pieces of paper. These papers were manually shuffled and handed to the speaker. Speakers were instructed to first read to themselves what was on the paper and be sure they understood it, and then to read the word or sentence at a normal speaking rate to be recorded. The speakers did this for each piece of paper in the stack, moving at their own speed from one to the next. If there were questions regarding the meaning of the sentence or word, these were addressed by speaker AT.[109]

In the case of the V.CV nouns, the speakers were instructed to repeat each word twice and there was a single pass through the words. Sentences, however, were read once in each pass, but were reshuffled and re-recorded nine times to make a total of ten tokens per sentence. In all, each speaker produced two repetitions each of 60 different V.CV nouns and ten repetitions each of 50 different sentences. The recording sessions were divided up over the course of two days for each person.

During the recording sessions, if the speaker clearly misread a sentence (as signaled by speaker AT, who was present during all recordings), the recording of that sentence was repeated. Later in the analysis of the sentences, some tokens were not kept because they included reading errors such as the repetition, correction, omission or addition of a word. This meant that for every test sentence spoken by a single speaker there was a maximum of ten tokens, but sometimes there were fewer than ten tokens that were able to be used for analysis. In the examination of the data

[109] I myself answered such questions in the recordings of speaker AT.

in this chapter, I note those cases where the full number of ten tokens was unavailable for analysis.

For every token that was retained, the vowels were manually segmented in Praat (Boersma & Weenink, 2015) based on visual observation of the acoustic waveform and the spectrographic analysis. The end boundary of an utterance-final vowel was placed at the point where the waveform ceased to have a distinctive repeating shape (Baart, 2010).

All vowels were labeled as Praat text files with the underlying tone associated to that TBU. For the V.C(C)V nouns, syllable onsets were labeled as containing either a sonorant, voiced obstruent, or voiceless obstruent onset. The recordings and segmented text files for all the data used in this study can be found at: https://drive.google.com/open?id=1viq0KzW2UEj_uflpW6DYBQ5VJ6PAwysg.

The measurement of pitch F_0 was generated automatically in Praat using two different scripts—one developed for the V.(C)CV nouns and one for the sentences. The scripts used were based on adaptations from other scripts found primarily in Boersma (2014), and secondarily in Kawahara (2014), improved through suggestions found in Styler (2015). Matthew Lee of SIL International and Jos Pacilly of Leiden University helped to adapt and improve these scripts for the purposes of this study.

The effect on the F_0 of a vowel of a preceding consonant in tonal languages is shown to be dissipated after the first 60 ms (Hombert, 1977). However, there can also be a perturbation on the tone of a vowel as it approaches the transition to the following consonant. For example, a voiced obstruent can produce a 'dip' in F_0 that is felt not only on the following vowel but also on the preceding one (Connell & Ladd, 1990). In a visual examination of the data, I found that the point of leveling or 'shoulder' of the F_0 of a level tone occurred most consistently at a position which was not at the midpoint of the vowel, but slightly later in the vowel. For all of these reasons, it was decided that for the measurement of tone within the vowels of the sentences, the Praat script would take a measurement at the time index which was at 66 percent into the duration of the vowel segment. However, in order to avoid too much loss of data in cases where Praat was unable to get a pitch value at that exact time index, the script included a loop which searched for the nearest time index at which a pitch reading could be made, and which recorded the pitch value at this alternative time index, making a note of the difference in time between the 66 percent time index and this new time index. All such alternative time indexes were manually inspected to make sure that the difference in timing was minimal.

For V.C(C)V nouns, the Praat script was adapted to allow a more extensive analysis of F_0 values throughout the duration of the vowel. To this end, pitch values were taken at ten points equally spaced throughout the time duration of each of the vowels.

After F_0 readings were generated using these scripts, the data were verified visually to check for missing or clearly erroneous readings. In several cases where

F_0 readings were proving to be difficult to obtain with consistency, the voicing threshhold in the analysis settings was changed from the 0.45 value used by default to a lower value of 0.25. This was done for a number of the sentences read by speaker KS and NG, who both tended to have some creakiness in their production of certain vowels. Also in several cases, the default low value of the F_0 range was increased from 75 Hz in order to force the pitch analysis calculations in Praat to favor a more reasonable value over one that was clearly erroneous. This was most often necessary for speaker NG. Any measurements from Praat that were still clearly aberrant based on visual and audio inspection were disregarded in statistical calculations and confidence intervals were adjusted accordingly. This is described in the following sections in each case where such adjustments were made.

7.2 Baseline utterances for all-H, all-M, and all-L

7.2.1 Research question and recorded utterances

The first goal was to establish baseline F_0 trends for utterances composed of multiple iterations of a single surface tone. The following is the research question that was proposed: for Saxwe speakers of similar origin and background, how do all-H, all-M, and all-L utterances differ from each other with respect to F_0?

To answer this question, the following six sentences were created and recorded. For each of the three tone options: all-H, all-M, and all-L, there was one sentence of eight syllables and one sentence of ten syllables created. Each sentence was recorded ten times total by each speaker, and the order of sentences was reshuffled between passes.

(422)	/$^{\text{M-}}$ kájí	tɔ́	lá	tʃá̰	vǎ	kú	fí/
	Kayi	father	DEF	also	come	die	now
	Kayi's father also finally died recently. (8 surface Hs)						

(423)	/$^{\text{M-}}$ tɪ̃́kʊ̃́sɪ̃́sjɛ̃́	lá	tʃã́	vǎ	bú	sésé/
	fruit	DEF	also	come	be.lost	completely
	The fruit also was eventually completely lost. (10 surface Hs)					

(424)	/ājānɔ̃̄	mɛ̃̄	nã̄	nyã̄	āwū/
	poor.person	that	FUT	wash	shirt
	That poor person will do laundry. (8 surface Ms)				

(425)	/ɛ̄mɛ̃̄xīxɔ̄	mɛ̃̄	nã̄	nɔ̃̄	ɖū	ājā/
	servant	that	FUT	HAB	eat	suffering
	That servant will (habitually) suffer. (10 surface Ms)					

(426)	/ᴹ⁻ glàgò	gàgà	gbĩ̀gbɔ̃̀	mɔ̃̀	dɾɔ̃̀/
	Glago	tall	return	REPET	be.remaining

Tall Glago's return is still expected. (8 surface Ls)

(427)	/ᴹ⁻ gã̀dʒà	glòbòtòtò	mɔ̃̀	hũ̀	gbàjà/
	trap	big.and.round	REPET	open	wide.open

A big round trap again opens wide open. (10 surface Ls)

The ideal for baseline testing would be that there be a total absence of any surface or underlying tone other than the one being focused on. The surface forms of these sentences were indeed all-H, all-M or all-L. However, if we look at underlying forms, we see that they were not strictly all-H, all-M or all-L—partially out of necessity and partially due to error. This is explained below.

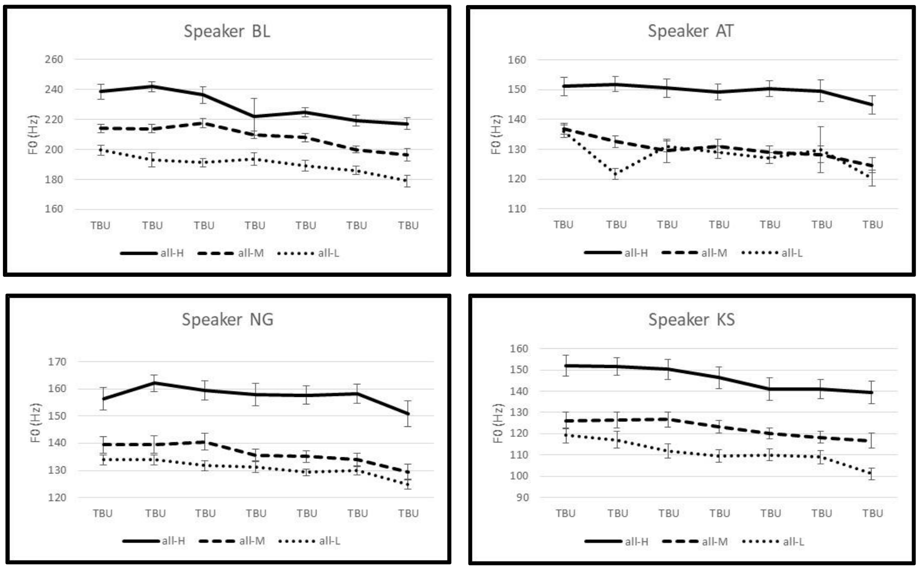
From section 4.3, we recall that PWs which function as the head of a noun phrase have a left M- floating tone if they do not have an initial vowel (all of which together are likely to be vestiges of a historic class-marking system). This presents a challenge in developing sentences of all-H and all-L tones. At the beginning of the all-H and all-L sentences, the left edge M- floating tone is present on the subject of the sentence out of necessity, as the first element in the utterance. However, no further nouns were incorporated in these sentences so as to avoid any further non-automatic downstep triggered by the presence of this left edge M- floating tone (see section 4.3). This deviation from the ideal on the subject noun was unavoidable.

An error was involved in the introduction of the word /vǎ/ 'come', used as a verbal auxiliary in sentences (422) and (423). As described in the rule of Contour simplification A (section 3.6.4), when a TBU has an underlying LH contour, this is simplified following a H by deleting the L. This results in a surface H realization, which is why this discrepancy in underlying tones was not noticed at the time of the finalization of the test sentences. In future tests, it would be preferable not to have the inclusion of this underlying tonal pattern in test sentences used for establishing an all-H baseline.

In Saxwe, there are utterance-final interactions with the right edge $L_{\%}$ IP boundary (section 3.5) that can have a significant effect on the surface realization of the final TBU of an utterance. It has also been documented that H tone can display utterance-final lowering (Herman, 1996). For these reasons, the F_0 measurements of utterance-final TBUs were not retained for any analysis which had to do with establishing baseline levels for tones. For the graphs in section 7.2.2, only the measurements from the first seven TBUs of sentences (422) to (427) were retained for graphing and statistical analysis. These were averaged together, giving a maximum count of 20 tokens per speaker (10 from the sentence of eight TBUs and 10 from the sentence of ten TBUs) for each TBU of an all-H, all-M, or all-L sentence.

7.2.2 Results

The following show results for each of the speakers. Speaker BL is female, while the other three speakers are male. The horizontal graphs show the mean F_0 for each of the first seven TBUs in the all-H, all-M, and all-L utterances. The vertical bars show the upper and lower limits of a 95% confidence interval calculated using a T distribution from the measurements taken at each TBU.[110]



(428) Baseline levels for all-H, all-M, and all-L utterances (avg. 20 tokens)

Rather than normalizing the data from each speaker in an effort to describe a single pattern of implementation for H, M and L in Saxwe, I believe it is more useful to look at the similarities and differences in these speakers' implementation of H, M and L in Saxwe.

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[110] As noted in the description of the methodology, recordings in which speakers made a reading error were not kept for analysis. Therefore in the following cases, fewer than 20 tokens were available for analysis: (1) speaker BL—the all-L data represent 19 tokens; (2) speaker KS—the all-H data represent 17 tokens and the all-M data represent 19 tokens; (3) speaker NG—the all-H data represent 18 tokens and the all-M data represent 19 tokens; (4) speaker AT—the all-M data represent 16 tokens. These differences are taken into account in the calculation of 95% confidence intervals. In addition, speaker NG consistently omitted the /vǎ/ morpheme in the first all-H sentence with the result that this sentence was seven syllables long rather than eight; this meant that the measurements from the final TBU of the utterance were exceptionally included for his ten tokens of this sentence.

First, I look at similarities. Note first that in all of the utterances, there is overall evidence of declination. In all cases, when a linear regression equation is applied to the data, the slope is negative. There is no generalized pattern, however, of the declination for any one of the three tones being more or less significant than that for the other tones. The following are the slopes of a linear regression line fit to each of the three tone graphs for each speaker: (1) speaker BL—H: -4.3, M: -3.2, L: -2.8; (2) speaker KS—H: -2.4, M: -1.8, L: -2.6; (3) speaker NG—H: -0.9, M: -1.7, L: -1.3; (4) speaker AT—H: -0.8, M: -1.6, L: -1.2.

Another similarity for three of the speakers is that the highest mean F_0 of production of H occurs not on the first TBU of the all-H utterance, but rather on the second. This is true for all speakers except speaker KS. This can be described as peak delay, a known phenomenon of phonetic implementation whereby the F_0 peak may occur on the syllable following the one to which a tone is lexically associated (Xu, 2001). Here, the transition from voicelessness preceding the utterance to the production of a multiple-H sequence results in some speakers 'sliding' up, so to speak, to the target of highest F_0, with the alignment for the peak finally occurring on the second syllable rather than on the first. This peak delay on an utterance-initial sequence of Hs is seen also in section 7.3.4.

The most noteworthy difference between speakers is in the relative distribution of the phonetic heights of H, M, and L within the F_0 range of the individual. Speaker BL is the only speaker who evenly distributes H, M, and L within her F_0 range and who does not have any overlap in the 95% confidence intervals for M and L measurements. We can say that speaker BL is the speaker who shows the least probability of the true value of her M being the same as that of her L at any point in the utterance.

Speakers NG and KS both have a F_0 target for H which is clearly distinct from the targets for M and L. For both speakers, the F_0 targets for M and L are closely spaced within the lower part of their F_0 range. For speaker KS, the 95% confidence intervals for M and L at the first TBU of the utterance are just touching; throughout the rest of the utterances there is more distance between the confidence intervals for M and L. For speaker NG, there is touching or slight overlap of the confidence intervals for M and L at multiple points throughout the utterances—at all but the third and fifth TBUs. Thus for speakers NG and KS, there is still a fairly strong indication that there is a difference between the true F_0 targets for M and L, albeit a relatively small one.

For speaker AT, there is considerable overlap of the 95% confidence intervals for the TBUs all along the lengths of the all-L and all-M utterances. This means that for speaker AT, there is no clear evidence of there being a F_0 target for M different from that for L in single-tone utterances (although we see in section 7.5 that underlying M and L TBUs are phonetically distinct for speaker AT in utterances which are not limited to a single tone). The exception to this is at the second TBU, where there is a single L whose F_0 dips visibly with respect to the general trend for L. This dip on the second L of two utterance-initial Ls seems to be his means of phonetically distinguishing a series of utterance-initial Ls from a series of utterance-initial Ms despite the fact that apart from this he has no clear difference in F_0 targets for M and L.

7.2.3 Discussion of results

The way speakers implement baseline all-H, all-M, and all-L utterances is best understood in light of the two features that lay behind the atomic tones H, M, and L. As seen in section 6.2.3, M and L are both [-upper], in contrast with H, which is [+upper].

(429)

	Underlying	After application of default rules
H	[+upper]	[+upper, +raised]
M	[+raised]	[-upper, +raised]
L	[-raised]	[-upper, -raised]

In the phonetic implementation, the distinction between the higher register and the lower register (between the values [+upper] and [-upper]) seems to be more salient for speakers than the distinction between [+raised] and [-raised] within the register [-upper]. Thus the distinction between H versus M/L is clearly established for all speakers at the level of the phonetic implementation, whereas the distinction between M and L is more variably realized depending on the speaker.

Speaker BL distributes all the three combinations of features quite evenly within her F_0 range in single-tone utterances. Speakers KS and NG appear to divide their F_0 ranges into equal parts for the values [+upper] and [-upper] and then subdivide [-upper] into the F_0 targets for the values [+raised] and [-raised]. And Speaker AT appears to make a single distinction between [+upper] and [-upper] within single-tone utterances, overlapping the values for [+/-raised] within the same F_0 layer in this context.

In all cases, what is *not* observed is the hypothetical situation where the [+/-raised] alternation would be clearly distinguished in the phonetic implementation at the expense of clearly making a difference between the [+/-upper] values.

7.3 Iterative automatic and non-automatic downstep of H

7.3.1 Definition of downstep in terms of pitch observations

A crucial issue for tests attempting to demonstrate the phenomenon of downstep in a language is the question of what defines downstep as distinct from other pitch lowering phenomena. Connell (2011) gives the following definition.

> An important, indeed defining, feature of downstep, in addition to its lowering of a H relative to a preceding H (or lowering of other tones relative to preceding tones of like phonological value) via a L (either surface or floating) that conditions the lowering is that, within specifiable bounds, the downstepped H sets a new ceiling for all subsequent Hs within a specifiable domain; *i.e.* these Hs do not rise above the height of the downstepped one, hence the descriptive label terracing… A further characteristic of downstep, it will be remembered, is its cumulative nature: successive downsteps result in successively lower pitch levels. (pp. 838-839)

It is a tricky issue to define downstep of H in a language where declination is always present and anticipatory raising of H is a reality—both of which are true in Saxwe. When we speak of lowering, we must specify what the lowering is in reference to. There are three possibilities: lowering relative to a preceding H, lowering relative to a baseline measurement from an all-H utterance, and lowering at a rate that exceeds the lowering of declination. All three types of lowering are observed among the four Saxwe speakers tested here, although not necessarily to the same degree by individual speakers. In addition, when we speak of successively lower levels, it is helpful to specify how many additional levels beyond the first must be observed in order to qualify as downstep.

Having considered all the challenges in assigning labels to lowering phenomena, I recognize here that my own labels will be subjective. I try, however, to be clear about the criteria I use so that comparisons can be made with pitch lowering observations from other languages. The following are the criteria I use in assigning or not assigning the label of "downstep".

First, there must be a minimum of two steps down, each representing a decline from the preceding H that exceeds the rate of declination. Because there is anticipatory raising of H, the lowering need not descend below the baseline for an all-H utterance. However, if it does not descend below this baseline, I label it as "delimited downstep", and if it does not continue within the prosodic domain further than the minimum of two steps down, I label it as "arrested downstep", borrowing from Rialland (2001). In a case of arrested downstep, there can still be, due to declination, progressive lowering of H. However, the rate of lowering will no longer exceed the rate of declination. Alternatively, there may be an upward reset of the level of H after the two steps of lowering. A speaker may implement downstep which is both delimited and arrested, but these two do not necessarily co-occur.

7.3.2 Research questions and recorded utterances

Automatic downstep of H in Saxwe is the lowering of the level of H triggered by a surface L, whereas non-automatic downstep of H is the lowering of the level of H triggered by a floating M. This floating M can be present because of the synchronic elision of a vowel (section 4.2), because it is part of an underlying tonal pattern (section 3.7.4), because of vestigial effects from loss of noun class marking (section 4.3), or because of the way the word has been incorporated into the language through borrowing (section 4.5). In the most common cases, however, a floating M is present because a preceding H or L tone has spread onto an underlying M TBU, causing it to be delinked (section 3.2). This latter situation is what we see in the test utterances of this section.

The following four research questions describe the information related to automatic and non-automatic downstep which is sought after: (1) Is the lowering of the F_0 of H which is attributed to a surface L between Hs greater than that which could be attributed to declination? (2) Is the lowering of the F_0 of L when it alternates with H greater than that which could be attributed to declination? (3) Is the lowering of the F_0 of H which is attributed to a floating M between Hs greater than that which could be attributed to declination? (4) Is the lowering of the F_0 of H which is attributed to a surface L between Hs equal to that which is attributed to a floating M between Hs?

In order to answer these questions, the following set of eight sentences was created and recorded. Each sentence was recorded ten times by each speaker, and sentences were reshuffled between each pass.

(430) /$^{M-}$ télà sɔ̃́/
The tailor left. (3 TBUs - /HLH/)

(431) /$^{M-}$ télà xé mɔ̃̀ sɔ̃́/
This tailor left again. (5 TBUs - /HLHLH/)

(432) /$^{M-}$ télà xé mɔ̃̀ tú vɔ̀ ké/
This tailor again finished paying. (7 TBUs - /HLHLHLH/)

(433) /$^{M-}$ télà $^{M-}$ sɛ̃́gbàtɔ́ mɔ̃̀ kpɔ̃́ $^{M-}$ mı̃̀ ké/ [111]
The lawbreaking tailor saw you (PL) again. (9 TBUs - /HLHLHLHLH/)

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[111] It would have been preferable not to have the initial floating M- tone on /$^{M-}$ sɛ̃́gbàtɔ́/ and /$^{M-}$ mı̃̀/, but the reality is that any noun which is used in a test sentence will have this initial floating M- tone if there is no initial vowel. All observations and tests indicate that a floating M word-initially or between a L and a H tone has no effect on the surface output.

(434) /ᴹ⁻ tʃītʃā sɔ̋/
The teacher left. (3 TBUs - /HMH/)

(435) /ᴹ⁻ tʃītʃā lá nā̋ sɔ̋/
That teacher will leave. (5 TBUs - /HMHMH/)

(436) /ᴹ⁻ tʃītʃā lá nā̋ kpɔ̋ ōtı̋/
That teacher will see a tree. (7 TBUs - /HMHMHMH/)

(437) /ᴹ⁻ tʃītʃā lá nā̋ kpɔ̋ ōtı̋ ātű/
That teacher will see five trees. (9 TBUs - /HMHMHMHMH/)

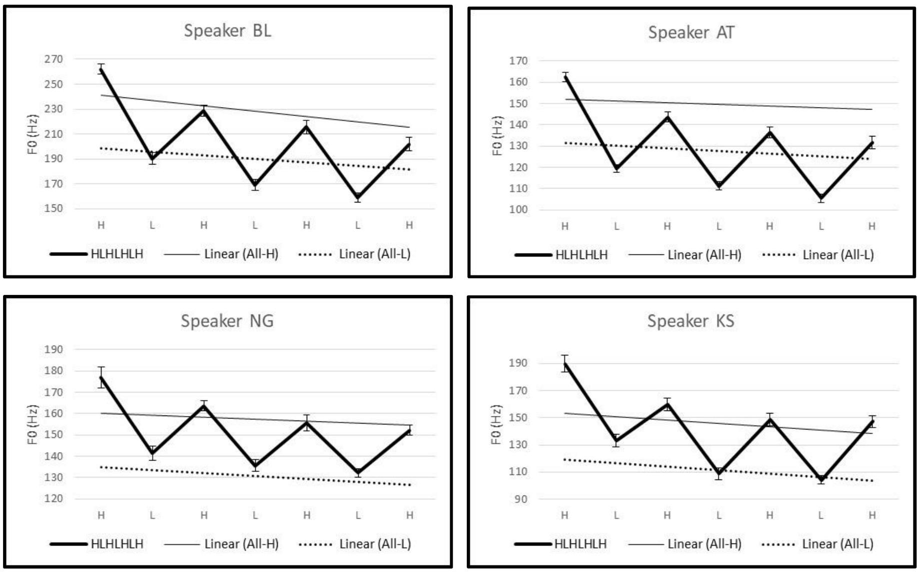
The sections below describes how the measurement obtained from these recordings were used.

7.3.3 Results: automatic downstep of H in alternating H–L sequences

This section deals specifically with the results pertaining to the lowering of H and L in alternating H-L sequences, and answers the first two research questions proposed in section 7.3: (1) Is the lowering of the F_0 of H which is attributed to a surface L between Hs greater than that which could be attributed to declination? (2) Is the lowering of the F_0 of L when it alternates with H greater than that which could be attributed to declination?

The data used to demonstrate the phonetic realization of alternating surface H and L tones come from the 10 repetitions of both the 7-TBU sentence (432) and the 9-TBU sentence (433). The F_0 measurements at each TBU (20 measurements in all) are averaged together to give a mean.[112] A 95% confidence interval is calculated using a T distribution, shown in these graphs by the vertical bars. In addition, a linear regression line is generated from the baseline data for all-H and all-L utterances seen in section 7.2.2. This is added to the graphs of alternating H and L surface tones.

[112] Occasionally a F_0 generated by Praat had to be excluded because it showed clear discrepancies (by being far outside of the realm of all other readings or of the pitch range of a given speaker). The 95% confidence intervals reflect this difference in number of readings.



(438) Iterative H–L sequences over 7 TBUs (20 tokens each)

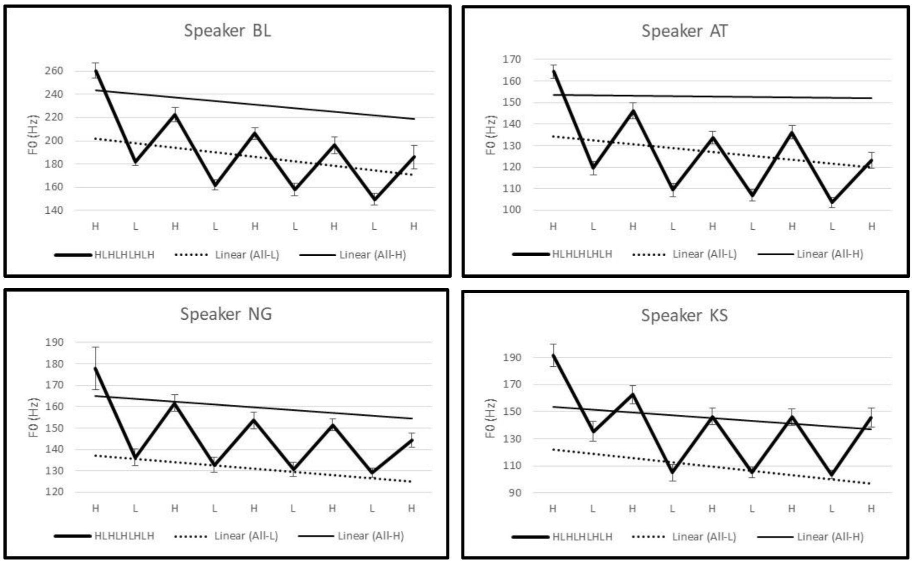
First, we consider whether the lowering of the F_0 of H attributed to a surface L between Hs is greater than that which could be attributed to declination. Clearly for all four speakers the lowering of F_0 from the first H (at the first TBU) to the second H (at the third TBU) is a greater decrease in terms of Hz than the corresponding declination seen for the all-H sentences between the first and third TBUs. What is also clear for all speakers is that this difference is achieved in large part because of the anticipatory raising of the initial H above the baseline level of H seen in all-H utterances. This strategy has been described for other languages (Rialland, 2001) and is in Saxwe a significant reason for the general auditory perception that there is automatic downstep of H.

For speaker AT, there is a smaller but recognizable second instance of lowering between the second and the third H (corresponding to the third and fifth TBUs). For this speaker, the confidence interval for the second H of the alternating utterance is slightly below the baseline for H, whereas the confidence interval for the third H of the alternating utterance is well below the baseline for H—in fact, midway between the baselines for all-H and all-L utterances.

For speakers NG and KS, there also seems to be a second instance of lowering of H beyond that which could be attributable to declination since the confidence interval bars for the second H are above the all-H baseline and the confidence interval bars for the third H are overlapping with the all-H baseline. For speaker BL, it is unclear whether there is a statistically significant second instance of lowering of H beyond that which could be attributable to declination.

The strongest conclusion that can be made from the graphs in (438) is that all of these Saxwe speakers show clear evidence of there being statistically significant lowering of H between the first and second H in an utterance composed of alternating H and L surface tones, achieved in large part through the anticipatory raising of H utterance-initially. After this, there seems to be for some speakers a second instance of lowering, smaller in Hz than the first. Following this, speakers use what Rialland (2001) terms a cancellation strategy; any subsequent lowering of the F_0 of H no longer exceeds that which can be attributed to declination. Recall from section 7.3.1 that according to the definition of downstep used here, there must be two steps down which both exceed the rate of declination in order for lowering to receive the label of downstep. If, after the two steps, the lowering does not exceed the rate of declination, the downstep is said to be arrested.

We can get another view on the matter by looking solely at the data coming only from the utterances of alternating H and L tones over 9 TBUs. For the graphs below, the F_0 measurements at each TBU are calculated from 10 repetitions of the 9-TBU sentence (433) only. A 95% confidence interval and a linear regression line for all-H and all-L utterances is again included. Here, the linear regression lines are calculated only from the all-H and all-L utterances that are 10 TBUs in length ((423) and (427)). This helps to ensure that we are comparing declination and downstep in sentences of roughly equivalent length.



(439) Iterative H–L sequences over 9 TBUs (10 tokens each)

Here we see again that from the initial raised level of H, there is clearly a first, statistically more significant lowering of H, followed by a second, less significant lowering. The second instance of lowering is clearly apparent for speakers AT and KS, and less clearly discernible for speakers BL and NG. After this, the lowering of Hs in the alternating H and L utterance does not significantly exceed the lowering that can be attributed to declination; the rate at which the Hs lower after this point produces a slope of no steeper incline than the rate at which Hs lower in an all-H utterance. Thus automatic downstep of H, if it is present for two steps, is arrested after these two first steps. In fact, for speakers AT and KS, there are some upward tendencies for H (a slight reset of H) after the second downstep.

Referring to the definition established for downstep in section 7.3.1, we can say that the automatic lowering of H of speakers AT and KS can be labeled as arrested automatic downstep and that for speakers BL and NG, it is not entirely clear whether there are two steps of lowering of which both decline at a rate that exceeds the rate of declination. If the pattern seen for speakers BL and NG is not labeled as downstep, we could describe it as an initial localized raising of H followed by a single instance of subsequent lowering of H, proceeded afterwards by lowering that is consistent with declination.

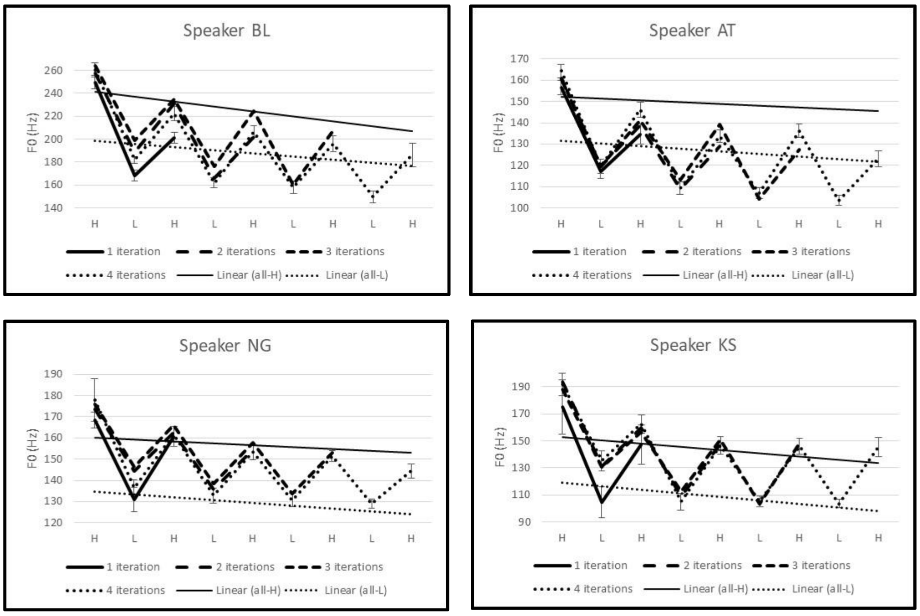
Briefly before moving on to answer the second research question, I highlight here a distinction that one can see in comparing the graphs of speakers BL and AT to the graphs of speakers NG and KS. For speakers NG and KS, the baseline for each tone correlates roughly with the lower limit of the F_0 range of that tone. A H tone can be produced above the baseline for H (in anticipatory raising) but not significantly below it, and a L can be produced above the baseline for L but not significantly below it. For speakers BL and AT, the baselines for H and L do not correlate with the lower limits of the F_0 range of these tones. A H can be realized both above and below the H baseline. Similarly, a L can be realized below the all-L baseline. (The data for speakers BL and AT do not answer the question whether a L can be realized above the L baseline.) This presence or absence of correlation between the baseline and the lower limit of F_0 range of a tone is seen again in the discussion of non-automatic downstep of H in section 7.3.4.

As stated in section 7.3.1, downstep which does not bring the level of H below the baseline level of H in all-H utterances is given the label "delimited" downstep. Therefore we can say that the downstep produced by speakers AT and KS is arrested downstep, and that additionally, the downstep produced by speaker KS is delimited downstep.

The graphs in (438) and (439) also address the second research question, which is whether the lowering of the F_0 of L when it alternates with H (automatic downstep of L) is greater than that which could be attributed to declination. For speakers BL, AT, and KS (the latter most clearly), there is one instance of lowering between the first and second L in the alternating utterance which exceeds the lowering of Ls in the all-L baseline. Following this initial downward trend for L, any further lowering of L does not exceed the lowering that can be attributed to declination, as indicated by the slope of the baseline all-L regression line. For speaker NG, there is a steady lowering of Ls in the alternating utterance which parallels the lowering attributable to declination in the all-L regression line.

For all four speakers, there is at most a single instance of lowering of L that would exceed the lowering that is attributable to declination. If we apply the same criteria to downstep of L as we do to downstep of H, we can conclude that none of these speakers produce automatic downstep of L. No speaker produces two steps of lowering of L which exceed the rate of decline attributable to declination. There is instead, for some speakers, a single localized instance of lowering of L from the first level of L found at the beginning of the utterance.

The question arises whether this initial single instance of lowering (for speakers BL, AT, and KS) is made possible by an anticipatory raising of the initial L in an utterance, similar to the anticipatory raising of an utterance-initial H. The graphs below show increasing numbers of iterations of Hs separated by L, with the data coming from recorded sentences (430) to (433). Bars indicating 95% confidence intervals are indicated only for the HLH utterances and the HLHLHLHLH utterances.



(440) Utterances of increasing iterations of Hs separated by L (10 tokens each)

In these graphs, we see that for three speakers (all except AT), the L in a short HLH utterance is lower in F_0 than the initial L in longer utterances of alternating H and L tones. This suggests that there could be a relationship between the anticipatory raising of the the initial L in longer utterances and the single instance of lowering of L that is observed for some speakers. It would be useful to explore this relationship further in studies involving more speakers and a larger data set.

To summarize the results in this section, we see that in utterances of alternating H and L surface tones, Saxwe speakers will implement one step of automatic lowering of H from a previously raised H, sometimes followed by a second, smaller step of lowering of H. Thus for some speakers, there is automatic downstep of H. Following this, any further lowering of H can generally be attributed to declination.

Another parameter related to downstep is how Hs and Ls in an utterance of alternating tones are realized in relation to all-H and all-L baselines. In longer utterances of alternating Hs and Ls, some speakers will permit Hs found late in the utterance to drop well below the baseline of an all-H utterance, and some speakers will not. Those who do not are labeled as having delimited downstep. The same speakers who permit Hs to drop well below the baseline of an all-H utterance also permit Ls to drop below the baseline of an all-L utterance.

According to the stated criteria for assigning the label of downstep (along with its sub-categories), the following statements can be made about these speakers' production of downstep: (1) speaker BL—weak evidence of arrested automatic downstep of H; (2) speaker AT—stronger evidence of arrested automatic downstep of H; (3) speaker NG—no clear evidence of downstep of H after the first step of lowering; and (4) speaker KS—some evidence of delimited, arrested automatic downstep of H. These initial conclusions are based on visual comparison of the descriptive statistics from multiple sets of data, taking into account confidence intervals. Further testing with larger data sets would allow more conclusive statements to be made.

We can also draw some conclusions about the lowering of L in alternating H and L surface tones. For speakers who do demonstrate any lowering of L in these utterances of alternating H and L, only one step of lowering of L is ever observed. Therefore, generalizing from these four speakers, I draw the conclusion that in Saxwe, there is no automatic downstep of L.

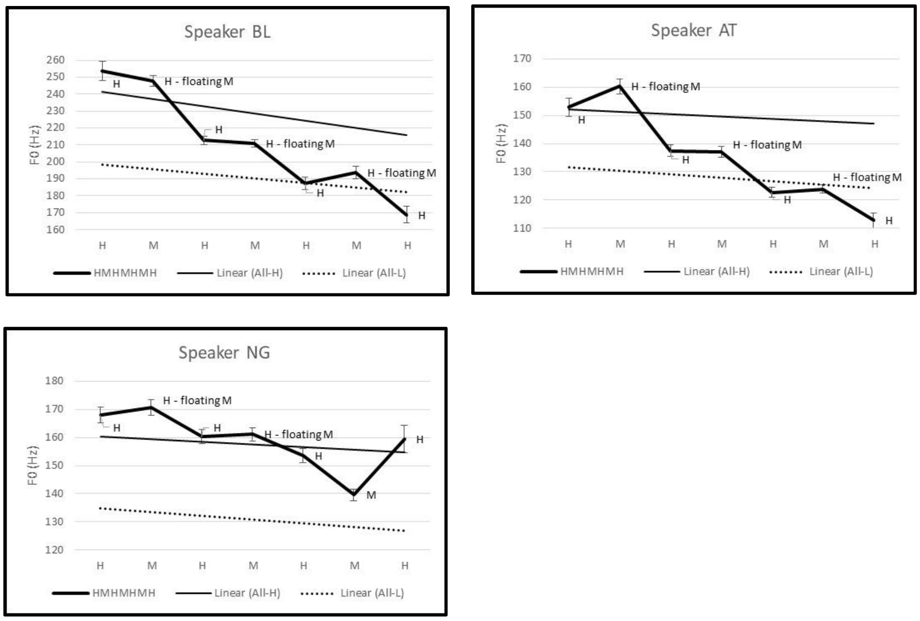
7.3.4 Results: the lowering of H triggered by a floating M

I turn now to the topic of the lowering of H triggered by a floating M, answering the question (3) from section 7.5: Is the lowering of the F_0 of H which is attributed to a floating M between Hs greater than that which could be attributed to declination?

In order to demonstrate the phonetic realization of utterances of alternating underlying H and M tones, F_0 data were obtained from 10 repetitions each of the 7-TBU sentence (436) and the 9-TBU sentence (437). This gave 20 measurements for each TBU, which were averaged to obtain a mean.[113] A 95% confidence interval was calculated using a T distribution, shown in these graphs by the vertical bars. In addition, a linear regression line was generated from the baseline data for all-H and all-L utterances seen in section 7.2.2.

In section 3.2, the claim is made that in Saxwe, H tone spreads to an underlying M TBU, delinking the M. This floating M between surface Hs triggers a lowering of the level of H. Thus an underlying /H–H–H/ sequence will be realized [H–H–H], whereas a /H–M–H/ sequence will be realized [H–H–ꜜH]. This lowering is phonologically contrastive as it is the means by which the underlying distinction between a M and a H can be recovered when these two tones occur between Hs.

The following graphs show the phonetic implementation of alternating underlying H and M tones for three of the four speakers. (The fourth is discussed separately.) Note that in these graphs, the underlying tones are marked on the x-axis and the output from the phonology is marked on the graphs.



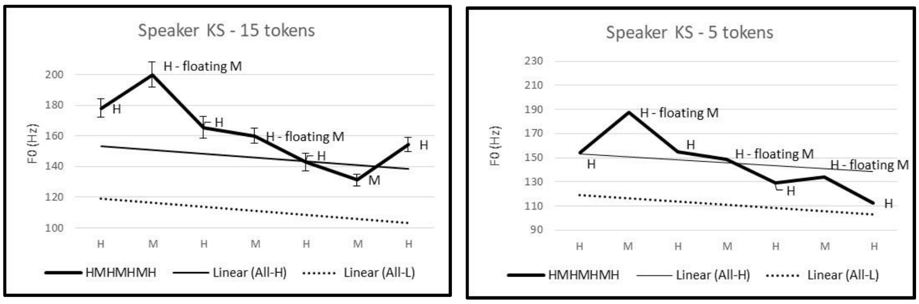
(441) Iterative underlying H–M sequences over 7 TBUs (20 tokens each)

[113] Occasionally, Praat generated a clearly erroneous measurement which was far out of the range of other measurements in the utterance. When this happened, the measurement was not included in the mean and the calculation of the 95% confidence interval took into account this difference in number of tokens.

In these graphs, we see that all speakers begin with a surface height for H which has been raised in anticipation of the lowering that will occur later in the utterance. As discussed in section 7.2, due to peak delay, the highest F_0 measurement of H occurs for some speakers on the second surface H TBU in the utterance rather than on the utterance-initial H. Here we see that happening for speakers AT and NG.

Speakers BL and AT have iterative lowering of the level of H which continues well below the baseline level for H and even below the baseline level for L in all-L utterances. In these graphs, we see three downsteps produced by these speakers. Speaker NG, however, limits the number of downsteps to two. Following this, downstep is arrested in a cancellation strategy (Rialland, 2001). For this speaker, Tonal spread no longer operates after two downsteps and he produces instead a surface M followed by a surface H which is reset above the level of the previous H. This allows speaker NG to avoid lowering the level of H significantly below the baseline level for H established in all-H utterances.

Speaker KS is discussed separately because in the 20 total tokens analyzed, he shows two different patterns—one observed in 15 tokens, and one observed in 5 tokens. These are shown below.



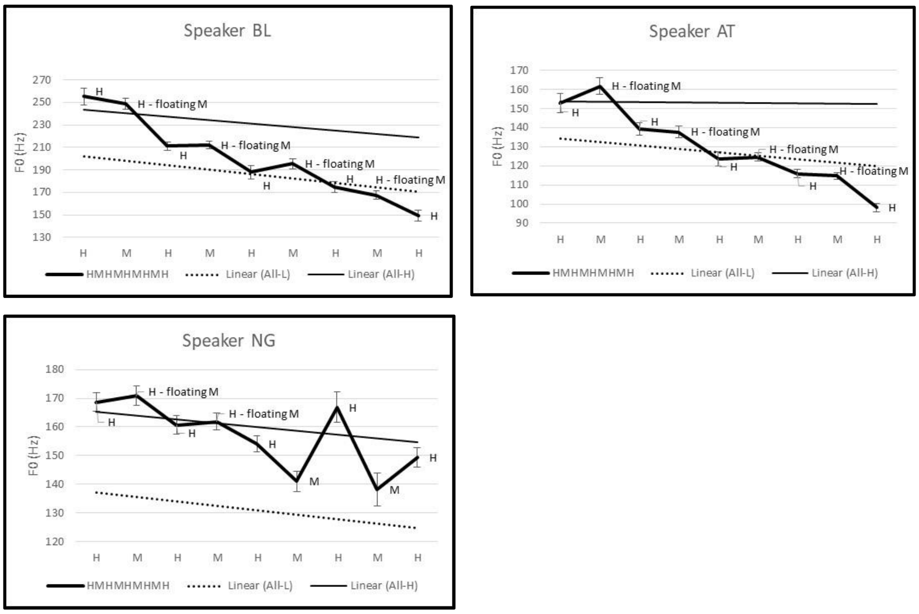
(442) Iterative underlying H–M sequences over 7 TBUs for speaker KS (20 tokens total divided into 2 patterns)

Note first that for speaker KS, there is again anticipatory raising of H above the baseline for H; the initial raised level of H reaches its peak on the second TBU of the utterance rather than on the first.

In fifteen of the twenty tokens, speaker KS employs the cancellation strategy. Just as with speaker NG, this cancellation occurs after two downsteps and allows speaker KS to avoid realizing H below the baseline level for H seen in all-H utterances. When Tonal spread fails to operate, H is reset above the level of the previous H.

In five of the twenty tokens, however, speaker KS employs the strategy seen above for speakers AT and BL and allows for continuous non-automatic downstepping of the level of H below the baseline for H (but not below the baseline for L). Thus speaker KS shows some variation in his realization of these longer utterances with some of his tokens following the pattern seen for speaker NG and others of his tokens following the pattern seen for speakers BL and AT.

We can focus on what happens in longer utterances by looking at the data coming solely from the utterance of 9 TBUs (437). First we see the patterns displayed by three of the four speakers. Speaker KS is again examined separately.

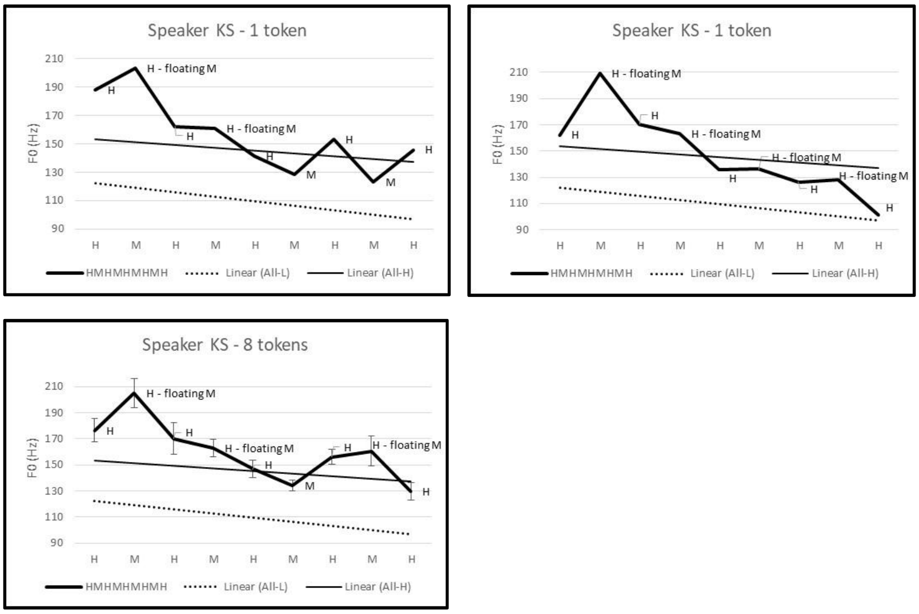


(443) Iterative underlying H–M sequences over 9 TBUs (10 tokens each)

Here we see that in an utterance of nine TBUs, speakers BL and AT continue to lower the F_0 of H until the final H ends well below the baseline level of L in all-L utterances of equivalent length. We also see that as the utterance progresses, there is a compression of the steps, so that the third step is smaller than the second, which is smaller than the first. (This relationship does not necessarily hold for the last downstep, however.) This compression of steps is likely a concession to accommodate the physical limitations of the pitch range.

In the graph of the data from speaker NG, non-automatic downstep is again canceled after two steps. Tonal spread no longer operates after this point and the following H is reset above the level of the previous H. Speaker NG does not spread H tone either in the third or final iteration of underlying /H–M/ sequences, so the underlying M tones in these sequences are realized as surface Ms with a F_0 produced roughly between the all-H and all-L baselines.

Speaker KS is not consistent in his production of the 9-TBU utterance. He employs three different patterns in his ten repetitions of the utterance. One pattern is employed for eight tokens, and the other two are each employed for a single token. This is demonstrated below.



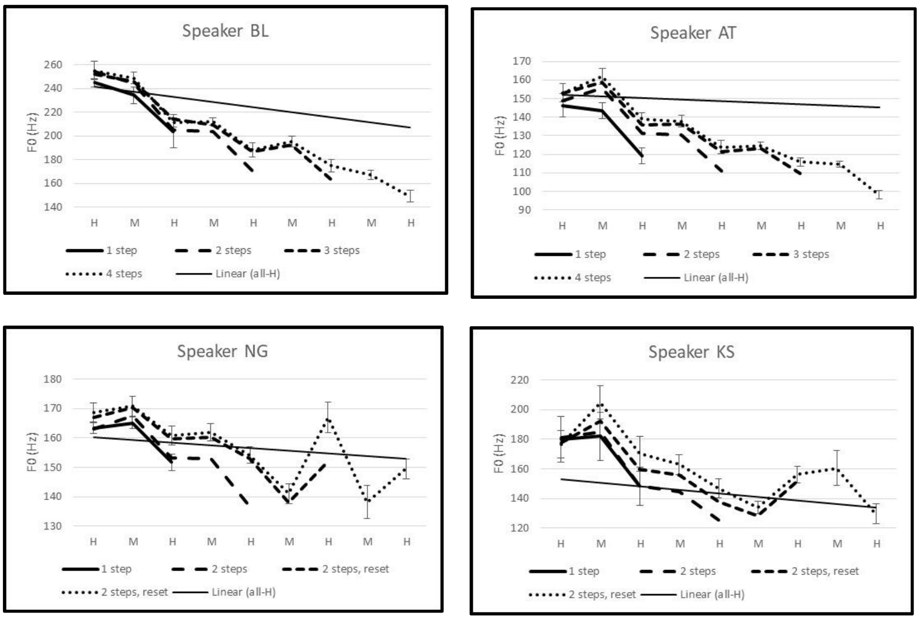
(444) Iterative underlying H–M sequences over 9 TBUs for speaker KS (10 tokens total divided into 3 patterns)

In one token, speaker KS employs the strategy used by speaker NG, canceling non-automatic downstep after 2 steps, and resetting H without reinitiating H spread throughout the rest of the utterance. In another token of the same sentence, he employs the strategy of speakers BL and AT of allowing continuous non-automatic downstep to occur throughout the entire utterance. This is assisted by a significant initial raising of H and a compression of downsteps two and three.

In the other eight tokens, non-automatic downstep is canceled after two steps, but this is a temporary cancellation. Speaker KS does not apply the rule of Tonal spread at this point in the utterance and H is reset above the level of the previous H. However, H spread is reinitiated again after this single reset of H and non-automatic downstep is triggered once again on the last H by a floating M.

We see, then, that speaker KS is eclectic in the strategies he employs in dealing with long utterances of alternating underlying Hs and Ms. In the majority of cases, however, he—like speaker NG—employs strategies that prevent the F_0 of H from dropping significantly below the baseline level of H that is established in all-H utterances.

We have seen that there is anticipatory raising of H involved in the production of non-automatic downstep of H. This anticipatory raising is often most clearly observed on the second surface H of the utterance rather than on the initial H—an effect of peak delay. We can look more closely at H raising in the context of non-automatic downstep by seeing what happens in utterances of alternating underlying Hs and Ms as they increase in length. The following graphs represent data from the utterances (434) through (437). Mean F_0 measurements are obtained from 10 tokens of each utterance.[114] The bars represent 95% confidence intervals for the /HMH/ and /HMHMHMHMH/ utterances.



(445) Increasing iterations of alternating underlying Hs and Ms (avg. 10 tokens)

For speakers AT, NG, and KS, the second surface H in the utterance is where one observes the greatest variance in the extent of H raising. For all speakers, the longest utterance (/HMHMHMHMH/) has the highest F_0 at this second TBU and the shortest utterance (/HMH/) has the lowest F_0 at this point. This is particularly true of speaker KS. It must be noted, however, that because the 95% confidence

[114] Because of a reading error, one token from the /HMH/ sentence of speaker NG was not able to be included. The confidence intervals given take into account this difference in the number of tokens. For speaker KS, the /HMHMHMHMH/ graph represents the eight tokens of his most common pattern of implementation.

intervals either touch or overlap at this point for all speakers except speaker AT, this finding would need to be verified through further studies with greater numbers of utterances.

To conclude this section, we see that there is a fairly clear and consistent distinction between the way speakers BL and AT manipulate H tone within their F_0 range and the way speakers NG and KS do so. Here in the discussion of non-automatic downstep, we see that for speakers BL and AT, the baseline for H does not correlate in any way with any limitations in the F_0 range of production of a H. A H tone can be realized both above and below the H baseline (and even below the L baseline). Speakers BL and AT produce non-automatic downstep of H which is not restricted or qualified in any way by the parameters tested here.

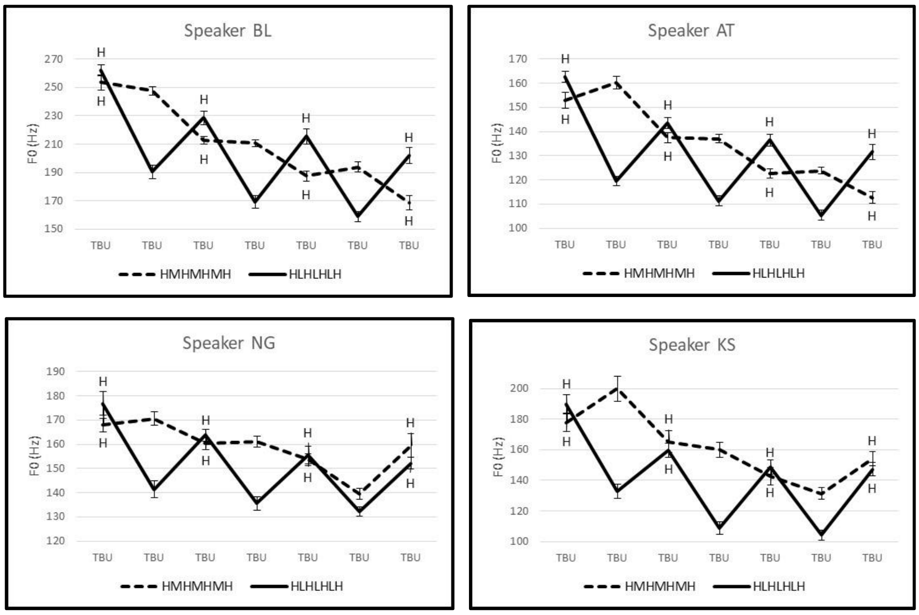
For speakers NG and KS, we see that in longer utterances (minimum of seven TBUs), speakers avoid producing a H significantly below the F_0 baseline for all-H tones. A H can be produced above the baseline for H through anticipatory raising, but these speakers avoid having a H tone fall significantly below it (although speaker KS is eclectic in his manipulation of tone and occasionally does permit pitch patterns that look like those of speakers BL and AT).

According to the stated criteria for downstep in section 7.3.1, the specific label given to the non-automatic downstep of H of speakers NG and KS is delimited, arrested non-automatic downstep. It is downstep that is delimited due to the avoidance of producing a H below a lower limit of F_0. In order to accommodate this constraint in the realization of H, speakers NG and KS both raise the level of H utterance-initially and compress the second downstep in comparison to the first. Despite both of these accommodations, only two downsteps are implemented before the level of H is reset. In this reset, Tonal spread fails to operate and a surface M is realized. This is followed by a H which has a F_0 higher than the H which preceded it. Any subsequent H is again lowered from this newly reset level. In the discussion of these results in 7.3.6, we look at the challenge of understanding how constraints regarding the limitations of the production of H are able to prevent phonological rules from being applied.

7.3.5 Comparison of automatic and non-automatic downstep

In this section, the final research question (4) from section 7.3.2 regarding downstep is addressed: Is the lowering of the F_0 of H which is attributed to a surface L between Hs equal to that which is attributed to a floating M between Hs?

The graphs below combine information previously seen in sections 7.3.3 and 7.3.4. For the solid line, the data come from 10 tokens each (20 tokens total) of utterances (432) and (433)—one utterance of 7 TBUs and one utterance of 9 TBUs, each with alternating surface H and L tones. For the dashed line, the data come from 10 tokens each (20 tokens total) of utterances (436) and (437)—one utterance of 7 TBUs and one utterance of 9 TBUs, this time each with alternating underlying H and M tones. Exceptionally in the case of speaker KS, the dashed line represents only 15 tokens total. This is because this comparison is taking into account only the most common of the two patterns that he uses for alternating sequences of H and M tones (section 7.3.4).



(446) Comparison of the lowering of H triggered by surface Ls or floating Ms

Once again these graphs highlight the fact that speakers AT and BL show patterns of phonetic implementation that are different than the patterns seen for speakers NG and KS. This has largely to do with the fact that speakers AT and BL have no lower F_0 threshold for the production of H, whereas speakers NG and KS usually do have such a threshold (although speaker KS allows for exceptions).

For speakers AT and BL, the lowering of H that is triggered by a surface L extends for a maximum of two instances of lowering (one larger and one smaller) that clearly exceed the rate of declination. After this, Hs that occur between Ls continue to lower, but at the same rate as declination—although having dropped below the baseline level of all-H utterances, they never return to that level (section 7.3.3). For these same speakers, the lowering of H that is triggered by a floating M is continuous throughout these utterances and brings the level of H to a position lower than the baseline level of all-L utterances (section 7.3.4). This means that the more iterations into the utterance, the greater the disparity between the F_0 of production of H as represented by the solid and dashed lines. After three non-automatic downsteps, the disparity between the F_0 of production of H in these two alternating sequences is highly significant. For these speakers, there is no equivalence in terms of Hz between the lowering of H that is triggered by a surface L and the lowering of H that is triggered by a floating M.

The situation is different for speakers NG and KS. In utterances that have a minimum of seven TBUs, these speakers have a relatively inflexible lower threshold of the F_0 production of H, correlating roughly with the baseline level of H found in all-H utterances. This lower limitation of the F_0 range of H is continually lowering throughout the prosodic unit at the rate of declination. Because these speakers avoid producing a H significantly below this limit, we find that in utterances where there is lowering of H triggered by a surface L and in those where lowering of H is triggered by a floating M, the F_0 levels for H at any given distance into the prosodic unit are quite close. In fact, after two non-automatic downsteps, there is considerable overlap of confidence intervals for the Hs in the two types of utterances. This is because in these longer utterances of both types, two downsteps is the maximum number of downsteps that can be produced before the level of H in these utterances reaches the threshold lower limits for H production.[115]

7.3.6 Discussion of results

We have seen that a significant issue raised by these tests is the question of what defines downstep as distinct from other pitch lowering phenomena. For purposes of comparison, the following is a reiteration from section 7.3.1 of the criteria used here to define downstep.

First, there must be a minimum of two steps down, each representing a decline from the preceding H that exceeds the rate of declination. Because there is anticipatory raising of H, the lowering need not descend below the baseline for an all-H utterance. However, if it does not descend below this baseline, I label it as "delimited downstep", and if it does not continue within the prosodic domain further than the minimum of two steps down, I give it the label "arrested downstep" (Rialland, 2001). In a case of "arrested downstep", there can still be, due to declination, progressive lowering of H beyond the two steps, but the rate of lowering will no longer exceed the rate of declination. Alternatively, there may be an upward resetting of the level of H after the two steps of lowering.

There are other descriptions of this type of situation where downstep is arrested and a phonologically-relevant lowering at an early stage in the utterance does not have lasting effects on the level of subsequent H tones late in the utterance. According to Genzel (2013), the lowering of the pitch F_0 of H in Akan is equivalent whether it is a case of automatic or non-automatic downstep. However, this lowering

[115] It seems that this threshold for the production of H is not as relevant in an utterance of five TBUs where exactly two non-automatic downsteps of H are realized, at which point the utterance ends. There seems to be an element of preplanning that is involved in the establishment of lower thresholds for H production over the course of longer utterances. This is a topic to be studied further.

is gradually offset over the course of a long utterance (of ten syllables) such that by the end of the utterance, the level of H is found to be equivalent to that of a H tone in an utterance of similar length composed only of H tones (Kügler, 2017). (In fact, there is a neutralization of both H and L at the end of the utterance.) The conclusion made is that Akan has 'phonologized declination' (Genzel, 2013).

There is also the observation that in some languages a surface L will cause a lowering of the immediately following H tone in a HLH sequence. In subsequent H tone syllables, however, the level of H will gradually creep up to the level of the initial H. It is concluded that this is a purely phonetic phenomenon (Connell, 2017).

Here in Saxwe, speakers NG and KS employ the strategy of resetting H tone after an initial one or two downward steps of H tone. As a result, in non-automatic downstep, levels of H tone at the end of a long utterance are roughly similar whether the utterance is composed solely of H tone, or whether there is an alternation between H and underlying M.

The results of these tests are in some ways quite surprising given the fact that these four speakers were chosen specifically because they were of similar age, of similar provenance, and because they speak the same dialect of Saxwe. The intention was to establish an understanding of the way that middle-aged speakers of the Saxwe variant spoken in the township of Houeyogbe manipulate pitch within the speaker's F_0 range in realizing certain sequences of tones. Instead, we see two rather divergent global approaches to manipulating tone—each approach employed by two speakers (although speaker KS vacillates occasionally between the two differing global approaches).

These global approaches differ primarily in whether or not in longer utterances there is a lower threshold for the realization of H. For speakers BL and AT, no such threshold is observed. In the case of speakers NG and KS, there is (usually) such a threshold and it corresponds roughly with the declining baseline levels of H in an all-H utterance.

This raises the question of how to view this threshold. It could simply be a strategy of preplanning which helps a speaker to avoid having to descend too low into his or her natural or comfortable range of production of pitch.

Taking into account the discussion of tone features in section 6.2, another possibility is that the distinguishing factor between these two global approaches is whether, in a given speaker's phonology, the distinction between [+upper] and [-upper] is purely relative to what precedes, or whether these values are divided by a more inflexible boundary in terms of F_0 production. In the latter case, the floating or surface feature [-upper] between two [+upper] TBUs will cause a lowering of F_0 so long as this does not result in crossing the relatively inflexible F_0 boundary that divides the [+upper] register from the [-upper] register.

An interesting observation is that for speakers BL and AT, whose "floor" for H is highly flexible, the F_0 lowering that is triggered by a floating M (non-automatic downstep) is clearly not equal in Hz to the lowering that is triggered by a surface L (automatic downstep). If one considers that what comes between the [+upper] register feature in both cases is the [-upper] feature (whether occuring as a floating M or as a surface L), one might expect that these two kinds of lowering would be equivalent.

Perhaps the reason for this difference is that the lowering triggered by a floating [-upper] tone can be the single element that marks a difference in meaning and is therefore phonologically contrastive. It has to exceed the rate of declination to be perceived by the hearer as distinct from the lowering of declination. The lowering triggered by a surface [-upper] tone is not phonologically contrastive and therefore does not have to exceed the rate of declination. Therefore, regardless of whether the sequence of register features is the same, these two types of lowering are implemented differently in the phonetic component in Saxwe. Their implementation is so different that in the case of speaker BL, we cannot even conclude (given the criteria established for downstep) that there is automatic downstep of H, whereas non-automatic downstep of H is clearly implemented for this speaker. This is very different from languages such as Chumburung in which the two types of downstep are shown to produce equal measurements of lowering in F_0 (Snider, 1998).

A final issue is how to explain the observation that for some speakers (such as NG and KS), Tonal spread may fail to occur in an utterance when its operation would result in bringing the level of the following H below the threshold of ideal production. This may be another indication that the predetermined inflexible boundary between the [+upper] and the [-upper] registers is part of the phonology of some speakers and not merely a product of the phonetic implementation. There are several arguments in support of this idea. First, it makes sense that a phonological parameter (such as whether register is defined in a relative manner or not) could be part of the conditioning environment for the application of a phonological rule such as Tonal spread. Second, the anticipatory failure of Tonal spread to occur cannot be easily explained by physical restrictions that impose themselves at the time of failure; the threshold for H is not at the lower limits of a speaker's F_0 range.

What is needed is further research within the Saxwe population in order to confirm whether this flexible/inflexible boundary between registers is truly a parameter that is relevant for all speakers and to what degree the observations noted here might be tied to other confounding factors, such as syntactic structures.

I turn now to lowering and other aspects of phonetic implementation having to do with L tone.

7.4 Phonetic implementation relating to L tone

In section 7.3, non-automatic downstep of H is described as the lowering of the level of H triggered by a floating M. Here in this section, the question explored is whether a floating M also triggers a lowering of the level of L. Stated otherwise, I explore whether there is non-automatic downstep of L in Saxwe. In the utterances used here, the floating M is present because a preceding H or L tone has spread onto an underlying M TBU, causing it to be delinked (section 3.2).

Recall from section 7.3.3 that pitch traces from alternating sequences of H and L TBUs reveal that there is no automatic downstep of L. In such an utterance, there is only a single instance of lowering of L beyond that which could be attributed to declination. Therefore, by the criteria I have laid out, we cannot claim that there is automatic downstep of L. Given this background, we turn to the question of whether there is non-automatic downstep of L.

7.4.1 Research question and utterances recorded

The following testing seeks to answer the research question: Is the lowering of the F_0 of L attributed to a floating M between Ls greater than that which could be attributed to declination?

In order to answer this question, the following set of eight sentences were created and recorded. Each sentence was recorded ten times by each speaker, and sentences were reshuffled between each pass.

(447) /$^{M-}$ télà sɔ̃́/
The tailor left. (3 TBUs - /HLH/)

(448) /$^{M-}$ télà ò sɔ̃́/
The tailor has left. (4 TBUs - /HLLH/)

(449) /$^{M-}$ télà ò gbɔ̃̀ sá/
The tailor already returned a while back. (5 TBUs - /HLLLH/)

(450) /$^{M-}$ télà gàgà ò gbɔ̃̀ sá/
The tall tailor already returned a while back. (7 TBUs - /HLLLLLH/)

(451) /$^{M-}$ télà gàgà gbɪ̃̀gbɔ̃̀ mɔ̃̀ drɔ̃̀ ké/
The tall tailor's return still remains [to be]. (9 TBUs - /HLLLLLLLH/)

(452) /$^{M-}$ télà nã̄ gbɔ̃̀ fí/
The tailor will return right away. (5 TBUs - /HLMLH/)

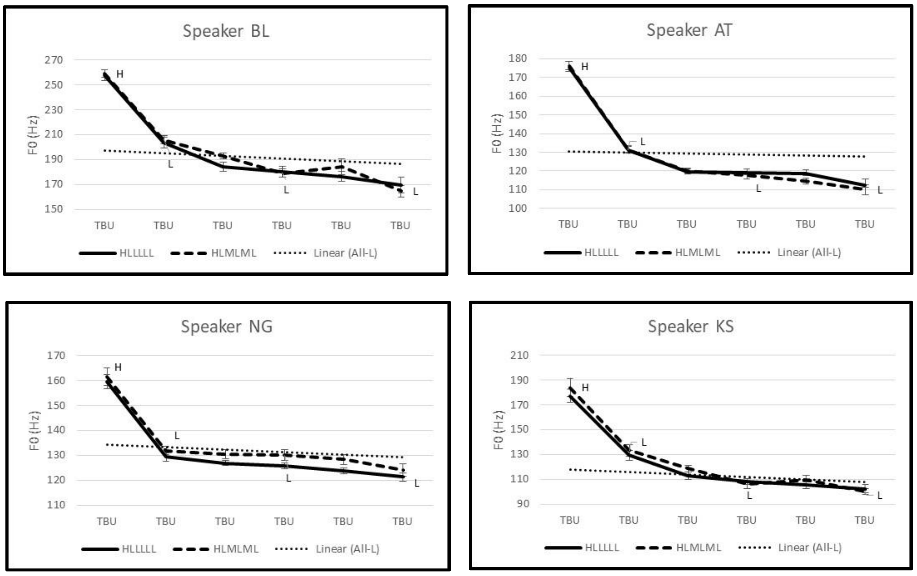
(453) /$^{M-}$ télà nã̄ ɦũ̀ ōɦɔ̃̀ fí/
The tailor will open the door right away. (7 TBUs - /HLMLMLH/)

(454) /$^{M-}$ télà nã̄ ɦɛ̃̀ āɦà mɛ̃̄ gbɔ̃̀ fí/
The tailor will bring that beverage back right away. (9 TBUs - /HLMLMLMLH/)

The sections below describes how the measurement obtained from these recordings were used.

7.4.2 Results

In the following graphs, all utterances begin with a H tone. The bold lines show the averages for repeated underlying Ls following the H. The dashed lines show the averages for alternating underlying Ls and Ms following the H. Each point in the graph is a mean calculated from 20 tokens.[116] These 20 tokens include 10 tokens of a 7 TBU-utterance and 10 tokens of a 9-TBU utterance. For the repeating Ls, data are taken from utterances (450) and (451), and for the sequences of alternating Ls and Ms, data are taken from utterances (453) and (454). Only data from the first six TBUs are included in these graphs; all utterances ended with a H tone as a frame, but it is the non-Hs that are in focus here. The bars represent 95% confidence intervals. In addition, a linear regression line from the all-L baseline data in section 7.2 is included.



(455) Iterative underlying Ls or L–M sequences over 5 TBUs (avg. 20 tokens)

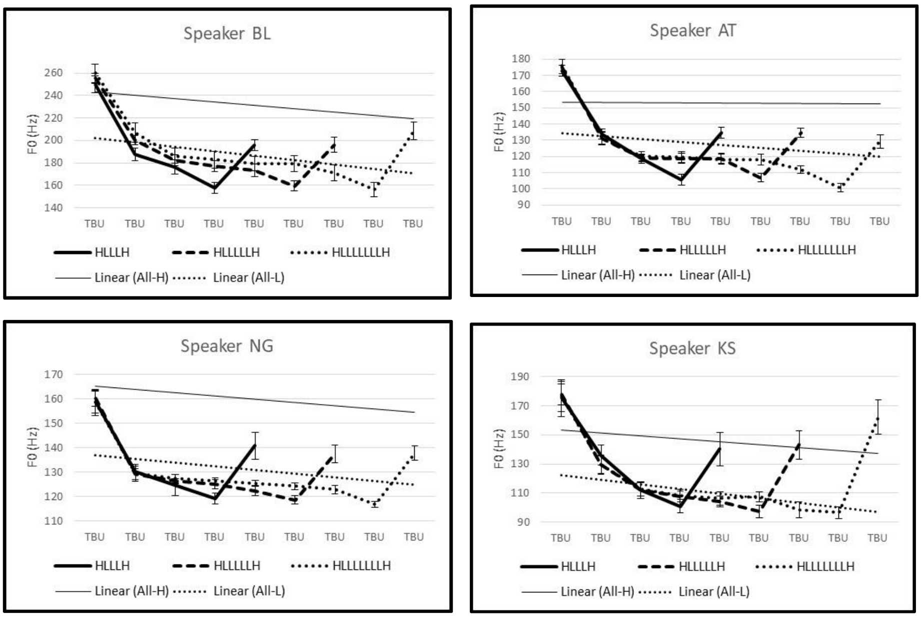
[116] Because of a reading error, speaker NG had only 19 tokens of the utterance with the sequence of Ls. The 95% confidence intervals take this into account.

In the alternating sequences of underlying Ls and Ms, L spreads to the M TBU, delinking this M. However, we do not see the same progressive down-stepping of pitch triggered by these floating Ms that we see when there is a floating M between underlying Hs (section 7.3.4). For all speakers, the /HLMLML/ sequence has confidence intervals that overlap at multiple places with the confidence intervals for the /HLLLLL/ sequence. For speakers AT and KS, the two pitch traces are essentially overlapping. Speakers BL and NG show some slight differences in the pitch traces of the two /HLMLML/ and /HLLLLL/ sequences, but by the last L TBU shown in these graphs, pitch levels are not significantly different from each other.

The conclusion is that just as there is no evidence of automatic downstep of L in Saxwe, there is also no evidence of non-automatic downstep of L in Saxwe. Floating M does not trigger downstep between L tones.

There is one interesting observation to be made, which is that the first L that follows the utterance-initial Hs in these utterances may be considered to be slightly raised in F_0. It is as of the third TBU that lowering happens at a stable rate parallel to the line of declination for all-L utterances. This is a phenomenon that could be described as reverse peak delay. One could label it more generally as "target achievement delay". Here, the target level of F_0 for L is achieved in the second L syllable following a H rather than the first. This can be seen most clearly for speakers AT and KS.When we include the final H tone from sentences (447) through (454) in a graph, we see another kind of lowering phenomenon which is worth noting. This lowering is not related to a floating M tone, but has to do with the final H TBU which was included in these sentences as a frame. In the following graphs, the three pitch traces represent 10 tokens each of a /HLLLH/, /HLLLLLH/, and /HLLLLLLLH/ utterance. [117] The vertical bars represent 95% confidence intervals.

[117] Speaker NG, because of reading errors, had only 9 tokens each of the /HLLLH/ and /HLLLLLLLH/ utterances.



(456) Increasing numbers of L TBUs between two Hs (avg. 10 tokens)

The most interesting thing to note from these graphs is that there is a dip in F_0 at the last L TBU in each utterance which immediately precedes the utterance-final H. Instead of continuing at the same rate of declination as the preceding Ls, this L is lowered at a steeper rate.

This is an anticipatory phonetic effect, like the raising of H before following L–H sequences (section 7.3.3). It is also, like the anticipatory raising of H, a dissimilation of tones which enhances tonal distinctions. Interestingly, while dissimilatory processes may be responsible for the anticipatory lowering of L *before* H, we do not see dissimilatory lowering of L *after* H—at least not when there are multiple Ls following this H. We have just seen that the first L that follows the utterance-initial Hs in these utterances may be slightly raised in F_0 with reference to the stable level of declining Ls that occurs afterwards in the utterance.

This means that for these speakers, the three Ls in a /HLLLH/ sequence are realized at three different positions with respect to the all-L baseline. For speaker AT, the first L in a /HLLLH/ utterance is at the L baseline, the second L is below the baseline at a stable point with reference to longer utterances, and the third L is lowered even further below the baseline in anticipation of the final H. For speaker KS, the first L is above the L baseline, the second is at the L baseline, and the third is below the baseline.

7.4.3 Discussion of results

We see in this section that there is no evidence of non-automatic downstep of L in Saxwe. Floating M does not trigger downstep between L tones. Downstep can only be triggered by a [-upper] register appearing between [+upper] registers. Since M and L are both [-upper] (differing only in the feature [+/- Raised]), alternating M–L sequences and all-L sequences are realized in approximately the same way. Lowering occurs in these contexts, but only at a rate consistent with declination.

While there is no lowering of L triggered by a floating M, there is another lowering-related phenomenon associated with L tones, which is that when multiple L TBUs precede a H, the last of these Ls is lowered beyond the level of lowering attributable to declination. This lowering of L before H is an anticipatory dissimilatory process—one which bears some similarities to the raising of H before L (section 7.3.3). Both are anticipatory processes, both involve dissimilation, and both occur in the sentences used for this testing between the two TBUs at the outermost edges of the IP.

It would be interesting to test whether, if the H were not utterance-final, this single instance of lowering of L before H would still be clearly observed. This would help to answer the question whether dissimilation in pitch implementation is most significant at the junction of two TBUs located either at the beginning or at the end of the IP.

Having treated several topics related to pitch implementation at the utterance level, I turn now to pitch implementation at the word level, focusing specifically on V.C(C)V nouns.

7.5 The most common tone patterns of V.C(C)V nouns

This section discusses the phonetic implementation of monomorphemic nouns (section 3.7). In this section, I concentrate on the nouns whose initial vowel is M; this excludes the /L.H/ noun tone pattern (section 3.7.8). I also exclude the extremely rare /M.H ^{M}/ tone pattern. The remaining six noun tone patterns are examined here: /M.H/, /M.M/, /M.L/, /M.M ^{H}/, /M.L ^{H}/, and /M.LH/.

For each of these six tone patterns, ten nouns were chosen to be recorded. These nouns are listed in Appendix D. They were chosen primarily for their ease of recognition from the French translation, but they also display the consonant-tone correspondences that are noted throughout this study—the /M.L/, /M.L ^{H}/, and /M.LH/ tone patterns most commonly have a depressor consonant (voiced obstruent) in their syllable onsets and the other tone patterns have a non-depressor consonant (voiceless obstruent, sonorant, /d̪/, or /b/) in their syllable onsets.

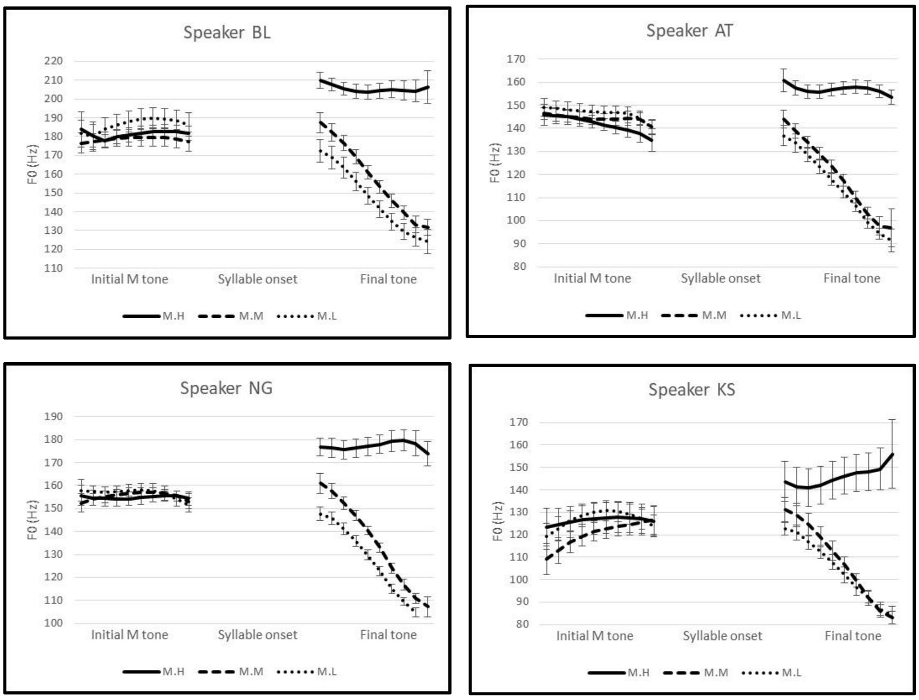
All sixty nouns were shuffled and a single pass was made through the words. Each word was pronounced two times. For speaker AT, this meant that there was a total of 20 tokens for each noun token pattern.

A variable that I had not predicted was that there was some interspeaker variation regarding the noun tone pattern assigned to certain of these nouns; the areas of divergence had largely to do with the tone pattern /M.L ^{H}/. Words that speaker AT pronounced with this tone pattern were not necessarily pronounced with that tone pattern by other speakers. This meant that for all speakers except AT, one or more of the six tone patterns had more than 20 tokens and the /M.L ^{H}/ had less than 20 tokens. The calculation of the 95% confidence intervals takes into account these differences. The following are the numbers of tokens for the speakers where they deviated from 20: speaker BL—22 of the /M.LH/ pattern, 22 of the /M.L/ pattern, 16 of the /M.L ^{H}/ pattern; speaker KS—22 of the /M.L/ pattern, 22 of the /M.M/ pattern, 16 of the /M.L ^{H}/ pattern; speaker NG—22 of the /M.L/ pattern, 16 of the /M.L ^{H}/ pattern, 2 of the /L.H/ pattern.[118]

7.5.1 The /M.H/, /M.M/, and /M.L/ tone patterns

The following graphs show the phonetic realization of the /M.H/, /M.M/, and /M.L/ tone patterns for all four speakers.

[118] Speaker BL did not include among words of the /M.L ^{H}/ pattern: [oɦjã] 'corn weevil' and [omlɛ̃] 'fishhook'. Speaker KS did not include among words of the /M.L ^{H}/ pattern: [omlɛ̃] 'fishhook' and [aɦa] 'side'. Speaker NG did not include among words of the /M.L ^{H}/ pattern: [oɦjã] 'corn weevil' and [aɦa] 'side'.



(457) Comparison of /M.H/, /M.M/, and /M.L/ tone patterns (avg. 20 tokens)

What we see very clearly from these graphs is the effect that the final $L_{\%}$ IP boundary has on utterance-final M and L tones. In section 3.5, I discuss the utterance-final lowering or downglide on any underlying M or L tone that does not have a floating H or boundary tone H following it. This utterance-final lowering occurs even when the underlying M is realized H because of Tonal spread (72). The mechanism which explains this final lowering or downglide is the right edge $L_{\%}$ IP boundary which links to the final M or L ([-upper]) TBU prior to Tonal spread.

In these graphs, we see again the observation made in section 7.2.2 that if there is an uneven distribution of H, M and L within the F_0 range of a speaker, it is M and L which are more closely localized within the range and H which is more distanced from M. This is true even before the lowering due to the IP boundary comes into play and is most clearly seen for speakers BL and AT. In fact, for speaker AT, 95% confidence intervals are overlapping during the realization of M and L both at the beginning of these final vowels and throughout their entire duration.[119]

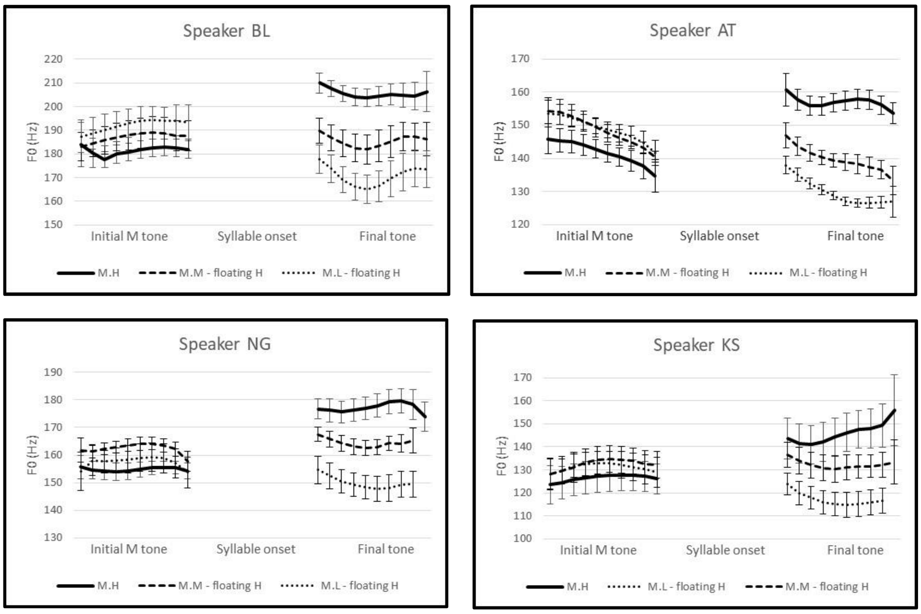
[119] The large confidence interval bars in the tenth measurement of the final vowel are due to the fact that Praat was often unable to produce a F_0 measurement at this final point in the duration of the vowel, and therefore confidence calculations are based on a small sample size.

As M and L are lowered over the course of the utterance-final TBU, the distinction between these tones becomes more neutralized so that for speakers BL, AT, and KS, there is overlapping of the 95% confidence intervals by the end of the duration of the final vowel even if there is no overlapping at the beginning of the vowel.

When the final $L_{\%}$ IP boundary is not in play, the outcome is quite different. This is what we see in the next section.

7.5.2 The /M.H/, /M.M ^{H}/, and /M.L ^{H}/ tone patterns

The following graphs show the surface realizations of the /M.H/, /M.M ^{H}/, and /M.L ^{H}/ tone patterns.



(458) Comparison of /M.H/, /M.M ^{H}/, and /M.L ^{H}/ tone patterns (avg. 20 tokens)

Because of the floating H tones on the /M.M ^{H}/ and /M.L ^{H}/ patterns, the final $L_{\%}$ IP boundary does not link to the utterance-final TBU and there is no final lowering on the M and L vowels like that seen in (457). In this context, we can see more clearly that there are three distinct levels for H, M and L, and that this distinction cannot simply be attributed to phonetically-driven consonantal influences because the contrasts remain relevant throughout the duration of the final vowel.

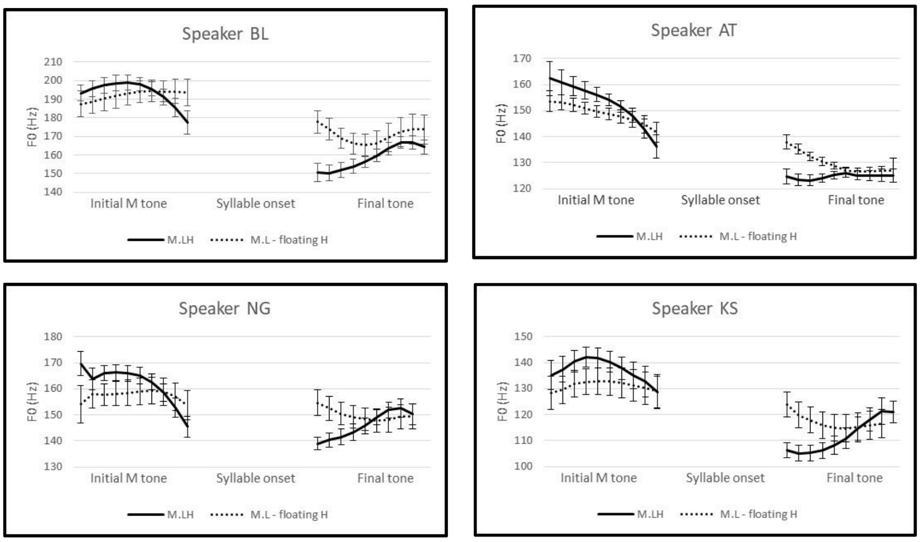
In these graphs, there is very little overlap of confidence intervals in the final vowel, and the overlap that exists is in the final measurements taken in the vowel. The large confidence intervals on the final measurement are due to the smaller numbers of F_0 readings provided by Praat at this point in the duration of the final vowel, and in some cases (speakers NG and KS), mean data points and confidence intervals were simply left off the final point of measurement because there were fewer than four data points available for these calculations.

We also see in these graphs some indication that there is a lowering of initial M before H in the M.H tone pattern. Although there is still a great deal of overlap of confidence intervals, we can see that the trend for all four speakers is that when it precedes H in the M.H pattern, M is realized lower in F_0 than it is for the other tone patterns shown in these graphs. This is an anticipatory phonetic process of dissimilation.

7.5.3 The /M.LH/ and /M.L ^{H}/ tone patterns

The /M.LH/ tone pattern is one of the more complex noun tone patterns in Saxwe. In section 3.7.5, we see that the LH contour in the /M.LH/ tone pattern is simplified—either by delinking the H (following L or M), or by deleting the L (following H). In the /M.LH/ noun, the contour is simplified by delinking the H. This makes the phonetic output sound very much like that of the /M.L ^{H}/ tone pattern.

In the derivations proposed for noun tone patterns in section 3.7, the difference between the phonetic output of /M.LH/ and /M.L ^{H}/ nouns lies in the fact that the floating H of the /M.L ^{H}/ tone pattern is deleted before the final output from the phonology, whereas the floating H which is a result of Contour simplification remains present in the output from the phonology. This accounts for the fact that there are some subtle differences in the F_0 traces. This can be seen in the following graphs.



(459) Comparison of /M.LH/ and /M.L ^{H}/ tone patterns (avg. 20 tokens)

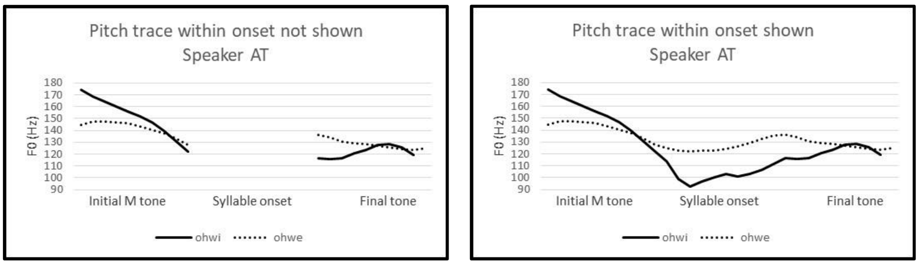
By about 60% into the duration of the final vowel, all speakers have largely overlapping confidence intervals for the /M.LH/ and /M.L ^{H}/ tone patterns, and for the remainder of the duration of the vowel, the F_0 traces are fairly close to each other. However, in the first half of the duration of this vowel, there is a difference in the pitch traces; for all speakers, the final vowel of the /M.LH/ tone pattern begins at a lower pitch than does the final vowel of the /M.L ^{H}/ tone pattern. The pitch then rises so that midway through the vowel, the two pitch traces have overlapping confidence intervals and start to be indistinguishable. This is the upglide or rising pitch that I represent in the notation of surface forms with the superscript [^{R}] as in [M.L ^{R}].

I do not have an explanation for why a final floating H in the output from the phonology triggers extra-low F_0 levels for a brief duration in the surface L vowel of the /M.LH/ pattern. However, these extra-low F_0 levels seem to be related to another observation—this time regarding the implementation of the initial M in the /M.LH/ tone pattern. This initial M is raised midway in the duration of the initial vowel in comparison with the M of the /M.L ^{H}/ tone pattern. Following this, the F_0 level slopes downward as it approaches the syllable onset.

The difference between surface realizations of these two tone patterns may be evident already in the production of the consonantal onset. We can see this if we look at the near-minimal tone pair /ōɦwǐ/ 'knife' and /ōɦwè ^{H}/ 'sun/fish'.[120] The

[120] The sound /ɦw/ functions as a single phoneme in Saxwe (section 1.4.3).

following pitch traces are averaged from two tokens of each word and come from the speaker AT.

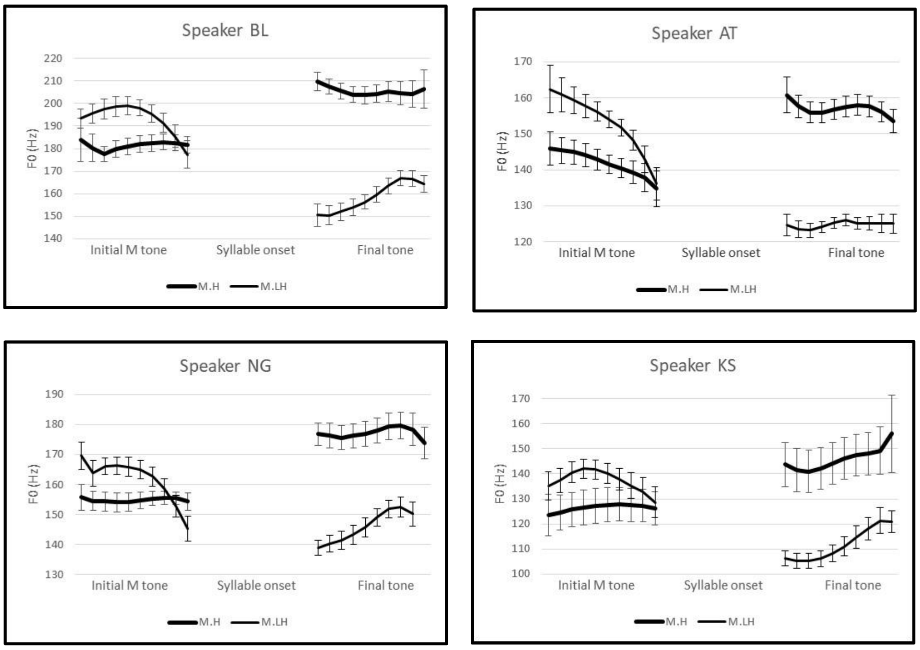


(460) /M.LH/ and /M.L ^{H}/ tone patterns in /ōɦwǐ/ and /ōɦwè ^{H}/ (2 tokens each)

These words share the same syllable onset but are realized differently due to their different underlying tone patterns. When we look at the pitch trace over the duration of the onset, we see that even during the articulation of the consonant onset, the pitch traces are dissimilar. This is an observation that needs to be explored in further studies of large data sets with words controlled for the consonant quality of the onset.

7.5.4 Dissimilatory effects on M in the /M.H/ and /M.LH/ tone patterns

Anticipatory dissimilation is a recurring phenomenon in the phonetic implementation of Saxwe tone. When looking at nouns produced in isolation, it is useful to compare the anticipatory raising of M before a [L ^{H}] vowel to the anticipatory lowering of M before a [H] vowel. This is what is shown in the following graphs.



(461) Comparison of /M.H/ and /M.LH/ tone patterns (avg. 20 tokens)

The surface realization of the initial underlying M of nouns in isolation varies considerably with respect to F_0. In these graphs, the 95% confidence intervals for the two realizations of M do not overlap during most of the duration of the vowel. These extremes (within a range of roughly 20 Hz) in the production of M can both be explained as anticipatory dissimilation. In the case of the /M.H/ pattern, M is realized at a relatively low F_0 before the following H. In the case of the /M.L ^{H}/ tone pattern, M is realized at a relatively high F_0 before the extra-low pitch produced early in the final vowel as a realization of the L–floating H combination. The result is that for speakers BL, AT, and KS, the initial M of the /M.L ^{H}/ tone pattern is realized at a F_0 value that is not too far from the F_0 value of the H in the /M.H/ pattern.

7.5.5 Discussion of results

In this section examining the six most common noun tone patterns (/M.H/, /M.M/, /M.L/, /M.M ^{H}/, /M.L ^{H}/, and /M.LH/), my principal objective is to illustrate by way of F_0 measurements the surface patterns that are described in earlier chapters of this study. In the course of doing so, certain trends become apparent.

First, there is a default utterance-final $L_{\%}$ IP boundary that links to a final M or L ([-upper]) TBU unless this TBU is followed by a floating or boundary H.

When the $L_{\%}$ IP boundary is linked to final M or L, the difference between these two tones is masked to some degree and 95% confidence intervals for the two means overlap, particularly toward the end of the duration of that final vowel (457). However, when this IP boundary is prevented from associating to the final TBU because of the presence of a floating H, we see in (458) three distinct levels of F_0 for H, M, and L.

Another observation made here is that the upgliding [M.L^R] surface form that is derived from a /M.LH/ underlying tone pattern can be distinguished from the non-falling [M.L°] surface form derived from /M.L^H/ by two relatively small pitch differences. First, the F_0 of the initial M of the /M.LH/ pattern is raised and then begins to trail downward as it approaches the consonantal onset. Second, following the consonantal onset, the F_0 of the surface L which follows begins extra-low and glides upward so that by the end of the vowel the F_0 measurements of the [M.L^R] and [M.L°] surface forms are largely overlapping. What happens within the consonantal onset is a topic that deserves further study and must be tested using a larger sample size of near-minimal pairs controlled for equal occurrences of specific depressor consonants. There are indications that the F_0 levels produced during the duration of the depressor consonant are manipulated in order to help distinguish between the /M.LH/ and /M.L ^{H}/ tone patterns—specifically to distinguish between the phonological output of the former which includes a floating H and the output of the latter which does not.

In (461), we see that M is realized at a relatively low F_0 before the H of the /M.H/ tone pattern and that in the /M.LH/ tone pattern, M is realized at a relatively high F_0 before the extra-low realization produced for the L–floating H combination. In these contexts, tonal oppositions are emphasized through anticipatory pitch dissimilation.

7.6 Summary: aspects of the phonetic implementation

The purpose of this chapter is to give instrumental support for claims made in this study regarding certain aspects of tonal implementation—including those made about the existence or non-existence of automatic and non-automatic downstep, as well as those made about the surface differences between underlying V.C(C)V tone patterns. The results described in this chapter also point to future areas where further and more comprehensive testing could be carried out to clarify aspects of the phonetic implementation of tone in Saxwe.

The four speakers recorded for this testing were intentionally chosen in an effort to have test subjects of similar sociolinguistic background. However, despite their similar linguistic background, there is interspeaker variation in details such as how the downstep of H is implemented, as well as the assignment of particular underlying tone patterns to certain of the V.C(C)V nouns.

One useful starting point for the description of the phonetics of tone is to establish baseline values for utterances of all-H, all-M, and all-L tones for each speaker. From the baseline values for these four speakers, it is clear that declination is relevant in the realization of all three tones. Taking into account the results from all four speakers, we see that the rates of declination are not consistently greater for one tone than for any other (section 7.2). Speakers vary in how they space all-H, all-M, and all-L utterances within their F_0 range; these are either spaced evenly or with a greater gap in F_0 between all-H and all-M than between all-M and all-L. This latter proximity between M and L may reflect the fact that these two tones are [-upper] register, whereas H is [+upper].

In examining the question of whether there is automatic downstep of either H or L in Saxwe (section 7.3), I include some discussion as to how precisely downstep is defined. Automatic downstep of H is typically described as the iterative lowering of the level (or the "ceiling") of H triggered by a surface L (Clements, 1979; Connell, 2011; Stewart, 1993). However, there is less consensus about the specifics—including whether the lowering must be in excess of lowering that can be attributed to declination (something that may be assumed but is not always stated explicitly). Although there are other ways to characterize the relationship between downstep and declination (Downing & Rialland, 2017a), the criteria chosen here are that in order to qualify as downstep, the lowering observed must be in excess of that attibutable to declination. Furthermore, there must be at least two iterative steps in order for the term "downstep" to be used.

The finding here is that for all four speakers, there is an anticipatory raising of H utterance-initially in consecutive H–L sequences. This anticipatory raising creates the space for a large first step down. However, whether there is a second downstep of the level of H is less clear among some of these speakers, and there is clearly no third downstep of the level of H. Therefore, downstep of H, if it is a reality for some speakers, is arrested after two steps. In fact, speaker AT—who most clearly seems to have a second downstep in longer utterances—follows his second downstep in longer utterances by a resetting of the next H at a F_0 higher than that of the previous H. We can say that judging from the speakers tested here, there is for some of the population an iterative automatic downstep of H, but it is an arrested downstep limited to two steps. This is perhaps understandable given the fact that the lowering of H in consecutive H–L sequences does not represent a phonologically salient distinction.

There is no justification in these data for claiming a phenomenon of automatic downstep of L in Saxwe. For the speakers tested here, there is in consecutive H–L sequences a maximum single instance of lowering of the level of L beyond that which could be attributable to declination.

A further observation made in the course of studying automatic downstep is that for speakers NG and KS, the declining baseline utterances for all-H and all-L utterances roughly delimit the lower threshold of the F_0 of production for H and L tones in long utterances of H–L sequences. For speakers BL and AT however, in consecutive H–L sequences, Hs are realized at a position lower in F_0 than the all-H baseline—although after the first or second instance of lowering, Hs and Ls are then produced in a pattern of decreasing F_0 roughly parallel to the lines of declination. One could say that the frequency range for production of Hs and Ls has shifted downward, but once shifted, remains in line with standard declination rates. This difference in implementation strategies highlights the need to define what constitutes downstep.

In studying the phenomenon of non-automatic downstep of H in Saxwe, we see that there is interspeaker variation on this issue, even for speakers chosen specifically for their similar sociolinguistic background (section 7.3.4). Non-automatic downstep in Saxwe is triggered by a floating M between Hs. In underlying iterative H–M sequences, H normally spreads to the M TBU, delinking the M and creating a floating M between Hs. Speakers BL and AT—those speakers whose single-tone baselines do not correlate with any limitations of production for those tones—allow for four downsteps of H, triggered each time by a floating M. It is possible that more downsteps would be possible; four was the highest number that was tested for in this study. After four downsteps, the final level of H for these speakers is below the all-L baseline.

However, speakers NG and KS only permit two non-automatic downsteps of H, after which downstep is arrested and the level of H is reset by means of the speakers' failure to spread H tone. This in turn results in a failure to create the floating M tone which would trigger downstep. Once again in the non-automatic downstep of H, we see that there is anticipatory raising of the initial H in preparation for subsequent lowering. It is because of this anticipatory raising that speakers NG and KS are able to realize two non-automatic downsteps before reaching their threshold of production for H.

The difference between these two groups of speakers seems to be whether or not there is a preferred lower threshold for the realization of H in long utterances (provisionally defined as an utterance of seven or more TBUs). The distinguishing factor between these two global approaches to tone implementation seems to be whether, in a given speaker's phonology, the distinction between [+upper] and [-upper] is purely relative to what precedes, or whether these values are divided by a predefined boundary. In the latter case, the floating or surface feature [-upper] between two features [+upper] will cause a lowering of F_0 so long as this does not result in crossing the threshold that divides the [+upper] register from the [-upper] register. This factor (relative *vs.* delimited boundaries between [+upper] and [-upper]) may be part the speaker's phonology rather than simply an issue of phonetic implementation. Having this limitation on the F_0 production of H means that there is a conflict involved in allowing the phonological rule of Tonal spread to operate if the result is that a floating M will subsequently trigger the realization of H at a F_0 level that is below the preferred threshold.

In comparing the non-automatic and automatic downstep of H (or at least the initial lowering of H we see in consecutive H–L sequences, since not all speakers have an iterative lowering of H in these sequences), we see that for speakers BL and AT, whose "floor" for H is relative, the two kinds of lowering are not at all equivalent in terms of F_0 (section 7.3.5). That is, the lowering that one observes in underlying H–M sequences (non-automatic downstep) is not equal in Hz to the lowering that one observes in surface H–L sequences. Automatic downstep of H, if it exists, does not exceed two steps for these speakers, whereas non-automatic downstep can continue lowering for at least four steps (the maximum tested here). This means that the closer to the end of the utterance, the greater the difference between the Hs in these two kinds of sequences.

For speakers who have a threshold limit for H, however, there is a fairly close correspondence between the F_0 of Hs when comparing long utterances of underlying H–M sequences to long utterances of surface H–L sequences. This is because the anticipatory raising of H is a reality in both types of utterances, and the threshold on the lowering of H is also a reality in both types of utterances. There can only be two steps down in either non-automatic or automatic downstep (if the latter exists) for these speakers. For this reason, it is labeled as delimited downstep.

The fact that non-automatic downstep of H (at least for the first two steps down) is clearly a relevant phonetic implementation strategy for all speakers is understandable given that non-automatic downstep reflects contrastive differences in meaning. Automatic downstep of H does not reflect contrastive differences in meaning, and therefore it is not surprising to find that this kind of downstep of H is not as clearly a relevant phonetic implementation strategy for all speakers.

Finishing off the topic of downstep, we see that just as automatic downstep of L is not a phenomenon observed in Saxwe, it is also clear that non-automatic downstep of L is not found in Saxwe either (section 7.4). There is no downstepping of the level of L triggered by a floating M in Saxwe. The fact that downstep (automatic or non-automatic) of L does not exist in Saxwe is not entirely surprising if we consider that downstep in Saxwe occurs when there is alternation between [+upper] and [-upper] registers. Both M and L are [-upper] register and therefore there is no such alternation when either a surface or floating M appears between Ls.

In further discussion of the realization of L, there are two types of phenomena which are worth summarizing. One phenomenon that is observed is seen in utterances where an initial H is followed by multiple Ls; there is a delay in achieving the target F_0 of L such that this target is reached for some speakers on the second L following the H rather than the first. This means that the first L following the H may appear slightly raised in F_0 compared to the more stabilized levels of L TBUs which follow. Another phenomenon that is observed is an anticipatory lowering of L before an utterance-final H (section 7.4.2).

Before turning to the discussion of noun tone patterns, I note that there are several generalizable trends of Saxwe phonetic implementation strategies that can be observed in multiple places in this chapter. The first trend we can label as anticipatory dissimilatory F_0 movement. This includes the raising of an utterance-initial H before a L–H sequence and the lowering of a L before the final H in an utterance.

Another trend we can generally refer to as target achievement delay. This label covers both the peak delay seen for utterance-initial Hs when the surface form begins with multiple Hs (seen in the all-H utterances of section 7.2.3 as well as the surface realizations of /HMH…/ utterances in section 7.3.4), as well as the delay in achieving the targeted F_0 of L after an initial H. Because the term peak delay indicates that we are dealing with a peak, target achievement delay covers both delays in attaining peak F_0 targets as well as delays in attaining trough F_0 targets.

We now turn to a summary of the phonetic implementation of the most common V.C(C)V noun tone patterns: /M.H/, /M.M/, /M.L/, /M.M ^{H}/, /M.L ^{H}/, and /M.LH/. We see clearly in section 7.5 the effects of the utterance-final $L_{\%}$ IP boundary as it links to a final M or L ([-upper]) tone, creating a downward falling pitch trace utterance-finally. In fact, the difference between these two tones is masked to some degree by this utterance-final $L_{\%}$ IP boundary as 95% confidence intervals for M and L values overlap.

The $L_{\%}$ IP boundary tone does not link to a final M or L tone if it is followed by a floating H in the underlying form. It is then that we observe three distinct levels of F_0 for H, M and L—levels which remain distinct throughout the duration of the vowel and not simply during the initial period of the vowel during which onset consonant quality may have an effect.

One result of the testing here was to distinguish instrumentally between the upgliding [M.L^R] surface form that is derived from a /M.LH/ underlying tone pattern and the the non-falling [M.L°] surface form derived from /M.L^H/. There are two subtle differences in F_0 traces that distinguish these. First, the F_0 of the initial M of the /M.LH/ pattern is raised and then begins to trail downward as it approaches the consonantal onset. Second, following the consonantal onset, the F_0 of the surface L which follows begins extra-low and glides upward so that by the end of the vowel the F_0 measurements of the [M.L^R] and [M.L°] surface forms are largely overlapping. What happens within the consonantal onset is a topic that deserves further study as it appears that there may be, as part of the realization of the underlying tone pattern, manipulation of F_0 levels within the duration of the consonant itself.

We also see within V.C(C)V noun tone patterns some anticipatory dissimilatory F_0 trends not unlike those seen in the testing of entire utterances. We see that M is realized at a relatively low F_0 before the final H of the /M.H/ tone pattern, but M is realized at a relatively high F_0 before the extra-low realization of the following L–floating H sequence which is the output from the /M.LH/ tone pattern. In each of these cases, what we see is a dissimilation of adjacent tones utterance-initially or utterance-finally through the anticipatory raising or lowering of F_0. This tendency to emphasize tonal oppositions occurs in all of these cases in the first two or last two TBUs of an IP.

8 Conclusions

In this chapter, I sketch a global view of the Saxwe tone system as the interplay of underlying lexical tones, grammatical tones, and structurally-driven boundary tones. These elements undergo changes in the phonology and are interpreted in the phonetic implementation. I then follow this by discussing both further avenues of research as well as the implications of this study in the field of tone studies.

I begin section 8.1 by giving an overview of lexical and postlexical operations. I also summarize the factors that help us to understand the asymmetry of the Saxwe inventory of underlying noun tone patterns, including historical factors related to consonant-tone interaction and language development. The tonal phenomena that are specifically related to prosodic structure are also outlined in this global overview. In addition, the Two-Feature model of tone is described as the best model for explaining the Saxwe data.

The possibilities for further research are discussed in section 8.2. Finally, in section 8.3. I look at the implications of this study in light of what is known about Kwa tone languages specifically and African tone languages more generally.

8.1 A global overview

8.1.1 Overview of lexical and postlexical operations

The phonological operations that make up the Saxwe tonal system can be divided into those that take place at the lexical stage and those that take place at the postlexical stage. These are summarized below along with some implementation details.

(462) Saxwe tonal phenomena in the lexical and postlexical stages

Lexical stage

input:	• Underlying lexical tone (sections 3.6 and 3.7)
further tone at the word-level:	• Left M- floating tone on head of NP in the absence of one of the initial vowels /a/, /ɛ/, or /o/ (section 4.3) • Right H_{ω} PW boundary (section 4.1) on PWs which have a right edge $]_{PW}]_{PW}$ structure (including compounds, as well as words derived through verbal reduplication)
morpho-phonological tonal operations (unordered):	• Optional word-initial elision of initial vowel of complex noun (243) • Obigatory word-internal elision of initial vowel of noun in complex forms (248) • Copy of tone to verb reduplication prefix (section 4.4.3) • Tonal phenomena associated with the affixation of 1SG and 3SG pronominal suffixes to the verb (section 4.6)

Postlexical stage

input:	• Words and their associated tones or tonal boundaries from the output of the lexical stage; grammatical tone (sections 5.1 through 5.7)
structurally-driven boundary tones at the level of the IP:	• Default right $L_{\%}$ IP boundary (section 3.5) • Right $H_{\%}$ IP boundary on topics in topicalization constructions (section 5.7) and on assertions which have on their right edge a clause with a syntactic gap (section 5.8)
postlexical tonal operations (ordered):	• $L_{\%}$ association (94) and (416) • Nominal floating H deletion (151) and (417) • Contour simplification A (159) and B (160) and (418) • Grammatical tone docking A and B (102) and (419) • Partial L spread (106) and (420) • Tonal spread (72) and (421)

In looking at this summary, we see that there are structurally-driven influences on tone in both the lexical and postlexical stages. Tonal PW boundaries are generated in the lexical stage, while tonal IP boundaries are generated in the postlexical stage. Interestingly, there is no tonal boundary associated specifically with the PhP in the Saxwe system.

8.1.2 Asymmetries in underlying tone patterns

When we look at the input for the lexical stage, we remark quickly that there are several kinds of asymmetry in the paradigms of underlying tone patterns. For example, if we take the case of nouns, there are some patterns which are only realized on nouns with non-depressor onsets (a category which includes /b/ and /ɖ/)

and other patterns which are realized most commonly, but not exclusively, on nouns with depressor onsets.

(463) V.C(C)V-shaped nouns – underlying patterns and surface tones

	Voiceless obstruents, sonorants, /ɖ/, and /b/ in onset		
/M.H/	[ōsɔ́]	horse	
/M.M/	[ōxɛ̄]	bird	
/M.M ^{H}/	[ōsī°]	female, wife	
/M.H ^{M}/	[ōklâ]	soul	(a category of 2 words only)
	Voiced obstruents in onset, but also at least one example with each of the other types of consonant categories above		
/M.LH/	[ōgbɔ̀^{R}]	goat	
/M.L/	[ōdȁ]	snake	
/M.L ^{H}/	[ōɦwè°]	fish	
/L.H/	[òdʒǔ]	rain	

As is discussed at length in chapter 3, a large part of this asymmetry is due to the lexicalization of phonological operations that, in the diachronic history, involved L tone being inserted in the environment of a depressor. This lexicalization was likely galvanized by language contact between speakers of a two-tone Gbe language with speakers of a three-tone Yoruboid language (section 1.1).

Cross-linguistically, there is a phonetic correlation between voiced obstruents and lowering of pitch and between voiceless obstruents and raising of pitch even in languages where there is no phonological relationship between consonants and tone. It is argued that the development of tone can be explained by the interrelationship between auditory and articulatory factors and pitch (Hombert et al., 1979). Once phonologization and subsequent lexicalization of tone occurs, however, lexical tone no longer has a consistent relationship with either phonetics or phonological features.

In section 3.6.5, we see that if we only considered Saxwe verbs, we could draw the conclusion that Saxwe is a tone system with an underlying two-way /H, Ø/ contrast and that there are phonological rules which govern L insertion and M insertion (section 3.9). Taking into account data from the rest of the language, however, we realize that such rules may describe historical sound changes, but cannot be considered to describe synchronic phonological processes. For example, the distribution of noun tone patterns is no longer consistent along lines of consonant type; there are a number of nouns that do not include a depressor consonant (defined from observations of verb tone as voiced obstruents excluding /b/ and /ɖ/), but that are nonetheless lexically assigned a tone pattern that is typically associated with depressors. In the noun inventory, a word that doesn't include a depressor consonant can still be lexically assigned a tone pattern like /M.LH/ or

/M.L/. This is evidence that L in Saxwe cannot be generated solely by an operation that would insert L following an underlyingly voiced consonant. In the synchronic phonology, tone patterns that include contrastive L tone may now be lexically assigned to any word.

Beyond the category of monomorphemic nouns, there are other words and morphemes in the lexicon that include L in their lexically-assigned tone patterns in the absence of any depressor consonant. These include borrowed words (section 4.5); ideophones (section 4.9); floating grammatical L morphemes that mark negation, YNQs, and fronted topics (sections 5.2, 5.6, and 5.7); and a handful of other grammatical morphemes.

The presence of the /L.H/ tone pattern is perhaps the most outstanding example of lack of symmetry in the paradigm of noun tone patterns given in (463) for two reasons. First, the initial vowel for these nouns is L rather than M. Second, the tone following the depressor consonant is H rather than LH. There are some reasons for thinking that language contact is the source of this tone pattern, and we can even hypothesize where these words may have originated. Not only is /L.H/ a pattern that exists in Yoruba—a language in which initial vowels of nouns can be either L or M—but this pattern is also phonetically implemented in Saxwe the same way as it would be in Yoruba, as [L.LH]. Yoruba has a rule which spreads L to a following H without delinking the H (Pulleyblank, 1986, p. 112), similar to the rule of Partial L spread in Saxwe (183).[121] Both of these facts lend some credence to the idea that nouns of the /L.H/ tone pattern come, either directly or indirectly, from a Yoruboid language or from Yoruba itself.

Words which are lexically assigned the /L.H/ pattern contain depressor consonants and nevertheless do *not* have an immediately following L tone. Other words that contain a depressor consonant but do not have a L linked underlyingly to the immediately following TBU are: borrowed words (section 4.7), ideophones (section 4.9), and the numeral /ɛ̄dɛ̃́/ 'six'.

Although in Saxwe L is no longer obligatorily related to the presence of a depressor, there is still some phonological interaction between consonants and tone in the present-day tone system—seen in an operation which groups together voiced obstruents with sonorants. The process of Partial L spread (106) applies when the intervening consonant between a L and a H is linked either to the feature [sonorant] or to the feature [voice] (the latter being the distinguishing feature of voiced obstruents). Partial L spread accounts for the surface [LH] contours on forms like [òdʒǔ] 'rain'. Voiced obstruents and sonorants have been known to function together as depressors in other languages, such as in Kotoko (Odden, 2007) and Ngizim (Bradshaw, 1999).

[121] The L spread rule in Yoruba applies in all contexts, whereas the rule of Partial L spread in Saxwe applies only when the consonant preceding the H is a voiced obstruent or a sonorant.

8.1.3 Tones that are relevant at the word level

At the word level, there is a left M- floating tone that is found on the head of a noun phrase (section 4.3) and a right H_{ω} boundary that is assigned to complex words created through derivation or compounding that have a structure of nested PW boundaries at their right edge (section 4.1).

The left M- floating tone cannot be understood without an understanding what the prototypical noun looks like in Saxwe. The canonical shape of a monomorphemic noun is V.C(C)V. The initial vowel is M (with the sole exception being the L initial vowel in the exceptional L.H pattern). If we look beyond the category of monomorphemic nouns in Saxwe, we see that nouns that begin with a consonant—whether pronouns, borrowed words, noun compounds, derived nouns, or any word of any other lexical category which functions in a clause as the head of an NP—all show evidence of having a M- floating tone on their left edge.[122] There are two kinds of evidence for this: (1) when the noun follows a H tone from a preceding word, the H on the first syllable of the noun is downstepped; and (2) when the first TBU of the noun is associated to both L and H in an underlying LH sequence, this sequence is always simplified in a manner that indicates the presence of a preceding [-upper] tone, regardless of what the tone on the preceding word in the utterance is.

In summary, the M initial vowel on nouns that are vowel-initial and the M- floating tone on the left edge of consonant-initial nouns and nominalized forms are in complementary distribution and all serve to satisfy what appears to be a templatic constraint that the head of an NP be distinguished by an initial M tone and that the initial consonant in the word be preceded by this M tone. Historically, the M initial vowels and the M- floating tone were most likely part of a now-defunct noun class marking system.[123]

The right H_{ω} boundary is assigned to complex words created through derivation or compounding which have at their right edge a structure of nested right edge PW boundaries (that is, a $]_{PW}]_{PW}$ structure). It is not assigned to words created through suffixation.

Yip (2002) notes some cross-linguistic findings regarding the similarities between lexical tone and phrasal boundaries, including the fact that both use level tone primitives, both can be subject to the OCP, and both can have one-to-many or many-to-one relationships of association. What the H_{ω} PW boundary has in common

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[122] Nouns of the L.H pattern could have a left M- floating tone. There is, however, no way to test for its presence; [-upper] is a feature of both L and M tone and given that this feature is shared, there is no downstep (section 7.4) or other tonal indication which could provide evidence of the M- floating tone.

[123] There are also noun-verb pairings that indicate that there may have been historic processes (no longer productive) that derived nouns from verbs through the prefixation of a vowel with M tone to a verb. Such pairings include examples like [ōkú] 'death' derived from [kú] 'die'.

with phrasal boundaries is that it is assigned to particular structural boundaries rather than to individual lexical items. Historically, it may well have had a surface realization; the H_{ω} boundary has cross-dialectical cognates where the H is realized as a surface H tone (section 4.1).

There is no difference between the behavior of the left M- floating tone and that of any other floating M. There is, however, an important difference between the behavior of the right H_{ω} boundary and that of a floating grammatical H; the right H_{ω} boundary does not dock to an adjacent TBU the way a floating grammatical H does (sections 5.4 and 5.5). Because neither the M- floating tone nor the H_{ω} boundary will dock to a TBU, they cannot be spread either.

8.1.4 Boundary tones at the level of the IP

Interestingly, boundary tones do not exist at the level of the PhP in Saxwe. Two boundary tones are generated at the level of the IP: the $L_{\%}$ and $H_{\%}$ IP boundaries. These boundary tones are assigned with relation to prosodically-defined structures, but the assignment of the $H_{\%}$ IP boundary also takes into account certain syntactic considerations.

The right $L_{\%}$ boundary is the default on an IP. The usefulness of the right $L_{\%}$ IP boundary is that it provides a single mechanism for all of the following observed realizations of a final underlying /M/ in utterance-final contexts: the final downglide on [L], the [ML] surface contour, and the [HL] surface contour. This is shown in the following examples.

(464)	a.	/$^{M-}$ kájí	sē	$^{L\%}$/	[kájí	**sê**]	Kayi heard.
							sxw-L0028-other clauses-un.wav
	b.	/$^{M-}$ sōsā	sē	$^{L\%}$/	[sōsā	**sȅ**]	Sosa heard.
							sxw-L0027-other clauses-un.wav
	c.	/$^{M-}$ kúdʒɔ̀	sē	$^{L\%}$/	[kúdʒɔ̀	**sè**]	Kudjo heard.
							sxw-L0026-other clauses-un.wav

The right $L_{\%}$ IP boundary is associated with finality or completeness and is therefore absent in contexts of incompleteness, such as at the right edge of a declarative clause that has a syntactic gap (section 5.8). In these cases, we do not get the final fall or downglide of F_0 on an underlying /M/ which we see when the $L_{\%}$ IP boundary is present. Instead, the alternative right $H_{\%}$ IP boundary is generated; it is responsible for the absence of any pitch-lowering phonetic phenomena. This is seen in (465).

(465)	/M- é	jí	ōwa̋	na̋	ōnű	na̋	M- é	sē Ø H% /
	[é	jí	↓wa̋	na̋	↓nű	na̋	↓é	**sé**]
	3SG	like (lit. receive odor)		of	thing	REL	3SG	hear

He liked the thing he heard. sxw-L0013-final fall tests-un.wav

Both the $L_{\%}$ IP boundary and the $H_{\%}$ IP have some phonetic characteristics that differentiate them from lexical or grammatical tone. The right $L_{\%}$ IP boundary is characterized by a downward descent toward the bottom of the speaker's F_0 range rather than the attainment of a certain low F_0 target. The right $H_{\%}$ IP boundary, unlike a floating grammatical H tone, does not dock to a TBU.[124]

8.1.5 Theoretical underpinnings: the Two-Feature model

Saxwe is a language that provides support for the view that the Two-Feature model of Yip (1980, 1989) and Clements (1981) has explanatory power when applied to African tone languages (chapter 6). The Two-Feature model provides an explanation for asymmetries in Saxwe tonal phenomena, especially the frequent occurrences where M and L function in an oppositional relationship to H. This asymmetry is captured well by the [+/-upper] distinction.

The relevance and primacy of the [+/-upper] register feature is understandable in light of the probable development of the current tonal system. This system likely evolved through language contact where one of the languages had a two-way underlying {H, M} or {H, Ø} contrast and a third surface height (L) derived in the environment of certain consonants (section 3.9). If the current underlying three-tone system has evolved through the subdivision of the lower height of a two-tone system, we correctly have a primary two-way distinction between [+/-upper] register, with a subdivision of the lower [-upper] register. In addition, we see now that some tonal phenomena support the notion of [-upper] being a natural class, while other tonal phenomena group together H and L in the natural class of [-raised] tones.

We also see in the Saxwe system evidence supporting Jiang-King's (1996) tonal hierarchy {[+U] > [-R] > [+R]}. Tonal processes such as Grammatical tone docking (419) and Tonal spread (421) favor the realization of H and L over that of M.

Finally, we see in section 7.3 that studies of the implementation of downstep point to speakers having differing strategies for the phonetic realization of the [+/-upper] registers in long utterances of seven or nine TBUs. Some speakers favor a relatively fixed threshold between the [+upper] and [-upper] registers, while others have a very flexible boundary between these registers. Those with the

[124] Topics in a topicalization structure which have extra prosodic lengthening may also have a slight upglide in F_0 attributable to the right $H_{\%}$ IP (section 5.7).

inflexible threshold will allow downstep of H to occur only until the F_0 of H reaches the speaker's lower limit of [+upper] realization (roughly corresponding with the F_0 baseline F_0 values for an all-H utterance), while those with the flexible boundary will allow downstep of H to continue iteratively without limit. Thus the realization of H at the end of an utterance may be well below where the all-L baseline F_0 values would be for that speaker.

For those speakers with a fixed threshold between the [+upper] and [-upper] registers, Tonal spread (421), normally an iterative operation, fails to apply at a certain point because otherwise it would produce the floating M tone which would trigger non-automatic downstep on the following TBU. This raises the question of whether the flexibility of the boundary between registers is an element of the phonetics or of the phonology. It seems likely that it is a parameter within the phonology since one would not expect an aspect of phonetic implementation to interfere with the operation of a phonological rule.

8.2 Further research

This study describes the variety of Saxwe spoken in and around the Houeyogbe township. However, Saxwe is part of the Gbe continuum (where "language" boundaries are fuzzy) and within the larger group of people who are generally understood to speak Saxwe, there are several sub-groups—including those who live in and around Houeyogbe, those who live in and around Bopa, and those who live in and around Lobogo (see map in Appendix A). There is considerable need for further research in exploring the differences in tonal realization of these different sub-groups of spoken Saxwe, and to what degree the differences are phonological (such as assigning differing underlying lexical tone patterns to words) and to what degree they are phonetic (such as having differing strategies of phonetic implementation).

Aside from dialectical differences, there is evidence that within single dialects, there is both interspeaker and intraspeaker variability in tonal production. In this study, I have noted periodic instances where I have had occasion to observe interspeaker or intraspeaker variability, but much could be done in checking the consistency of production of tone among speakers and in repeated observations of single speakers. A particular area of interest would be to look into the minor noun tone patterns (section 3.7) to see how much variability there is in the lexical assignment of these patterns to specific words. Another possibility would be to check some of the more tonally complex grammatical tone paradigms that involve floating tones or the $H_{\%}$ IP boundary (sections 5.4, 5.5, 5.8) to see how much variability there is in tonal production in these contexts.

There are multiple topics in the domain of phonetic implementation that merit more study. For example, there are some indications from this study that underlying tone on the TBU of a syllable may already be exerting an effect on F_0 production during the duration of syllable onsets, specifically voiced consonant onsets (section 7.5.3). This may be most clearly observed in comparing the /M.LH/

noun tone pattern with the /M.L ^{H}/ pattern, since there are fairly subtle phonetic differences between the surface realizations of these two patterns. This would need to be studied using test parameters that closely control for syllable onset.

Another question related to phonetic implementation is the question of which factors play into the preplanning that governs the anticipatory raising of H. For example, one could explore whether the anticipatory raising of H has more to do with the number of L–H iterations that follow within an utterance or whether it more closely correlates with the number of TBUs there are in the utterance (section 7.3).

Again related to preplanning is the question of whether the anticipatory raising of H before L is more significant in terms of F_0 values before an alternating H–L–H sequence of tones than it would be if this sequence was simply a H–L sequence, and furthermore whether this anticipatory raising of H would be as significant if the sequence of H–L–H alternating tones was found later in the utterance. Similarly, one could study whether the anticipatory lowering of L before a H is more significant when it occurs on the penultimate TBU of an utterance than it would be elsewhere within the utterance. These two latter tests would help contribute to a more general understanding of whether anticipatory dissimilatory F_0 phenomena are more extreme at the beginning or end of the utterance than they would be at an utterance-medial position.

The downstep of H tone in Saxwe also needs to be explored more fully. In particular, what is needed is further research within the Saxwe population in order to confirm whether the flexible/inflexible threshold between the [+upper] and [-upper] registers is truly a parameter that is relevant for all speakers and to what degree the observations noted here in this study might be altered by other confounding factors such as the length of the utterances being recorded and the relative complexity of syntactic structure within utterances.

8.3 Broader implications

This study of Saxwe tone provides the first comprehensive documentation of a previously undocumented tone system. It also gives evidence for a three-way underlying tone contrast in a Gbe language. From this study, we have insight into what can happen when a (Gbe) language with a two-way underlying tonal contrast and phonological consonant-tone interactions comes into contact with a (Yoruboid) language with a three-way underlying tonal contrast and no phonological consonantal influence. There are at least three potential possibilities.

The first possibility would be a simplification of tonal complexity that reduces both systems to the lowest common denominator. The phonological consonant influences would be lost from the one side (resulting in an underlying *and* surface two-way distinction), and the three-way underlying tonal contrast from the other side would be reduced to a two-way contrast—perhaps by reanalyzing the two bottom levels of tone as members of a single tonal category.

The second possibility would be a preservation of the phonological relationship of consonant-tone interaction in an underlying two-way system. If this route were taken, all lexical items from the language whose surface tone did not conform to such a system might be reanalyzed in light of syllable-initial consonant features, and their lexically assigned tones would be redefined if necessary so that they might generate surface tones in conformity with the system.

The third possibility, which is what we observe, is that the complexity of having a three-way underlying contrast is preserved. For this to happen, the surface tonal heights which are generated from phonological rules of consonant interaction are reanalyzed as underlying tones and those words coming from the language with the three-way tonal contrast end up skewing distributional patterns that might otherwise look symmetrical.

So it is currently the case, for example, that any of the three H, M, or L tones can follow a non-depressor consonant in Saxwe (section 3.7). However, as a vestige of the system in which phonological rules governed a consonant's influence on tone, we see that only H or L—never M—is seen to follow a depressor consonant (strictly defined as voiced obstruents excluding /b/ and /ɖ/).[125]

We see then that the process of tone change leading to the current Saxwe system appears to have favored greater complexity in the lexicon over greater complexity in the phonological component—specifically a complexity involving consonant-tone interaction. This finding supports literature on the subject of tonogenesis which hypothesizes a diachronic progression starting with the universally recognized phonetic effects of consonant quality on initial F_0 levels of the following vowel, leading to a phonologized relationship between consonants and surface tone heights, and ending with a lexicalization of multiple tone levels (Hombert et al., 1979).

It is interesting to consider the question of how relatively robust or fragile might be the intermediary state of affairs where a language has phonologized consonant-tone interactions. How often or how long is this phonologized consonant-tone interaction preserved in a language contact situation when there is competing pressure to lexicalize phonologically-derived tone heights? This question will be difficult to answer because languages that have phonologized consonant-tone interaction are relatively rare and there is not often enough documentation of these systems dated from an early enough time to be able to consider whether tone change has taken place in the interim. The Saxwe data suggest that this stage is strongly susceptible to evolving and moving toward the lexicalization of tonal heights. It would be particularly interesting to study cases where there are multiple closely related languages of which only one or two show evidence of having phonologized

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[125] Another possibility, documented in Pearce (2007), is that a new kind of phonologized consonant-tone interaction may develop such that lexical items whose tone does not conform to expectations of the relationship between consonants and tone have their syllable-initial consonant features reanalyzed in light of the tone.

consonant-tone interaction. In this case, the questions to explore would be whether the anomalous languages showed evidence of evolving toward lexicalization and whether the surrounding languages showed evidence of evolving from a previous stage of phonologized consonant-tone interaction.

Moving on from the subject of consonant-tone interaction, we see in this study that one of the claims made is that PW and IP boundaries play a significant role in the final realization of utterances. Lexical tones and structurally-generated tones interact and are both relevant during the phonetic implementation. If these claims regarding the significance of these prosodic boundaries in Saxwe are true, it would be profitable to compare the roles played by prosodic boundaries in other Gbe languages and, more widely, in the Kwa languages. Boundary phenomena have been explored in Ewe; specifically, a PhP boundary is identified in Ewe (Clements, 1978). This kind of boundary has not been identified in Saxwe, nor do there appear to be any PhP-level boundary phenomena in Saxwe. In addition, several different kinds of floating tones have been identified at the edge of certain categories of words in Ewe and Mina (Ameka, 1999; Bole-Richard, 1983; Stahlke, 1971). If these floating tones are derived in the environment of particular structures at the PW-level (whether or not there are syntactic considerations involved), I propose that the terminology of PW boundaries could also be used for these floating tones. The fact that in some of these cases, the floating tone associates to a TBU prior to phonetic implementation does not make it ineligible to be labeled as a boundary tone (Yip, 2002).

The right edge $L_{\%}$ IP boundary is not always labeled as such; frequently, it is simply assumed that in the phonetic implementation, there is a final downglide of F_0 on L tone at the right edge of the IP unless this L is followed by a floating H. It is also frequently assumed that this same downglide does not occur on a H found at the right edge of the IP. Whether there is downglide or a falling pitch on final underlying M may not always be specified. As a result of examining the Saxwe system, I am convinced that it is useful, particularly in light of cross-language comparisons, to formalize the presence of the $L_{\%}$ IP boundary and the interactions this boundary has with specific tones, as well as the syntactic considerations that may contribute to the presence or absence of this boundary.

A practical implication coming from the observation of boundary tonal phenomena is that tonal studies must always compare forms that are syntactically equivalent, starting with the most basic monomorphemic forms and moving on in complexity only when the tones of these basic forms are well understood. This argument, made by Snider (2014) and Marlo (2013) among others, has proven to be of great importance in the present study on Saxwe tone. Without an *a priori* understanding of the importance of boundary tonology and syntactically-conditioned tonal phenomena in a given language, improper pairings of forms can be presented as demonstrating constrast. Only a comparison that controls for boundary and syntactically-conditioned factors can be counted on to represent a true case of contrast in analogous environments.

Moving to the topic of phonetic implementation, we see that this study highlights the difficulty of stating conclusively whether downstep exists in a given language. There may be a need for a universally recognized understanding of downstep—possibly specifying such things as how many iterative steps of lowering one would expect to observe and whether the lowering of F_0 must exceed the rate of lowering that can be attributed simply to declination. A confounding factor in describing the lowering of F_0 is the anticipatory raising of F_0. When we describe lowering trends, we must be clear whether we are describing lowering with respect to an initially raised level of F_0, or whether the lowering is defined only with respect to baseline trends of F_0 production for single-tone utterances.

A final statement with regard to downstep is that there is a continuing need for cross-linguistic comparisons of the phonetic implementation of tone. The Saxwe data suggest that within a given language, there is a possibility that there could be considerable interspeaker variation in phonetic implementation.

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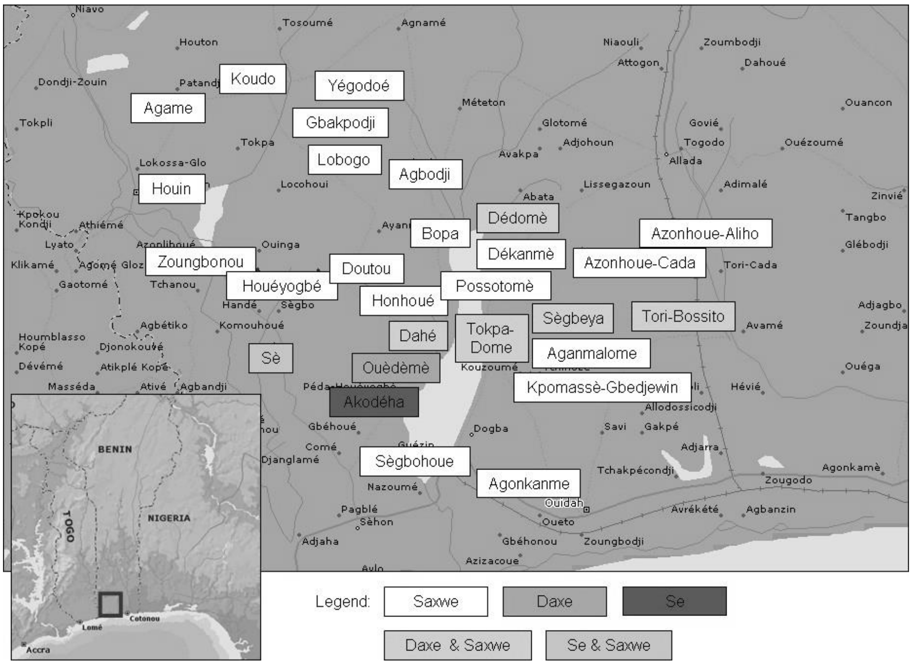
Appendix A: Map of Saxwe speakers

The following figure is included by permission of Kluge and Johnson, editor and author respectively of an SIL Electronic Survey Report (Johnson & SIL International, 2011) on the Saxwe language. As the legend indicates, the towns framed in white boxes are reported by members of the local population as being places where Saxwe is spoken.

Figure 1: Map of the Saxwe, Daxe, and Se language areas (based on Microsoft Corporation 2002)[126]



[126] The data contained in this map represent the perceptions of Saxwe, Daxe, and Se speakers and have not been otherwise confirmed. This map displays those places known to Microsoft Encarta's "World atlas" (Microsoft Corporation, 2002), and Google's Map data (Google Maps, 2009).

Appendix B: Monomorphemic verbs

The following is a list of the monomorphemic verbs that were used for the analysis of verb tone patterns. Recordings are available online at the following site: https://drive.google.com/open?id=1Lsu0ipaXPX8yb7DGoF7dH57S73NoSpBQ.

The file name for each recording can be obtained by substituting the appropriate list number and gloss given below in the following formula: sxw-[List number]-verbs-[gloss]-un.wav.

L0162	cold (be)	fa	[H]
L0182	embrace	fã	[H]
L0143	wake up	fɔ̃	[H]
L0165	burn	fjɔ	[H]
L0161	tight (be)	fjɔ̃	[H]
L0163	press	fjɔ̃	[H]
L0173	shell	fle	[H]
L0167	fall	flɛ	[H]
L0164	displace, overturn	fli	[H]
L0175	scatter	fu	[H]
L0172	pulverize	fũ	[H]
L0181	lift up	kɔ	[H]
L0170	skin an animal	kɔ̃	[H]
L0171	remove the innards	kɛ	[H]
L0154	bid fare-well to	klã	[H]
L0151	clean	klɔ	[H]
L0157	shine	klɛ̃	[H]
L0158	end	kpa	[H]
L0177	end	kpa	[H]
L0145	close to (be)	kpɔ	[H]
L0199	see	kpɔ̃	[H]
L0180	meet	kpe	[H]
L0183	suffice	kpe	[H]
L0169	learn, teach	kplã	[H]
L0166	put together	kple	[H]
L0146	bring together	kpli	[H]
L0142	die	ku	[H]

L0156	take, choose	sɔ	[H]
L0141	leave	sɔ̃	[H]
L0188	run away	si	[H]
L0190	respect	si	[H]
L0185	go and arrive somewhere	sĩ	[H]
L0189	crawl	ta	[H]
L0198	fabricate	ta	[H]
L0203	draw	ta	[H]
L0197	begin	tɔ	[H]
L0202	touch	tɔ	[H]
L0144	go out	tɔ̃	[H]
L0186	pierce	tɔ̃	[H]
L0187	turn on, light	tɛ	[H]
L0178	join together	ʧa	[H]
L0179	choose	ʧã	[H]
L0174	watch over	ʧɔ	[H]
L0168	cover	ʧɔ̃	[H]
L0176	remain somewhere	ʧi	[H]
L0184	turn off	ʧi	[H]
L0152	explain	tĩ	[H]
L0148	pound	to	[H]
L0149	turn sth	tɾɔ	[H]
L0221	stop	tre	[H]
L0159	rip	tɾɛ̃	[H]
L0153	interweave	tɾo	[H]
L0192	vomit	tɾu	[H]
L0196	close	tu	[H]

L0201	untie	tũ	[H]
L0194	bend	xa	[H]
L0195	rolled up (be)	xa	[H]
L0200	climb	xɛ	[H]
L0193	tickle	xjɔ	[H]
L0155	dry (be)	xu	[H]
L0160	bend down	xwi	[H]
L0191	dry	xwja	[H]
L0120	rent	da	[L]
L0130	weigh	da	[L]
L0134	throw	da	[L]
L0135	pull	dɔ̃	[L]
L0076	last long	dɛ̃	[L]
L0002	remain	dɾɔ̃	[L]
L0127	stretch out	dɾɛ̃	[L]
L0125	rain	dʒa	[L]
L0073	happen, occur	dʒɔ	[L]
L0126	upright (be)	dʒɔ	[L]
L0059	fall	dʒɛ	[L]
L0092	suit	dʒɛ	[L]
L0084	give birth	dʒi	[L]
L0124	remove kernels	gã	[L]
L0081	break, shatter	gba	[L]
L0013	breathe	gbɔ̃	[L]
L0014	return	gbɔ̃	[L]
L0060	pass by	gbɔ̃	[L]
L0094	pick	gbɛ̃	[L]
L0086	knock against	gbla	[L]
L0140	too big (be)	gbla	[L]
L0129	lukewarm (be)	gblɔ	[L]
L0121	cut	gbo	[L]
L0011	cease	gɔ	[L]
L0136	heal	gɔ	[L]
L0056	rub	glĩ	[L]
L0012	fat (be)	glo	[L]
L0087	examine	glo	[L]
L0122	rip up, dig up	ɦɔ̃	[L]
L0085	carry	ɦɛ̃	[L]

L0132	cloudy (be)	ɦlu	[L]
L0074	kill	ɦu	[L]
L0080	open	ɦũ	[L]
L0055	move	ɦwã	[L]
L0069	missing (be), few	ɦwe	[L]
L0083	grill	ɦwi	[L]
L0133	fight over	ɦwlɛ̃	[L]
L0068	buy a liquid	jɛ	[L]
L0036	make seedling, transplant	va	[L]
L0001	finish	vɔ	[L]
L0010	at ease (be)	vo	[L]
L0038	comb one's hair	vũ	[L]
L0063	sweep	za	[L]
L0015	fly, hop, walk	zɔ̃	[L]
L0112	saw	zɛ	[L]
L0101	intelligent (be)	zĩ	[L]
L0045	lean against	zjɔ̃	[L]
L0042	insult	zũ	[L]
L0066	become	zũ	[L]
L0058	blessed (be)	cɛ	[L]
L0082	knead sth moist	fã	[L]
L0061	find, happen upon	fɔ	[L]
L0070	steal	fĩ	[L]
L0095	blow one's nose	fĩ	[L]
L0018	walk briskly	fja	[L]
L0131	itch	fjɔ	[L]
L0139	troubled (be)	fjɛ	[L]
L0138	throw	flɛ̃	[L]
L0017	remember	flĩ	[L]
L0075	travel in spirit	fo	[L]
L0054	concern	kã	[L]
L0079	look for	kã	[L]
L0008	light up	kɔ̃	[L]
L0090	pour	kɔ̃	[L]

L0067	big (be)	kɛ	[L]
L0091	open	kɛ	[L]
L0106	open with care	klɛ	[L]
L0113	hit against	klɛ̃	[L]
L0072	scratch skin	klu	[L]
L0078	mock	ko	[L]
L0033	praise	kpa	[L]
L0114	peel, remove outside	kpa	[L]
L0077	carry on back	kpã	[L]
L0009	cheap (be)	kpɔ	[L]
L0034	weed	kpɔ	[L]
L0007	heavy (be)	kpɛ̃	[L]
L0089	hang up	kpla	[L]
L0108	lead, accompany	kplɔ	[L]
L0111	dull (be)	kpo	[L]
L0115	poke	kpo	[L]
L0103	drive	kũ	[L]
L0107	dig	kũ	[L]
L0041	knot	sa	[L]
L0099	sell	sa	[L]
L0040	filter	sɔ̃	[L]
L0020	hear	se	[L]
L0031	sense, feel	se	[L]
L0028	worship	sɛ̃	[L]
L0049	harvest (by cutting)	si	[L]
L0016	mature	sĩ	[L]
L0100	stubborn (be)	sjã	[L]
L0117	have diarrhea	sɾa	[L]
L0006	numerous (be), suffice	su	[L]
L0052	sift	ta	[L]
L0027	sew	tɔ	[L]
L0051	fry in oil	tɔ	[L]
L0019	limp	tɔ̃	[L]
L0109	swollen (be)	tɛ	[L]
L0097	sew	tʃĩ	[L]
L0039	organize	to	[L]
L0118	thick (be)	tɾi	[L]
L0047	buy	xɔ	[L]
L0064	burp	xɔ	[L]
L0026	hit, beat	xo	[L]
L0050	hit	xo	[L]
L0110	plant	xwa	[L]
L0102	bargain	xwle	[L]
L0150	shave	xwlɛ	[L]
L0273	draw up, pour out liquid	ba	[L]
L0276	meet together	bɔ	[L]
L0272	hide, be hidden	bɛ	[L]
L0274	burn	bi	[L]
L0278	ripe (be)	bja	[L]
L0275	roll	bli	[L]
L0277	think	bu	[L]
L0123	cook	ɖa	[L]
L0057	remove	ɖe	[L]
L0062	harvest	ɖe	[L]
L0071	marry	ɖe	[L]
L0096	draw	ɖe	[L]
L0088	seem	ɖi	[L]
L0137	bury	ɖi	[L]
L0128	eat	ɖu	[L]
L0093	yawn	ɣã	[L]
L0025	go	ji	[L]
L0116	tell, say	lɔ	[L]
L0021	accept	lɔ̃	[L]
L0035	weave	lɔ̃	[L]
L0005	be at, exist	le	[L]
L0030	wet oneself, sprinkle oneself	lɛ	[L]
L0003	grind	li	[L]
L0037	grind	li	[L]
L0269	grill	mɛ̃	[L]
L0270	sting, bite	mɛ̃	[L]
L0271	swallow	mĩ	[L]
L0279	fall over, demolished (be)	mũ	[L]

L0029	wash	ɲã	[L]
L0032	knead	ɲã	[L]
L0044	chase	ɲã	[L]
L0098	rest, lie on	nɔ̃	[L]
L0046	rotten (be)	ɲɔ̃	[L]
L0104	wet (be)	ɲɔ̃	[L]
L0022	bad (be), ugly (be)	ɲɾã	[L]
L0024	drink	nũ	[L]
L0043	do	wa	[L]
L0119	pierce	wɔ	[L]
L0023	forget	wɔ̃	[L]
L0004	black (be)	wi	[L]
L0048	sneeze	wĩ	[L]
L0065	do animal husbandry	wĩ	[L]
L0105	write	wlã	[L]
L0210	sleep	dɔ	[L^R]
L0234	command, order	dɔ̃	[L^R]
L0205	missing (be)	dɛ̃	[L^R]
L0216	succeed	dĩ	[L^R]
L0246	dress oneself	do	[L^R]
L0253	plant	do	[L^R]
L0252	cut into pieces	dʒa	[L^R]
L0258	busy (be)	dʒã	[L^R]
L0244	swell up	dʒi	[L^R]
L0241	publish	dʒla	[L^R]
L0237	measure	dʒlɛ	[L^R]
L0233	desire	dʒlo	[L^R]
L0255	saved (be)	gã	[L^R]
L0254	build	gba	[L^R]
L0259	wrap a skirt	gba	[L^R]
L0209	refuse	gbɛ	[L^R]
L0206	break, ruined (be)	gble	[L^R]
L0232	bark	gbo	[L^R]
L0236	full (be)	gɔ	[L^R]
L0257	half close	gla	[L^R]
L0242	twist	glɔ̃	[L^R]
L0248	avoid	glo	[L^R]
L0251	impossible (be)	glo	[L^R]
L0204	ruined (be)	gu	[L^R]
L0231	in need of (be)	ɦjã	[L^R]
L0239	scatter	ɦlɛ̃	[L^R]
L0260	acid (be)	ɦwã	[L^R]
L0247	lend, borrow	ɦwe	[L^R]
L0243	smell	ɦwɛ̃	[L^R]
L0245	mature	ɦwɛ̃	[L^R]
L0240	hide	ɦwla	[L^R]
L0208	come	va	[L^R]
L0229	afraid of (be)	vɔ	[L^R]
L0222	expensive (be)	vɛ	[L^R]
L0261	bitter (be)	vɛ	[L^R]
L0224	unfold	vlu	[L^R]
L0217	rip	vũ	[L^R]
L0223	mistreat	zã	[L^R]
L0211	appear suddenly	ze	[L^R]
L0284	begin	bɛ	[LH]
L0285	gather up	bɛ	[LH]
L0290	cooked (be)	bi	[LH]
L0291	ask for sth	bjɔ	[LH]
L0286	attach	bla	[LH]
L0215	sharpen	ɖa	[LH]
L0256	sharp (be)	ɖa	[LH]
L0235	have	ɖo	[LH]
L0238	put in piles	ɖo	[LH]
L0249	pronounce	ɖo	[LH]
L0230	enter	ɖjɛ	[LH]
L0250	scrape	ɣa	[LH]
L0268	hurry up	ja	[LH]
L0214	call	jɔ	[LH]
L0264	receive	ji	[LH]
L0263	bless	jra	[LH]
L0226	hit and carry off	lɔ	[LH]
L0267	swell up	lɔ̃	[LH]
L0213	leave	lɛ	[LH]
L0220	level (be)	li	[LH]
L0262	stack wood	li	[LH]
L0281	divide	mã	[LH]
L0283	force-feed	mɔ̃	[LH]

L0288	deny	mɔ̃	[LH]
L0289	bald (be)	mɔ̃	[LH]
L0280	clean (be)	mɛ̃	[LH]
L0282	fine (be)	mɛ̃	[LH]
L0287	tighten	mjɔ̃	[LH]
L0218	give	nã	[LH]
L0207	good (be)	ɲɔ̃	[LH]
L0212	know	ɲɔ̃	[LH]
L0266	be	ɲĩ	[LH]
L0227	wet, soak	ɲrɔ̃	[LH]
L0147	white (be)	we	[LH]
L0265	break, crack	wɛ̃	[LH]
L0225	fold	wlã	[LH]
L0228	catch	wle	[LH]
L0219	germinate, grow	wu	[LH]

Appendix C: Monomorphemic nouns

The following is a list of the monomorphemic nouns that were used for the analysis of noun tone patterns. Recordings are available online at the following site: https://drive.google.com/open?id=1muj7g8mvBq33Fyq5c2-4XkEdiNPXs8xB.

The file name for each recording can be obtained by substituting the appropriate list number and gloss given below in the following formula: sxw-[List number]-VCV nouns-[gloss]-un.wav.

L0051	arm	abɔ	[M.H]
L0050	soap	aɖi	[M.H]
L0052	tooth	aɖu	[M.H]
L0104	comb	aja	[M.H]
L0215	foreskin	aju	[M.H]
L0053	coal	akã	[M.H]
L0057	fist	akɔ̃	[M.H]
L0055	boat	aklo	[M.H]
L0107	type of porridge	akpli	[M.H]
L0046	liver	alĩ	[M.H]
L0054	corn dish	amã	[M.H]
L0223	raw food	amũ	[M.H]
L0102	crab (sp)	asɔ̃	[M.H]
L0103	hand (archaic)	asi	[M.H]
L0056	beauty	atʃɔ	[M.H]
L0061	debt	axɔ	[M.H]
L0219	tongue	ɛɖɛ	[M.H]
L0216	washing powder	ɛfɛ	[M.H]
L0059	thanks	ɛkpɛ	[M.H]
L0109	rock	ɛkpɛ̃	[M.H]
L0217	cough	ɛkpjɔ̃	[M.H]
L0108	dry season	ɛku	[M.H]
L0188	mosquito	ɛmwĩ	[M.H]
L0164	spirit	ɛsɛ	[M.H]
L0058	gazelle	ɛtjɛ	[M.H]
L0060	water-born parasite	ɛtɾɛ	[M.H]
L0106	gunpowder	ɛwɛ	[M.H]
L0220	harmattan	obja	[M.H]
L0045	amulet	obo	[M.H]
L0221	silence	oɖa	[M.H]
L0187	dirt	oɖju	[M.H]
L0163	error	ofɛ̃	[M.H]
L0082	place	ofi	[M.H]
L0081	ashes	ofĩ	[M.H]
L0105	dry season	ofjo	[M.H]
L0222	fur	ofũ	[M.H]
L0170	call	ojɔ	[M.H]
L0101	sweet potato	ojwe	[M.H]
L0236	calabash	oka	[M.H]
L0137	neighbor-hood	okɔ	[M.H]
L0139	sand, earth	okɔ	[M.H]
L0142	stomach	okɔ	[M.H]
L0171	termite	okɔ	[M.H]
L0296	woven pouch	okɛ̃	[M.H]
L0240	enclosure	okpa	[M.H]
L0047	meeting	okpli	[M.H]
L0048	widow	okpo	[M.H]
L0228	mountain	okpo	[M.H]
L0168	death	oku	[M.H]
L0083	grain	okũ	[M.H]
L0235	crocodile	olo	[M.H]
L0239	proverb	olo	[M.H]
L0227	path	omɔ̃	[M.H]

L0143	thing	onũ	[M.H]
L0165	goodness	oɲwɛ̃	[M.H]
L0231	horse	osɔ	[M.H]
L0084	law, interdiction	osɛ̃	[M.H]
L0234	boulder	oso	[M.H]
L0238	thorn	oso	[M.H]
L0226	husband, male	osu	[M.H]
L0140	saliva	otã	[M.H]
L0230	father	otɔ	[M.H]
L0172	grinding stone	ote	[M.H]
L0218	cadaver	otʃɔ	[M.H]
L0166	tree	otĩ	[M.H]
L0169	hill	oto	[M.H]
L0233	ear	oto	[M.H]
L0237	group	oto	[M.H]
L0136	gun	otu	[M.H]
L0049	caterpillar (sp)	owã	[M.H]
L0225	odor	owã	[M.H]
L0167	corn flour	owɔ	[M.H]
L0144	caterpillar (sp)	owe	[M.H]
L0284	white	owe	[M.H]
L0138	bee	owĩ	[M.H]
L0085	broom	oxa	[M.H]
L0232	word, news	oxo	[M.H]
L0224	bone	oxu	[M.H]
L0141	corn worm	oxwi	[M.H]
L0249	forked branch	aba	[M.M]
L0243	wound	abi	[M.M]
L0247	shot, syringe	abwi	[M.M]
L0242	anger	aɖi	[M.M]
L0267	leg	afɔ	[M.M]
L0128	suffering	aja	[M.M]
L0126	bean	aji	[M.M]
L0244	butterfly	akɔ	[M.M]
L0265	paternal lineage	akɔ	[M.M]
L0092	pocket	akpo	[M.M]

L0255	pocket	akpo	[M.M]
L0245	hand	alɔ	[M.M]
L0241	incest	ale	[M.M]
L0248	benefit	ale	[M.M]
L0301	kidneys, waist, hips, lower back	alĩ	[M.M]
L0266	toothpick	alo	[M.M]
L0264	oil	amĩ	[M.M]
L0173	diarrhea	asɾa	[M.M]
L0287	hive	atɔ	[M.M]
L0176	red monkey	ato	[M.M]
L0149	raindrop	atɾɔ	[M.M]
L0044	clothing	awu	[M.M]
L0131	ocean, sea	axu	[M.M]
L0175	hernia	axu	[M.M]
L0130	wing	axwe	[M.M]
L0148	nail, claw	ɛfɛ̃	[M.M]
L0145	theft	ɛfĩ	[M.M]
L0146	destiny	ɛjɛ	[M.M]
L0147	person	ɛmɛ̃	[M.M]
L0099	water	ɛsĩ	[M.M]
L0080	straw	ɛtɛ	[M.M]
L0127	announce-ment	ɛwɛ̃	[M.M]
L0110	sea, ocean	ɛxu	[M.M]
L0174	hair	oɖa	[M.M]
L0129	bean (sp)	ofjo	[M.M]
L0263	memory	oflĩ	[M.M]
L0259	rope, cord	okã	[M.M]
L0150	neck	okɔ	[M.M]
L0251	hole	oklo	[M.M]
L0151	panther	okpɔ	[M.M]
L0258	whistle	okpɛ̃	[M.M]
L0100	meat, animal	olã	[M.M]
L0292	millet	oli	[M.M]
L0153	cow	oɲĩ	[M.M]
L0254	interdiction	osu	[M.M]
L0253	lake	otɔ	[M.M]
L0256	shrew	otɔ̃	[M.M]
L0261	mortar	oto	[M.M]
L0268	village, geographic region	oto	[M.M]

L0246	palm grub	otɾã	[M.M]
L0155	bachelor	otɾɛ̃	[M.M]
L0097	hole, piercing	otro	[M.M]
L0152	bush animal (sp)	owɔ	[M.M]
L0096	danse	owe	[M.M]
L0260	necklace	owlɔ	[M.M]
L0252	room, house	oxɔ	[M.M]
L0262	bird	oxɛ	[M.M]
L0257	wild grass (sp)	oxo	[M.M]
L0118	first growing season	oxwe	[M.M]
L0156	rainy season	oxwe	[M.M]
L0250	year	oxwe	[M.M]
L0154	market	oxwi	[M.M]
L0014	descent	aklɔ	[M.M°]
L0008	fish (sp)	akpa	[M.M°]
L0010	peel, bark	akpa	[M.M°]
L0009	leaf	amã	[M.M°]
L0012	left side	amjɔ̃	[M.M°]
L0013	divination tool	ɛkplɛ	[M.M°]
L0015	corn starch dish	oɖju	[M.M°]
L0006	root	okjɔ̃	[M.M°]
L0002	stick	okpo	[M.M°]
L0016	chair	okpo	[M.M°]
L0283	mother	onɔ̃	[M.M°]
L0001	mouth	onũ	[M.M°]
L0007	wife, female	osi	[M.M°]
L0005	manioc	ote	[M.M°]
L0003	cloth roll to protect head	otu	[M.M°]
L0011	black	owi	[M.M°]
L0095	board	oxwlɛ	[M.M°]
L0018	soul	okla	[M.HL]
L0229	day	oklo	[M.HL]

L0177	corn porridge	adã	[M.L^{R}]
L0279	palm kernel oil	adi	[M.L^{R}]
L0132	commerce	adʒɔ	[M.L^{R}]
L0180	wasp	agbɔ̃	[M.L^{R}]
L0041	tumor	agbi	[M.L^{R}]
L0179	knot	ago	[M.L^{R}]
L0288	navel	aɦɔ̃	[M.L^{R}]
L0063	mist	aɦũ	[M.L^{R}]
L0124	breast	anɔ̃	[M.L^{R}]
L0274	date	azã	[M.L^{R}]
L0273	peanut	azĩ	[M.L^{R}]
L0078	palm nut	ɛde	[M.L^{R}]
L0042	sweat	ɛdɛ̃	[M.L^{R}]
L0276	cock's comb	ɛdɛ̃	[M.L^{R}]
L0079	palm nut center	ɛnɛ̃	[M.L^{R}]
L0275	monkey	ɛzĩ	[M.L^{R}]
L0272	work	odã	[M.L^{R}]
L0074	frog	odĩ	[M.L^{R}]
L0070	armoire	odrɔ̃	[M.L^{R}]
L0280	dream	odɾɔ	[M.L^{R}]
L0133	tomato, oil condiment	odʒa	[M.L^{R}]
L0075	flea, louse	odʒɔ	[M.L^{R}]
L0073	animal fat	odʒu	[M.L^{R}]
L0043	chief	oga	[M.L^{R}]
L0125	box for valuables	ogba	[M.L^{R}]
L0065	goat	ogbɔ	[M.L^{R}]
L0277	menstrual period	ogbe	[M.L^{R}]
L0278	grass	ogbe	[M.L^{R}]
L0077	eggplant (sp)	ogbo	[M.L^{R}]
L0281	pocket	ogo	[M.L^{R}]
L0134	millipede	oɦã	[M.L^{R}]
L0269	hawk	oɦɔ̃	[M.L^{R}]
L0270	money	oɦo	[M.L^{R}]
L0076	vehicle, car	oɦũ	[M.L^{R}]
L0271	drum	oɦũ	[M.L^{R}]
L0069	projectile	oɦwã	[M.L^{R}]
L0135	knife	oɦwi	[M.L^{R}]

L0068	hoe	olĩ	[M.L^{R}]
L0123	excrement	omĩ	[M.L^{R}]
L0072	intestinal worm	ovɔ̃	[M.L^{R}]
L0088	monitor lizard	ovɛ	[M.L^{R}]
L0067	child	ovi	[M.L^{R}]
L0064	dog	ovũ	[M.L^{R}]
L0066	night	ozã	[M.L^{R}]
L0071	clay jar	ozɛ̃	[M.L^{R}]
L0294	invisibility powers	ozĩ	[M.L^{R}]
L0295	short dry season	ozo	[M.L^{R}]
L0184	cooked beans	abɔ	[M.L]
L0212	sickness	adɔ̃	[M.L]
L0112	cat	ade	[M.L]
L0086	cage	adʒa	[M.L]
L0289	agricultural abundance, yield	adʒi	[M.L]
L0214	load	agbã	[M.L]
L0189	underside	agɔ	[M.L]
L0302	tardiness	agɔ	[M.L]
L0286	palmyra palm fruit	agɔ̃	[M.L]
L0158	jaw	aglã	[M.L]
L0178	crab	aglã	[M.L]
L0113	group	agũ	[M.L]
L0157	drink	aɦã	[M.L]
L0182	marrow	aɦɔ̃	[M.L]
L0183	brain	aɦɔ̃	[M.L]
L0185	snake (sp)	aɦɔ̃	[M.L]
L0191	locust bean pod	aɦwa	[M.L]
L0094	war	aɦwã	[M.L]
L0198	granary	ava	[M.L]
L0202	cloth	avɔ	[M.L]
L0290	palm leaf bud	azã	[M.L]
L0114	smoke, haze	azɔ	[M.L]
L0194	tobacco	azɔ	[M.L]
L0201	egg	azĩ	[M.L]

L0098	cane rat	azo	[M.L]
L0119	horn	azo	[M.L]
L0121	life	ɛgbɛ	[M.L]
L0200	beard	ɛgɛ̃	[M.L]
L0193	blood	ɛɦũ	[M.L]
L0192	scar	ɛɦwɛ	[M.L]
L0122	dispute	ɛvũ	[M.L]
L0093	manioc dish	oba	[M.L]
L0197	crossbow	oda	[M.L]
L0039	snake	odã	[M.L]
L0203	fishing net	oɖɔ	[M.L]
L0091	border	ode	[M.L]
L0111	land boundary	odo	[M.L]
L0181	underside	odo	[M.L]
L0211	straw mat	odʒã	[M.L]
L0205	long thin insect (sp)	odʒɔ	[M.L]
L0209	salt	odʒɛ	[M.L]
L0206	heart	odʒi	[M.L]
L0208	dispute, fight	odʒlɛ	[M.L]
L0195	hour, time	ogã	[M.L]
L0196	proclamation	ogã	[M.L]
L0213	iron	ogã	[M.L]
L0087	animal footprint	ogbã	[M.L]
L0190	language	ogbe	[M.L]
L0090	bean fried snack	ogbo	[M.L]
L0199	field	ogle	[M.L]
L0040	wall	ogli	[M.L]
L0120	hole	ogũ	[M.L]
L0115	pig	oɦa	[M.L]
L0116	song	oɦã	[M.L]
L0204	forest	oɦɔ̃	[M.L]
L0207	door	oɦɔ̃	[M.L]
L0210	throat	ohlo	[M.L]
L0291	religion of some Saxwe	oɦũ	[M.L]
L0161	machine	omɔ̃	[M.L]

L0089	kola nut	ovi	[M.L]	L0285	red	ovɛ	[M.L°]
L0162	ax	ovja	[M.L]	L0186	penis	ada	[L.LH]
L0160	fire	ozo	[M.L]	L0038	nest	adɔ	[L.LH]
L0117	insult	ozũ	[M.L]	L0030	red dirt wall	ado	[L.LH]
L0026	genie	agja	[M.L°]				
L0020	side	aɦa	[M.L°]	L0031	dish	agbã	[L.LH]
L0029	rabbit	azwi	[M.L°]	L0159	ram	agbo	[L.LH]
L0027	black snake	ɛglɛ	[M.L°]	L0062	tofu	amɔ	[L.LH]
L0028	squirrel	odwɛ	[M.L°]	L0032	disabled person	obo	[L.LH]
L0025	bottle	ogo	[M.L°]				
L0024	corn weevil	oɦjã	[M.L°]	L0036	trash	odũ	[L.LH]
L0021	fish	oɦwe	[M.L°]	L0037	desire	odʒlo	[L.LH]
L0023	sun	oɦwe	[M.L°]	L0033	rain	odʒu	[L.LH]
L0004	spider	ojɛ	[M.L°]	L0035	hat	ogba	[L.LH]
L0022	fishhook	omlɛ̃	[M.L°]	L0034	evil	ovwɛ̃	[L.LH]
L0019	head	ota	[M.L°]				

Appendix D: Nouns recorded for phonetic implementation discussion

The following is the list of nouns recorded by four speakers as the basis for the description of the phonetic implementation of V.C(C)V nouns (section 7.5). Six tone patterns were selected for recording.

/M.H/	/M.M/	/M.L/	/M.M ^{H}/	/M.L ^{H}/	/M.LH/
oka 'calebash'	aɖi 'anger'	agbã 'baggage'	owi 'black (NOM)'	ogo 'bottle'	oɦũ 'car'
akã 'charcoal'	alɔ 'hand'	ɛgɛ̃ 'beard'	akpa 'carp'	oɦjã 'corn weevil'	ovi 'child'
aja 'comb'	ɛfɛ̃ 'fingernail'	ɛɦũ 'blood'	ote 'yam'	omlɛ̃ 'fishhook'	ovũ 'dog'
okɔ 'dirt'	oɖa 'hair'	aɦɔ̃ 'brain'	amã 'leaf'	ota 'head'	ogbɔ 'goat'
ofɛ̃ 'error'	afɔ 'leg'	avɔ 'cloth'	onɔ̃ 'mother'	azwi 'rabbit'	oɦɔ̃ 'hawk'
ofũ 'fur'	axu 'ocean'	azĩ 'egg'	onũ 'mouth'	ovɛ 'red (NOM)'	olĩ 'hoe'
ɛkpɛ̃ 'rock'	amĩ 'oil'	ava 'granary'	otu 'rag'	aɦa 'side'	oɦwi 'knife'
aɖi 'soap'	aja 'suffering'	oba 'manioc porridge'	okjɔ̃ 'root'	ojɛ 'spider'	oɦo 'money'
ɛɖɛ 'tongue'	ɛfĩ 'theft'	odʒã 'mat'	okpo 'stick'	odwɛ 'squirrel'	ozã 'night'
aɖu 'tooth'	ɛsĩ 'water'	odʒɛ 'salt'	osi 'wife'	oɦwe 'sun'	azĩ 'peanut'

Appendix E: Text with underlying and surface tones

The following text is found in its entirety at the site:
https://drive.google.com/open?id=10LDp4U5snDEMBlXbSvZKiq-YHvivjvaS.
The filename for the recording of this text is: sxw-T0002-texts-un.wav, and excerpts of this text with free translations in French are found in the recordings within the same folder running from: sxw-T0022-texts-un.wav to sxw-T0028-texts-un.wav.

lé	nã̄	$^{M-}$ jē ^{H}	nɔ̃̄	gbɛ̃̀	ājī	ɖó	$^{M-}$ xɛ̃́	$^{L\%}$
lḗ	nã́	jé	nɔ̃́	gbɛ̃̀	àjì	ɖó	↓xɛ̃́	
how	SUB	3PL	HAB	pick	beans	how:PART	this	

This is how they pick beans.

nã̄	^{H}	ājī	lá	sjɛ̃́	vɔ̀	^{L}	$^{H}{}_{\%}$
nã̄		ájí	↓lá	sjɛ̃́	vɔ̀°:		
SUB	FUNCTION.UNKNOWN	beans[127]	DET	harden	COMPL	TOP	

When the beans have finished growing,

$^{M-}$ jē ^{H}	nã̄	vǎ	jī	gbɛ̃̀-V̄	$^{L\%}$
jē	nã̄	và	jì	gbɛ̃̀:	
3PL	FUT	come	go	pick-3SG	

they will go pick them.

$^{M-}$ jē ^{H}	gbɛ̃̀-V̄	^{L}	$^{H}{}_{\%}$
jē	gbɛ̃̀°:		
3PL	pick-3SG	TOP	

When they have picked them,

$^{M-}$ jē ^{H}	nã̄	sɔ́	xwjá	dǒ	$^{M-}$ ɦwè ^{H}-nũ̄ $^{H\omega}$	$^{L\%}$
jē	nã̄	sɔ́	xwjá	dó	ɦwè-nũ̀°	
3PL	FUT	take	dry.out	at	sun-plane	

they will take and dry them out in the outdoors,

[127] Note that /aji/ 'beans' is a mass noun in Saxwe.

M- é	bā	xú	L%
é	bá	↓xú	
3SG	CONJ:DS	be.dry	

and they will dry,

M- jē H	bā	bɛ́	dǒ	ātī	mɛ̄̄	L%
jē	bā	bɛ́	dó	átí	mɛ̂̄	
3PL	CONJ:DS	gather	at	sack	in	

and they will gather [them] in a sack,

á	bō	tó-V̄	L%
á	bó	↓twê:	
CONJ:SS	CONJ	pound-3SG	

and pound them.

M- jē H	tó-V̄	vɔ̀	L	H%	M- jē H	nā̄	fú-V̄	L%
jē	twé:	vɔ̀°:			jē	nā̄	fwî:	
3PL	pound-3SG	COMPL	TOP		3PL	FUT	winnow-3SG	

When they've finished pounding them, they will winnow them,

á	bō	dǒ-V̄	M- dɔ̀-kpō Hω	mɛ̄̄	L%
á	bó	dwè:	dɔ̀-kpò	mɛ̀̄	
CONJ:SS	CONJ	put-3SG	stomach-pouch	in	

and put them in a sack.

Appendix F: Locations of audio files

The audio files which accompany this study are located at the following sites. This table gives the location of audio files referred to in all chapters except chapter 7, which deals with phonetic implementation. (Those audio files are listed further in this appendix.)

Zipped file related to:	**URL**
Alternate reduplication	https://drive.google.com/open?id=1vhq94YfLA9BtPkDog3D58v2lanqHp93U
Associative construction	https://drive.google.com/open?id=1sWYrpvJXdq1O8DxYY05ynoql49S-Q6RR
Auxiliaries	https://drive.google.com/open?id=1jRcLhyU95g2dhpGC6PYg93wO2XgCvP1E
Borrowed words	https://drive.google.com/open?id=1k5e5UA29N9_T27pTOEgbmxDXdLuCeEUy
Clause connectives	https://drive.google.com/open?id=1vCT-wa3OtznacyLfBK0-CdNay00_K6uo
Clause frames	https://drive.google.com/open?id=11_hAvJveshfLpQDFaxhNdrEgXA37SA7y
Connective plus jussive	https://drive.google.com/open?id=16hw050WCEEul9tdDEyerJKhCifmC6_-F
Effect of emotion	https://drive.google.com/open?id=1r1pdhrza8lIN6RvisfW0E4Z59F5QqmuD
Exceptional tone patterns	https://drive.google.com/open?id=1oy-iVVc-ecFYkEcd3pitYtJjzhqvj0Ud
Final fall tests	https://drive.google.com/open?id=1EmtyActo9ayfGN90HlhtEpQsTLQo87-Y
Focus markers	https://drive.google.com/open?id=1SGlytjM83sk9ygTdjtB2tMYQQ02NCI0x
Ideophones	https://drive.google.com/open?id=1UmEUJ7cKtV5EhAz64QpXPKZeSjJcOKJC
Left boundary	https://drive.google.com/open?id=1MORckJXc7J911yRV5LFm4fV7mvuFjJar

Low spread tests	https://drive.google.com/open?id=1NlANCcRohlbEkHSPyEvn0nwYmyPTQx8F
Multi-clause utterances	https://drive.google.com/open?id=1t4iZCyPILxIepKXN1fQ1RCgkDaW_iSwO
Negation	https://drive.google.com/open?id=1AGWvnXCtXsPX8EuLAgjidLlVu7UnemkW
Noun phrases	https://drive.google.com/open?id=1efM_N1AFgLyolxzP5qMhZL5iPrYaZHao
NP boundary tests	https://drive.google.com/open?id=1j0R1M4eIavI-u_efWsfRCkpV227J6oZg
Numbers	https://drive.google.com/open?id=1cs8dsYGKGU8JItAyq9cq7yafWY4vxzPI
Other clauses	https://drive.google.com/open?id=1B0ndj34Rkoeujh8NSrh8R_8_gHATqMBO
Other nouns	https://drive.google.com/open?id=1-UpNONf043Yop6zv-f0uHlsYFy628HG1
Other verbs	https://drive.google.com/open?id=1Xn3qdIoobLDhmF7RDZmJ39WcLhEt5vjt
Polymorphemic nouns	https://drive.google.com/open?id=1LC-xwQhbaeSWo_zPOW1fpyAvMdg8XxhG
Possessive pronouns	https://drive.google.com/open?id=19MTVziZe-NKKfXygnvOuwpGx2pW73kHJ
Postpositions	https://drive.google.com/open?id=1v5LSA_l9l0pi1lFCQ07eclQzBx-SpGo7
Preposition na	https://drive.google.com/open?id=13veH2TyOfUS0xJ0y8iQ0qBPyCkZwIkxY
Prepositions	https://drive.google.com/open?id=1AxNRtIkOQ_wSbw83dDZO_1DOlwRUnEmc
Presentatives	https://drive.google.com/open?id=1DJ_dxsILIE6k9Cm6NrOH82JOlyhAID8N
Pronouns	https://drive.google.com/open?id=1J7IrrOL54erMX9btQIhisi-_FELE9hLC
Questions	https://drive.google.com/open?id=1YfN0k-SIivLXvDxTmLK3v7Unwybi2o9C
Register tests	https://drive.google.com/open?id=1nA_Z9DcHIQV9nGXGmoYfz-f2gB_FVSMj
Right H boundary	https://drive.google.com/open?id=1XFgTkCrAZ_CTDzTn8SL_ulccrf_YsMLr

Serial verbs	https://drive.google.com/open?id=1LAzn7vAcoQ5XTakfz17nioyjZsVhzAvc
Subordinating morpheme	https://drive.google.com/open?id=1UtHvbSXbIHZzFVRzmZ1DL_aUm3WEmV2k
Texts	https://drive.google.com/open?id=10LDp4U5snDEMBlXbSvZKiq-YHvivjvaS
VCV nouns	https://drive.google.com/open?id=1muj7g8mvBq33Fyq5c2-4XkEdiNPXs8xB
Verb plus pronoun	https://drive.google.com/open?id=1090PyvMeXZNbSfykGk9ZBVeKCRzPYviS
Verb reduplication	https://drive.google.com/open?id=1nS9RAGSEm8Ql-dUGbNBI76jdtHvdSSpP
Verbs	https://drive.google.com/open?id=1Lsu0ipaXPX8yb7DGoF7dH57S73NoSpBQ
Ynquestions	https://drive.google.com/open?id=1H-RKnk0ba-77_6D-lNfIEaGvfotjFlvZ
Abbreviations, speaker bio, permissions, date and time	https://drive.google.com/open?id=1zljxMrVa5XhY8okiStHsdgXUDxdEojqY

Below are the locations of the audio files which support the findings described in chapter 7, which deals specifically with phonetic implementation.

Zipped file related to:	**URL**
Downstep	https://drive.google.com/open?id=1lI_jzULj4t1gujRGxtT7OkrFc_0vazFB
Non-Hs between Hs	https://drive.google.com/open?id=19443iToWLYBuUgbhr1ES5qDcQaNzoKfr
One tone	https://drive.google.com/open?id=1NNs-KZnIpen4ix5OjRECeKNRVPjq2B2o
VCV nouns	https://drive.google.com/open?id=1lqDmGsM9RRJsl-0SlqwhGA-twiyXQ8-8
Permissions	https://drive.google.com/open?id=1qUAS_IejRtIPoR3zCNY2qNVwb9ch8Diq

English summary

In this study, the Saxwe tone system is described as an interplay of underlying lexical tones, grammatical tones, and structurally-driven boundary tones. These elements undergo changes in the phonology and are interpreted in the phonetic implementation. This study takes a derivational approach to explaining tonal phenomena.

First, the underlying tonal contrast of the Saxwe system is described as a three-way {H, M, L} contrast. This contrast is demonstrated in the course of the analysis of underlying tone patterns of monomorphemic verbs and nouns.

In the context of studying monomorphemic nouns, several asymmetries are observed in the distribution of tone patterns. These asymmetries are likely due to the lexicalization of phonological operations that, in the diachronic history, involved L tone being inserted in the environment of a depressor. This lexicalization was galvanized by language contact between speakers of a two-tone Gbe language with speakers of a three-tone Yoruboid language.

The postlexical rules that help to explain surface forms in Saxwe are the following, listed in the order in which they operate.

$L_{\%}$ association
Nominal floating H deletion
Contour simplification A and B
Grammatical tone docking A and B
Partial L spread
Tonal spread

Structurally-driven boundary tones are generated at two levels of the prosodic hierarchy: at the level of the PW and at the level of the IP. The PW boundaries are assigned during the lexical stage of the derivation, and the IP boundaries are assigned during the postlexical stage. Interestingly, boundary tones do not exist at the level of the PhP in Saxwe.

At the level of the PW, there is a right H_{ω} boundary that is assigned to complex words created through derivation or compounding that have a $]_{PW}]_{PW}$ structure of nested right edge PW boundaries. It is not assigned to words created through suffixation.

The other boundary tones that exist in Saxwe are generated at the level of the IP. The $L_{\%}$ and $H_{\%}$ IP boundaries are assigned with relation to prosodically-defined structures, but the assignment of the $H_{\%}$ IP boundary also takes into account certain syntactic considerations.

The right $L_{\%}$ boundary is the default on an IP. The usefulness of the right $L_{\%}$ IP boundary is that it provides a single mechanism for all of the following observed realizations of a final underlying /M/ in utterance-final contexts: the final downglide on [L], the [ML] surface contour, and the [HL] surface contour. The right $L_{\%}$ IP boundary is associated with finality or completeness and is therefore absent in contexts of incompleteness, such as at the right edge of a declarative clause that has a syntactic gap. Instead, the alternative right $H_{\%}$ IP boundary is generated; it is responsible for the absence of any pitch-lowering phonetic phenomena.

In a chapter focusing on word-level tonal phenomena, the following topics are examined: the left M- floating tone that is present on all nouns that do not have an initial vowel (initial vowels and this floating tone all representing vestiges of a historic class marking system), the affixation of the first and third singular pronominal suffixes to the verb and associated tonal phenomena; the tonal treatment of nouns that have been borrowed into Saxwe from English; tone as it relates to ideophones; and the definite marker [lá] which is an enclitic with unusual tonal behavior.

In a separate chapter focusing on clause-level tonal phenomena, grammatical tone which is unaccompanied by segmental-level information is addressed, including the following: the imperfective construction which involves two morphemes, one of which is a preverbal floating M; unmarked negation which also has two morphemes, one of which is a clause-final L; the negation of future events which involves a floating H marking irrealis modality; marking of the prospective which also includes the floating H marking irrealis; and YNQ formation which involves a clause-final L.

The Two-Feature model of Yip (1980, 1989) and Clements (1981) has explanatory power when applied to the Saxwe tone system. The Two-Feature model provides an explanation for asymmetries in Saxwe tonal phenomena, especially the frequent occurrences where M and L function in an oppositional relationship to H. This asymmetry is captured well by the [+/-upper] distinction.

In a chapter on the phonetic implementation of tone in Saxwe, instrumental data are presented in support of the phonetic representations given in this study. Topics covered include: baseline F_0 traces for all-H, all-M, and all-L utterances; a discussion of iterative automatic and non-automatic downstep of H; evidence that there is no iterative automatic or non-automatic downstep of L; observations regarding the anticipatory raising of H before successive L–H sequences; and the phonetic realization of the most common tone patterns of V.C(C)V nouns. Of particular interest in the study of the implementation of downstep is the fact that speakers have differing strategies for the phonetic realization of the [+/-upper] registers in long utterances of seven or nine TBUs. Some speakers favor a relatively fixed threshold between the [+upper] and [-upper] registers, while others have a very flexible boundary between these registers.

Samenvatting

Dit boek beschrijft het toonsysteem van Saxwe als wisselwerking van onderliggende tonen, lexicale, grammaticale tonen en structurerende grenstonen. Deze elementen ondergaan veranderingen in de fonologie en krijgen hun interpretatie in de fonetische implementatie. Ik hanteer een derivationele aanpak voor het begrijpen van toonverschijnselen.

Het onderliggende tooncontrast van Saxwe analyseer ik allereerst als een drie-toon systeem {H,M,L}. Deze contrasten blijken uit de analyse van onderliggende toonpatronen van werkwoorden en naamwoorden die bestaan uit één morfeem.

De distributie van toonpatronen blijkt assymetrisch in deze monomorfematische naamwoorden. Dit is naar alle waarschijnlijkheid het gevolg van lexicalisatie van een fonologische proces in het verleden dat een lage toon invoegde in de omgeving van een verlagende consonant. Deze lexicalisatie werd versterkt door taalcontact tussen een 2-toon Gbe taal en een 3-toon taal uit de Yorubagroep.

De post-lexicale regels die de oppervlaktevormen in Saxwe verklaren zijn de volgende, in volgorde van toepassing:

Associatie van $L_{\%}$
Deletie van nominale zwevende toon
Vereenvoudiging A en B van contourtonen
Verankering van grammaticale tonen A en B
Gedeeltelijke Spreiding van L lage toon
Toonspreiding

Structurerende grenstonen ontstaanop twee niveaus van prosodische hierarchie: Op het niveau van het Fonologisch Woord en op het niveau van de Intonationele Frase. De grenzen van het Fonologisch Woord verschijnen in de lexicale derivatie en die van de Intonationele Frase daarna. Er zijn geen grenstonen op het niveau van de Fonologische Frase in Saxwe.

Op het niveau van het Fonologische Woord is er een rechter H_{ω} grens die wordt toegevoegd aan complexe woorden die onstaan uit afleiding of uit de formatie van samenstellingen die een $]_{PW}]_{PW}$ structuur hebben van geneste rechter woordgrenzen, maar niet als gevolg van suffigering.

Behalve de woordgrenstoon kent Saxwe ook grenstonen van de Intonationele Frase. De $L_{\%}$ en $H_{\%}$ grenstonen van de Intonationele Frase hangen samen met prosodische structuren; maar ook syntactische overwegingen spelen een rol bij de $H_{\%}$ grenstoon van de Intonationele Frase.

De rechter $L_{\%}$ is de standaard grenstoon van een Intonationele Frase. De verklarende kracht van de rechter $L_{\%}$ grens van de Intonationele Frase is dat het met één enkel mechanisme alle volgende waargenomen realisaties van een onderliggende /M/ toon in uitingsfinale omgeving verklaart: de finale *downglide* van [L], de [ML] oppervlakte tooncontour, en de [HL] oppervlakte contour. De rechter $L_{\%}$ grenstoon voor Intonationele Frase is geassocieerd met finaliteit of volledigheid en is daarom afwezig in omgeving van onvoltooidheid, zoals bijvoorbeeld aan de rechtergrens van een mededelende zin met een syntactisch gat. In plaats daarvan wordt dan de rechter $H_{\%}$ gebruikt die er voor zorgt dat er geen fonetische toonverlaging plaatsvindt.

In het hoofdstuk over tonale verschijnselen op het niveau van het woord komen de volgende onderwerpen aan bod: toon in naamwoorden die geen initiele klinker hebben (intiële klinkers en de zwevende toon als overblijfselen van een historische naamwoordklasmarkeringssysteem); de suffigering van eerste en derde persoon voornaamwoordelijke achtervoegsels aan het werkwoord en de toonverschijnselen die daarmee samengaan; de tonale aanpassingen van leenwoorden uit het Engels; toonverschijnselen van ideofonen; en de markeerder [lá] voor bepaaldheid, een encliticum met ongebruikelijk tonaal gedrag.

In een afzonderlijk hoofdstuk behandel ik in toonverschijnselen op het niveau van de zin en met name grammaticale toon: de onvoltooide tijd constructie bestaande uit twee morfemen waarvan één een preverbale zwevende M toon is; de standaard ontkenning eveneens bestaande uit twee morfemen waarvan één een zinsfinale L toon is; de negatie van de toekomende tijd met gebruik van een zwevende H toon die irrealis aangeeft; ook de prospectief hanteert de zwevende H toon van de irrealis; en ja/nee vragen die een zinsfinale L toon gebruiken.

Het Twee-Kenmerken-model van Yip (1980,1989) en Clements (1981) kan de Saxwe toonverschijnselen uitstekend verklaren zoals de asymetrieën in de Saxwe toonverschijnselen en in het bijzonder de veelvoorkomende situatie waarin M en L in oppositie staan tegenover H. Deze oppositie is te begrijpen door het kenmerk [+/-Upper].

Het hoofdstuk over de fonetische implementatie van toon in Saxwe bevat de meetgegevens die de fonetische representatie in deze studie staven. De volgende onderwerpen komen aan bod: Basis F_0 weergaves voor uitingen met alleen H, alleen M en alleen L; een bespreking van herhaalde automatische en niet-automatische downstep van H; bewijs dat er geen herhaalde automatische en niet-automatische downstep van L is; observaties over de vooruitblikkende verhoging van H vóór L-H opeenvolgingen; en de fonetische realisatie van de meest gebruikelijke toonpatronen van V.C(C)V naamwoorden. Opmerkelijk is dat de studie van de toepassing van downstep laat zien dat sprekers verschillende strategieën hebben voor de fonetische realisatie van het [+/-upper] register in langere uitingen van zeven tot negen toondragende eenheden. Sommige sprekers gebruiken liever een vrij vaste grens tussen de [+upper] en [-upper] registers terwijl anderen een meer flexibele grens hanteren tussen deze registers.

Curriculum vitae

Virginia Renee Beavon-Ham was born in Besançon, France on October 27, 1975. After graduating from Hudsonville High School in Michigan (U.S.) in 1993, she attended Wheaton College in Illinois, graduating *summa cum laude* in 1997 with a Bachelor's degree in French. Following this, she studied at the University of Texas at Arlington, where she received in 2000 a Master's degree in linguistics. She began work in 2002 under the auspices of SIL International in the country of Benin, helping to develop literacy materials and doing linguistic research. The languages she worked most closely with were Aja and Saxwe—two languages spoken in the southern part of Benin that belong to the Gbe continuum. Administrative roles she filled included those of Training Coordinator and Linguistics Coordinator for the collective activities of SIL in the countries of Benin and Togo. Currently, she works in the country of Cameroon and is involved in staffing linguistics training courses, as well as coordinating a linguistics service team which serves the Central African countries.