Tone Paradigms in Grassfields Bantu

Andrei Anghelescu

September 16, 2011
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<td>ˊV</td>
<td>High tone</td>
<td>H</td>
<td>[—]</td>
</tr>
<tr>
<td>ˋV</td>
<td>Low tone</td>
<td>L</td>
<td>[—]</td>
</tr>
<tr>
<td>ˇV</td>
<td>Mid tone</td>
<td>M</td>
<td>[—]</td>
</tr>
<tr>
<td>ˇV</td>
<td>High to low falling tone</td>
<td>HL</td>
<td>[—]</td>
</tr>
<tr>
<td>ʰˇV</td>
<td>Downstepped high tone</td>
<td>ʰH</td>
<td>[—]</td>
</tr>
<tr>
<td>ʰˇV</td>
<td>Upstepped low tone</td>
<td>ʰL</td>
<td>[—]</td>
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<tr>
<td>ˇV/ʰˇV</td>
<td>Lowered mid tone</td>
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<td>[—]</td>
</tr>
<tr>
<td>ˇV…°</td>
<td>Level utterance final low tone</td>
<td>L°</td>
<td>[—]</td>
</tr>
<tr>
<td></td>
<td>Floating tone</td>
<td></td>
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I would like to thank my advisor, Alexei Kochetov, who very patiently read through each chapter of this paper as it grew. His guidance throughout this project helped guide it and lead to many improvements.

To the members of the 2011 cohort, I owe a great deal of gratitude. They put up with countless presentations and discussions about tone, which fueled much of the work that went into this paper. Special thanks are owed to Radu Craioveanu, who assisted with many technical issues with typesetting and layout. I would also like to thank the members of the CRC-sponsored Summer Phonetics/Phonology Workshop at University of Toronto. Finally, I would like to thank Myles Leitch who provided detailed comments on many aspects of the paper.

I would like to collectively thank the members of the 2011 cohort once again, for helping me retain my sanity as I wrote this paper. Thanks go to Jonathan and Danny, who kept me from working too hard. Finally, I would like to thank Xu for giving me some light at the end of the tunnel and my mother for supporting and driving me to pursue my work.
Abstract

This paper presents an Optimality Theory (OT) analysis of tone in the nominal paradigms of three Grassfields Bantu languages: Medumba, Dschang and Ngamambo. I utilize OT as a means of comparing across languages in a meaningful manner. The goal of examining tone patterns is to formulate a typology of relationships between underlying (input) and surface (output) forms.

I represent tone using a system introduced by Hyman (1993). I explain the features and geometry used by this system as well as how underlying arrangements of features are translated into surface forms.

Since the three languages under investigation are closely related, we expect to find a degree of similarity; indeed, they share many features, such as downstep and falling low tones. These similarities are cashed out in terms of constraint rankings.

I conclude that Medumba and Dschang are demonstrable more similar to each other than to Ngamambo. This is not unexpected given their genetic relation. Ngamambo presents a variety of interesting differences, such as a distinction between right-to-left and left-to-right association of tones; at the same time, there are similarities between Ngamambo and Medumba and Dschang, such as the role of floating high tones, which is shared between all three languages, and downstep, which is shared by Ngamambo and Dshang.
Chapter 1

Introduction

In this paper I examine the tonal paradigms of several Grassfields Bantu languages, formulate an Optimality Theory analysis for each language, and compare the repair strategies for illicit strings of tones across languages (Prince and Smolensky, 1993). The goal of this work is to identify common strategies and analyze why they are common and likewise to analyze why languages differ in their repair strategies. This investigation will contribute to the greater goal of creating a phonological typology of tone; however, the goal is approached from the perspective of optimal outputs and constraint interactions rather than a surface descriptive typology.

Though Grassfields Bantu languages have in the past been popular topics for phonological research, not many studies have been conducted that attempt to compare and contrast languages within the family, at the very least not using the powerful typological tools which OT has brought to the discipline. In this paper I attempt to build off of the research on Grassfields Bantu languages without accepting theoretically motivated facts, namely those tied to rule based systems of phonology. Nevertheless, I do adopt a tiered representational system, though I believe that it is uncontroversial that something similar is required regardless of which language and analytical tools are being used.

I show that Medumba and Dschang, two closely related languages belonging to the Mbam-Nkam subgroup differ only in the ranking of two constraints. This falls out from the observation
that downstep is permissible for a prosodic word in Dschang, but not in Medumba. The analysis of Ngamambo is more complicated and shows a distinction not only between types of tonemes, but also between tiers and between directionality of association. While retaining many of the GB characteristics that Medumba and Dschang display, Ngamambo also makes use of mid tones which are derived from high and low tones.

In order to properly describe and analyze this complex data, I adopt the hierarchical tone representation proposed by Hyman (1993) in conjunction with features he describes. Along with these representational tools, I formulate common tonal constraints, such as *ASSOCIATE, in terms of these structures.

The rest of this paper is laid out as follows. In chapter 2, I introduce general issues in representing tone and present the framework which I will use for my analysis. I then go on to discuss previous work in Optimality Theory on tone. In chapter 3, I introduce the data from Medumba, Ngamambo and Dschang and compare the three languages. In chapter 4, I provide a list of constraints and show how they function in an analysis of the nominal paradigms of each language; next, I present analyses of Medumba, Dschang and Ngamambo nouns in their citation forms. Last, I discuss the analysis, focusing on similarities and differences between the languages. Finally, in chapter 5, I provide closing remarks and discuss additional avenues of research.
Chapter 2

Tone

In this chapter I will discuss relevant theoretical literature. In section 2.1 I describe a system to represent the underlying structure of tone and show how it can be used to account for all of the data provided in chapter 3. In section 2.2 I introduce three common phenomenon in the corpus, spreading, contour tones and register shift, and show how they can be treated in the framework introduced section 2.1. In section 2.3 I introduce Optimality Theory (OT) approaches to tone, beginning with previous approaches to modelling tone in OT and then introducing the constraints which will be used for the analysis at hand.

2.1 Representing Tone

In this section I will layout a system by which we can represent the underlying structure of tone. These units are then arranged on a tiered structure which essentially divides tone into register and pitch, allowing for register shifts like downstep to be captured quite readily.

The rest of this section is laid out as follows. In section 2.1.1 I discuss the choice of H and L as privative tone features and why this choice is well motivated for the GB languages under examination. In section 2.1.2 I layout the tiered model of tone and show how it can account for a variety of relevant phenomenon.
2.1.1 Tone Features

Since we are dealing with only Grassfields Bantu (GB) languages, I will not be considering the greatest challenge for a two height system, namely that there is a plethora of evidence that more than two (and up to five) level tones are necessary; I will briefly consider how we can represent up to four levels with the system presented here, but I will not delve into specific examples nor will I touch on five level tone languages.

In order to represent tone, I have adopted the system proposed by Hyman (1993). The tone features [HIGH] and [LOW], abbreviated H and L respectively, are defined in (2) below.

\[(2) \text{ Tone Features (Hyman, 1993)}\]
\[\text{a. } [\text{HIGH}] = \text{at or above neutral reference tone}\]
\[\text{b. } [\text{LOW}] = \text{at or above neutral reference tone}\]

The definitions of H and L are formulated in terms of instructions for pitch. For a tone bearing unit (TBU) with a H linked to it, for instance, the phonology would instruct the phonetics module to produce that TBU at or above neutral reference height. All things being equal, it would be produced at a pitch higher than anything preceding it; however, it could potentially be produced at neutral reference height if the TBU bearing the H tone also has a L, or if the H is downstepped (which will be discussed in section 2.1.2).

Before proceeding, it might be useful to consider what we mean by [HIGH] and [LOW], and more generally, what features describing tone are actually capturing. Clearly, H and L do not relate to absolute frequencies, nor even specific ranges, given speaker variation and other factors.

As Anderson (1978) frames it, in phonological representation, “two items should be distinctly represented only if they can potentially distinguish two signs in the system of language.” We have evidence for at least two levels; however, looking at the data in chapter 3, there are far more levels presented. Additional pitch levels are largely predictable in all three languages, most arising from downstep, which will be discussed in section 2.2. The only apparent wrinkle surfaces in
Ngamambo, where there is a mid tone which does not act to raise or lower the register (upstep or downstep)\(^1\).

The account provided for Ngamambo will involve synchronic interactions between H and L to yield a mid tone. The interesting aspect of this process is how it is similar to and different from downstep in other GB languages, and how downstep works in Ngamambo.

In the remainder of this section I will examine other options for features we could have used to capture the two tone distinction. Underspecification is not the best option for GB languages due to certain historical reasons, but there is no real reason that a three way H, L, \(\emptyset\) system could not capture three tone levels. One shortcoming of this system lies outside the scope of GB languages: any system of tone should be able to capture the maximum number of empirical levels of tone, five (found in Black Miao (Kwan, 1971)). Most of the seriously considered systems of representing tone capture only four levels. Consider the system proposed by Yip (2001), show in (3) below. She uses two features, \([\text{REGISTER}]\) and \([\text{PITCH}]\), to divide the pitch space in half and then divides the resulting halves, resulting in four levels.

\(^1\)This additional level is unproblematic when using two features since we can actually have three tone heights in the most simple linking schema. I show this in the example in (1) below where a TBU without either an H or L linked to it is realized as a mid tone.

(1) a. \[
\begin{array}{c}
\text{High Tone} \\
\text{L} \\
\text{H}
\end{array}
\]
b. \[
\begin{array}{c}
\text{Low Tone} \\
\text{L} \\
\text{H}
\end{array}
\]
c. \[
\begin{array}{c}
\text{Mid Tone} \\
\text{L} \\
\text{H}
\end{array}
\]

In the following section I will propose a more complicated tiered representation of tone instead of the underspecification account. One reason to reject underspecification and additional underlying level tones (such as a \([\text{MID}]\) or \(\text{M}\)) in GB languages is that we have historical and cross-linguistic evidence for tone patterns that make use of only H and L. This could rule out a M tone level immediately unless we could historically motivate it using the H and L tones that we do have evidence for.
(3) Yip (2001)’s tone features

<table>
<thead>
<tr>
<th>REGISTER</th>
<th>Upper</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>PITCH</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Tone Specifications</td>
<td>High Tone</td>
<td>High-Mid Tone</td>
</tr>
</tbody>
</table>

Obviously to capture five levels we would need another feature to use; however, doing so would over generate. Such systems exist, such as in Sampson (1969); Woo (1969); Maddieson (1970). In these systems, the third feature is limited in scope, adding only “extreme” tone levels. Importantly, the features in these systems are not defined in the same way as Hyman (1993)’s tone features, rather they are more conventionally defined to be “above/below a reference point.” The primary significance of this is that no toneme should be able to be [+H, +L] since it cannot be simultaneously high and low pitch. The systems are summarized in (4) below. Sampson (1969)’s system is shown in (4a) and Maddieson (1970)’s in (4b).

(4)  

a. Sampson (1969)’s tone features  

<table>
<thead>
<tr>
<th>[HIGH]</th>
<th>[LOW]</th>
<th>[MID]</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>HM</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>M</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LM</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>L</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

b. Maddieson (1970)’s tone features  

<table>
<thead>
<tr>
<th>[HIGH]</th>
<th>[LOW]</th>
<th>[EXTREME]</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>XH</td>
<td>+</td>
</tr>
<tr>
<td>HM</td>
<td>H</td>
<td>+</td>
</tr>
<tr>
<td>M</td>
<td>M</td>
<td>-</td>
</tr>
<tr>
<td>LM</td>
<td>L</td>
<td>-</td>
</tr>
<tr>
<td>L</td>
<td>XL</td>
<td>-</td>
</tr>
</tbody>
</table>

What is considered “extreme” varies, for Sampson (1969), the central tones (HM, M, LM) are the “additional” divisions supplied by the third feature, [MID] in this case, on the reasoning that every language begins by dividing a tone space of equal size and then proceed to add levels from that space. This is shown in (4a), where the mid, high-mid and low-mid tones are all [+MID] to the exclusion of the high and low tones. The mid tone is redundantly specified for [MID], since [-H, -L] is already contrastive on its own, we might predict that both [+MID, -H, -L]
and \([-MID\), \(-HIGH\), \(-LOW\)] would be legitimate specifications; however, stipulatively this is not the case.

Maddieson (1970) uses empirical evidence to show that languages that have four or five levels treat the lowest and highest tones as more marked; therefore, his system uses the additional feature to distinguish extreme highs and extreme lows. This is shown in (4b), where extra-high (XH) and extra-low (XL) tones are \([+EXTRA\]ME\)] to the exclusion of the central high, mid and low tones. Though this system is grounded in an empirical observation, it does suffer from the odd theoretical prediction that XH and XL tones should form a natural class, as Hyman (1986) points out.

As far as the data relevant to this paper, any of these systems could work so long as they allow a language to not use unnecessary specifications. The current system could also be expanded to use a third feature, such as Yip (2001)’s [PITCH] or Maddieson (1970)’s [EXTRA\]ME], keeping the points made above in mind. The more problematic issue, which I will cover in section 2.1.2 below, is how register lowering is handled. What we want to avoid is having downstepped H, for instance, be represented as another level tone. This is precisely because downstepped H tones do not share the same properties as other level tones, specifically, they lower the pitch ceiling for all following TBUs bearing a H tone.

Essentially, handling tone using a matrix of features for each level is probably not the most natural way of capturing the phenomena. One of the key intuitions of autosegmental phonology is that features can exist on different tiers (Goldsmith, 1976). One of the first approaches to allude to this is Clements (1983), who uses “rows”, which are roughly equivalent to tiers. In the next section I will layout the tier component of Hyman (1993)’s system.

### 2.1.2 Tone Geometry

The second portion of the system relies on two distinct planes, one regulating basic tone height, and the other regulating register features, such as lowering and raising of the register. This proposal is drawn directly from Hyman (1993). In principle it’s similar to other proposals which use tiered representations of tone such as Yip (1989); Snider (1999). The essential role which this geometry
plays in our analysis is handling derived level tones as well as iterative lowering, i.e., downstep.

In both of these systems there is a division of labor between two tiers, though the specifics vary slightly. Notably, for Snider (1999), level tones are created using combinations of tones on both tiers. This differs from the proposal I will adopt in which level tones reside solely on one tier while the second tier modulates the register. I will compare these two option in more depth once I have laid out the basic system. In (5) below I show the basic layout of the tiers.

In (5) below, I show two nodes, the tonal node (TN) attached to the tonal root node (TRN) which is then attached to the tone bearing unit (TBU). A tone feature, or combination of features, link to the TN\(^2\). The TN then links to the TRN which controls the register of the tone, directing it higher or lower, depending on the type of tone attached to it\(^3\); in Hyman (1993), it is very clear that the exact same type features found linked to the TN can also be linked to the TRN but behave differently. This contrasts with systems like Yip (2002) and Snider (1999) which use different features for the basic identity of a tone and the modulation of register.

(5) Skeletal tone structure

```
µ
 / \ Tone bearing unit
 |   |
 o   Tonal root node
 |   |
 o   Tonal node
 |   |
 T   Tone
```

Both Hyman (1993) and Snider (1999) take the mora to be the only possible TBU, with some languages restricting the TBU to the first mora of a syllable, therefore making it appear that the TBU is a syllable.

Previously, I mentioned that the two tone features H and L could be combined under one tonal

\(^2\)Hyman (1993) only discusses up to two tones attaching to the TN, I speculate about the possibility of more than two tones attaching to the TN later on.

\(^3\)Unlike the TN, only one tone may link to the TRN. It is not clear from Hyman (1993) how to interpret a structure if multiple tones were linked to the same TRN.
node to yield a third height, a mid tone. This is due to both the definitions ascribed to the features themselves and the functions performed by them once attached to the TN. In (6) below I show simple high, low and mid tones. Note that the mid tone is simply both the H and L linked to a single TN, recall that the definitions for each of these features specified that a TBU bearing them would be “at or above/below neutral reference height”; therefore, when both are on a single TBU, the only logical pitch to produce the TBU at is “neutral reference height.”

(6) Level Tones

(a) $\mu$

(b) $\mu$

(c) $\mu$

Low Tone

High Tone

Mid Tone

Focusing on (6c), the mid tone, the ordering of the tones linked to the TN is not important, that is to say, (6c) above is equivalent to (7) below. On the other hand, nodes themselves are ordered, as we will see for contour tones shortly.

(7) $\mu$

Mid Tone

The function of the TRN is to control the overall height of the register. Linking a L to the TRN will lower the register, and likewise, linking a H will raise it. This is shown in (8) below.
This function is the key to upstep and downstep in this framework. We must crucially treat a L linked to the TRN as an instruction to lower a tone linked to that TN as well as any following TN, without spreading the L to them. This is because we want a L linked to the TRN to successively lower the register. In principle another option would be to spread any L attached to the TRN in an unbounded fashion to the right and allow multiply linked L’s on the TRN to have a cumulative effect. The issue we would run into with this approach is one that already exists for this system, namely a way to limit how many tones can link to a single node.

Finally, multiple tones can link to a single TBU, this results in complex contour tones composed of multiple level tones of the kind normally found on heavy syllables or word final syllables in African languages (Yip, 2002). In (9) below I show a simple contour tone in (9a) and a more intricate example in (9b). The second example in (9b) includes a L simultaneously linked to its own independent TN as well as to the TRN of an adjacent TN hosting a H. This possibility is left open by Hyman (1993)’s system; however, we may not want to allow it for several reasons.
The problem with the example in (9b) concerns how much power any single instance of a feature should exhibit. If we allow a tone to occupy both a TN and a TRN, then why couldn’t it attach to its own TRN, lowering or raising its own register, for instance. Likewise, no part of the system intrinsically tells us how far a tone can spread, or if it can skip between TN, TRN and TBU freely.

There are some additional gaps in the system; for instance, Hyman never discusses the consequences of more than three tones attaching to a single node. Interestingly, this may be a way to obtain additional levels, consider a case in which three tones have linked to one TN: H, L, L. Since order does not matter, we need focus only on quantity; in the example in (6c) we saw that a TN with a H and L linked to it resulted in a mid tone, perhaps a TN with two L’s and a H would result in a level tone between a low and mid tone, likewise, a TN with two H’s and one L linked to it would result in a level between high and mid tone. This would allow an infinite number of discrete levels, with any levels other than the initial H and L being more and more marked, capturing the empirical observation made by Maddieson (1970).

A final issue to address is the distinction between level low and falling low tones in the utterance final context. In terms of pitch, these are clearly distinct; however, in terms of features and geometric arrangement, they are identical. Instead, I distinguish them by the presence or absence of a floating high tone following an utterance (word). Inkelas (1989) proposes making the distinction an underlying one instead of a contextual one. Inkelas proposes a system that contrasts level
low and falling low tone; the level low is represented as a L linked to the TN and an H linked to the TRN. The falling low is represented as a L linked to the TN and a L linked to the TRN. This makes use of the contrast that would otherwise define upstepped and downstepped L tones. I show these representations in (10) below.

(10) Inkelas (1989)’s low tone representations

| a. µ    | b. µ    |
|——|——|
|    |          |
|    |          |
|    |          |
|    |          |
| L | H |
| L | L |

Level low tone          Falling low tone

This would not work with the data at hand since it prevents the possibility of a downstepped non-falling low tone. Since Dschang does have this distinction, we cannot adopt this representation for the distinction between level low and falling low pitch.

I will now examine how the framework handles common tone processes. In the next section I will review how Hyman (1993)’s system can capture tone spreading, contour tone formation and register shift.

### 2.2 Tone Processes

In this section I will discuss common properties of tone which distinguish the phonology of tone from segmental phonology. I will go about this primarily by looking at some common properties: high tone spreading, contour tone formation, and register shifting phenomena, i.e., downstep and upstep. The layout of this section is as follows. In section 2.2.1 I discuss spreading, in section 2.2.2 I discuss contour tones, finally, in section 2.2.3 I discuss register shift.
2.2.1 Spreading

Tone has several distinguishing properties, a tone can surface on a segment other than the one which sponsored it and tone can multiply attach to segments (Yip, 2002). These two properties characterize tone spreading. They are not unique to tone however; harmonizing features, such as vowel height and some properties of consonants can also spread or agree over long spans.

In the languages examined in this paper, spreading is rather limited due to the relatively short word length (see chapter 3. I will first present an extreme case and then two proposed spreading rules in Grassfields Bantu languages.

In Chilungu, a Bantu language spoken in Zambia, there is unbounded spreading of a high tone introduced by a verbal prefix ‘kú-’ (Bickmore, 1996). Below I have reproduced a set of examples showing that the high tone on ‘kú-’ can appear over a seemingly unlimited number of syllables.

(11) Chilungu high tone spread (Bickmore, 1996)

kú-vúl-à ‘to be enough’
kí-vímb-à ‘to thatch’
kú-fúlmúm-à ‘to boil over’
kú-sáakúl-à ‘to comb’
kú-sóoból-à ‘to sort out’

The H tone is argued to be sponsored on the prefix and spread through the word, up until the final syllable, which hosts a L, which cannot be spread onto in Chilungu. This is schematized below in (12)

(12) kú-sóobólól-à
  H

In Dschang, Hyman (1985) proposes a high tone spreading rule which can displace low tones. This rule is slightly different from the Chilungu case in that it spreads to TBUs which already bear
tones, whereas Chilungu spreading appears to be blocked by the presence of a tone linked to a TBU. Furthermore, floating tones may be spread by this rule and low tones are displaced by spread high tones. I have shown this rule in (13) below. Note that X represents the TBU in (13) and following examples.

(13) Dschang high tone spreading (Hyman, 1985)

\[
\begin{array}{c}
\text{(X) } \text{X} \\
\text{H} \quad \text{L}
\end{array} \rightarrow \begin{array}{c}
\text{(X) } \text{X} \\
\text{H} \quad \text{L}
\end{array}
\]

The result of this rule is two high adjacent high tone syllables, unless the high tone is floating (as indicated by the optional TBU hosting the H tone), followed by a floating low tone. In addition, the floating low tone is claimed to metathesize, moving to the left of an associated high tone, to cause downstep. I schematize this process in (14), below.

(14) Dschang tone metathesis Pulleyblank (1986); Hyman (1985)

\[
\begin{array}{c}
\text{X} \\
\text{L} \quad \text{H}
\end{array} \rightarrow \begin{array}{c}
\text{X} \\
\text{L} \quad \text{H}
\end{array}
\]

I have shown an example below in which the floating low tone is claimed to metathesize and cause downstep of the spreading H tone.

(15) Dschang spreading and metathesis (Hyman, 1985)

\[
\begin{array}{c}
a-\text{zâ)b + a } + \text{ma } -\text{tso}\eta \\
\text{L} \quad \text{L} \quad \text{H} \quad \text{L} \quad \text{H}
\end{array} \rightarrow \begin{array}{c}
\text{àzâ)b + } +\text{mâts}\eta \text{O}
\end{array}
\]

‘song of thieves’

In Ngamambo, Hyman (1986) proposes two spreading rules, they differ slightly from the Dschang rule in that Ngamambo appears to allow contour tone formation instead of delinking of tones. For this reason both spreading rules in Ngamambo result in contour tones. I will begin
with the high tone spreading rule which Hyman proposes to account for the forms like ‘rò-bum’ which are underlyingly low tone roots with a high tone prefix and surface with a falling tone on the noun root.

\[(16) \quad \text{Ngamambo high tone spreading (Hyman, 1986)} \]
\[
\begin{array}{c}
X \\
\hline
X \\
\hline
H \\
\hline
L
\end{array}
\]

[Condition: L is not followed by an unlinked H]

Interestingly the condition on spreading is formulated to allow this rule to apply in only the cases where the noun root is of the level low pitch class. The low tone spreading rule looks quite similar, except for it’s condition of application.

\[(17) \quad \text{Ngamambo low tone spreading (Hyman, 1986)} \]
\[
\begin{array}{c}
X \\
\hline
X \\
\hline
L \\
\hline
H \\
\hline
X
\end{array}
\]

[where X = \emptyset or H]

Notice that in this case, spreading can only apply to H tone noun roots but not HL roots.

Having briefly shown possible analysis of spreading in Dshcang and Ngamambo, I will now briefly address contour tone formation, which has already been exemplified in Ngamambo.

### 2.2.2 Contour tones

Unlike in Mandarin Chinese where contour tones can appear on any syllable in a largely unrestricted fashion, in Bantu languages, contour tones are most commonly found on the final syllable of a word. This is due to interactions between spreading and limited tonal inventories.

As we have seen, two spreading processes in Ngamambo can result in the creation of a contour. The same can be observed in Yoruba, but more clearly. Since Yoruba, like GB languages, only has two specified tones, H and L, it is an apt comparison. Unlike GB languages, TBUs which are not specified for tone surface with a pitch between high and low, usually called mid (Akinlabi and
Liberman, 1995). Similar to the Ngamambo example, words with the underlying tone pattern /H.L/ and /L.H/ surface with a falling or rising contour on the second syllable, respectively. This is due to spreading of the first tone, as in (18) below.

(18) Yourba contour tone formation

\[
\begin{array}{c}
X \\
L \\
\hline
H \\
\end{array}
\]

(Akinlabi and Liberman, 1995)

Yip (2002) explains this sort of spreading and the resulting contour tone as a perseveratory coarticulation which has been phonologized as a rule. The coarticulatory nature of the process is argued to arise from the tendency of tone to be realized relatively late on the TBU that it is linked to, therefore, when a second TBU follows the tone, it has a tendency to be partially realized on this second TBU.

The key point to keep in mind about contour tones in Bantu and GB is that they are derived elements, not underlying tonemes. Though there are some African languages that appear to use unitary contours, that is, contours that do not appear to be composed of multiple level tones but rather function as independent entities, for the purpose of this study we need only worry about composed contours, usually derived from spreading. Another option exists, which is contour formation due to TBU deletion. This is exemplified by data from Nupe (Smith, 1967; George, 1970). The deletion of a final vowel strands a mid tone, resulting in a mid to low fall on the following TBU.

(19) Nupe contour tone formation

\[
\begin{array}{c|c|c|c|c|c}
\text{musa} & \text{egi} & \rightarrow & \text{musa} & \text{egi} \\
M & M & L & H & M & H \\
\end{array}
\]

(George, 1970)

‘Musa is eating’
2.2.3 Register shift

I will use the term register shift to capture a change in the overall pitch space of an utterance. I will specifically address downstep, and to a lesser degree upstep. Strictly speaking, there are two separate phenomena that cause downward trends in pitch, collectively, I will refer to them as downtrends. The one that is most relevant to this study is downstep, but for the sake of clarity I will cover both downdrift and downstep. In the following examples, numerals are used to indicate pitch levels; the higher a number is, the higher the pitch it represents. In the following examples, five is the highest pitch and one is the lowest.

I have schematized this general environment in (20) below. A high tone will become lowered in pitch when it is not the first high tone in an utterance and is preceded by a low tone.

(20) Downstep environment

\[ \text{H} \rightarrow \text{4H} \backslash \text{H} \ldots \text{L} \]

The key distinction between the downdrift and downstep is the triggering environment. Generally, a high tone lowers after a low tone if it is not the first high tone in a string. That is to say, the first high tone in a phrase is usually not lowered. In downdrift, the triggering low tone is segmentally realized, i.e., attached to a TBU. In downstep, the triggering low is not realized, i.e., not attached to a TBU. In (21), I show the environments for downstep and downdrift, for comparison.

(21) a. Downdrift

\[
\begin{array}{c}
\text{INPUT: } /\text{H} \text{L H L H} \ldots / \\
\text{OUTPUT: } [5 \ 1 \ 3 \ 1 \ldots ]
\end{array}
\]

b. Downstep

\[
\begin{array}{c}
\text{INPUT: } /\text{H} \uparrow \text{H} \downarrow \text{H} \ldots / \\
\text{OUTPUT: } [5 \ 3 \ 1 \ldots ]
\end{array}
\]

For all GB languages under consideration, it is claimed that there is no downdrift (Voorhoeve, 1971; Hyman, 1985, 1986). In (22) below, I show several examples of downstep from Medumba. This data will be explained and expanded upon in the following chapter.
Another shared property of downtrends is that the ceiling for high tones is lowered with each successive lowering; all high tones that follow a lowered high tone will be realized at it’s pitch and not higher (for instance, to the height of the first high tone.) This results in languages which appear to have far more level tones on the surface since the high tone ceiling is constantly resetting. I show this in (23) below.

(23) input: /H L H H/  
downstep: /H L !H H/  
output: [5 3 3]

For downstep, the high tone will lower when preceded by a floating low tone. This is the more interesting case since it involves a certain level of opacity. I have already shown application of downstep in all three languages under examination (though it is only relevant in the nominal paradigms of Dschang and Ngamambo). Also note that for the current formulation of downstep, only preceding floating low tones can trigger lowering of a high tone. This is the central motivation for the metathesis rule proposed for Dschang (Hyman, 1985; Pulleyblank, 1986).

I will not adopt this notion of directionality. It appears that downstep can occur from both preceding and following floating low tones, one solution for this is to force metathesis of floating low tones that seem to downstep high tones before them. Instead, I will use a combination of constraints to capture the fact that downstep usually occurs in a progressive (left to right) fashion, but can occurs in a regressive (right to left) fashion. This is no problem for the representational
system I have adopted since features are unordered with respect to nodes. In (24) below I show how downstep from the left and from the right would be represented; compare these two structures to the two possible realizations of a mid tone in (6c) and (7) above, reproduced as (25) below.

(24) a. Regressive downstep
\[ \mu \overset{\circ}{\circ} L H \]

b. Progressive downstep
\[ \mu \overset{\circ}{\circ} L H \]

(25) a. Mid Tone (1)
\[ \mu \overset{\circ}{\circ} L H \]

b. Mid Tone (2)
\[ \mu \overset{\circ}{\circ} H L \]

Upstep differs from downstep in that it is far more rare and does not involve the raising of the low tone floor, like downstep lowers the high tone ceiling. That is to say, while downstep lowers the pitch of successive high tones, upstep does not raise the pitch of successive low tones. This may be simply due to phonetic reasons, such as the difficulty of narrowing the pitch range from both the top and bottom. There do not appear to be any claims of upstep in GB languages; however, I mention it here as it appears to be an analytical possibility in the case of Ngamambo. Consider the data in (26) below in which a derived mid tone is lowered.

(26) Mid tone lowering
\[ / H . L (\overline{H}) / \rightarrow [H . \overset{\mu}{M}] \text{ or } [\overline{\text{——}} \text{ }] \]

ex. r̃a-kīn ‘pots’

I want to leave open the analytical possibility that the tone in question is actually a raised low
tone, as shown in (27) below.

(27) Low tone raising

/ H L \H / → [H . 'L] or [—— ]

ex. rɔ-kˈiŋ ‘pots’

For now I will leave the issue as a possibility, it will be further explored in chapter 4. Before the analysis can be presented, I must review one last piece of theoretical machinery. As I mentioned in this section, I will make use of Optimality Theory (OT) constraints in order to deal with directionality. In the next section I elaborate on my constraints and explore previous attempts at handling tone in OT.

2.3 Optimality Theory

I have chosen to analyze the Grassfields Bantu nominal paradigms in an OT framework for several reasons (Prince and Smolensky, 1993). First, OT allows us to compare how constraints are ordered across the three languages in this study, something which I do not believe would be as easy to tease apart in a rule ordered system. The benefit of being able to compare languages using this metric is that we can make typological conclusions using constraints as a reference. In addition to this, OT is considered to be the state of the art in modern phonology; while not a good reason to cast this particular set of data in an OT analysis, it does mean that current researchers can make use of this analysis in their work. Finally, being a study done in OT, it informs current phonological theory and provides evidence for the activity of certain constraints.

This section is organized as follows. In section 2.3.1 I show two approaches to tone in OT, Bickmore (1996) and Yip (2002). In section 4.1 I provide the constraints that I will use in my analysis along with examples explaining them, this section demonstrates how constraints can refer to the structures proposed in section 2.1 above.

I will assume that readers have basic knowledge of OT; specifically, how penalties are assigned...
and simple interactions between Faithfulness and Markedness constraints. There are several sources for this background, McCarthy (2008) provides methodological information to OT while Kager (1999) addresses a variety of theoretical issues.

2.3.1 Previous Work

Bickmore (1996) presents a comprehensive analysis of various Bantu tone processes using OT. Likewise, Yip (2002) advocates an OT treatment of tone. As far as I know, no other author has presented an OT analysis that uses the same framework for underlying representations that I have chosen; presumably this is related to the lack of work on languages with complex floating tone and register shift.

Bickmore (1996)

Bickmore (1996)’s approach to tone in OT relies on the ALIGN family of constraints. He concerns himself mostly with languages in which only one tone is specified, namely the high tone. Needless to say, these types of languages differ from Grassfields Bantu. Regardless, Bickmore expands upon some fundamental machinery introduced by McCarthy and Prince (1995). In (28) and (29) below I show two key constraints used by Bickmore, where we have set the Element to be a tone.

(28) **DEP-ELEMENT**

Every tone must have a correspondent TBU

=*FLOA*T

(29) **MAX-ET** (McCarthy and Prince, 1995)

Every tone-bearing element have a correspondent tone

=SPECIFY (T)

The purpose of these constraints is to capture the fact that, all things being equal, tones prefer to be associated to a TBU and TBUs prefer to bear a tone. Bickmore does not assume any particular
methods of representing tone while I adopt the hierarchical system proposed in Hyman (1993). This essentially means that all of Bickmore’s work could potentially be recast in terms of the feature geometry I adopt.

In addition to the two tone specific constraints shown above, Bickmore makes use of MAX-IO and DEP-IO constraints. Together, these constraints prevent insertion or deletion of an element. MAX-IO ensure that if an element is present in the input, it is present in the output and if it is not, it assigned a penalty against output forms lacking the element. In short, MAX-IO prevents deletion of elements in the input. DEP-IO ensures that if an element is present in the output, it has a corresponding element in the input, and if it does not, the constraints assigns a penalty against forms which have elements in the output that don’t have correspondent elements in the input. In short, DEP-IO prevents insertion of new elements into the output string. In (30) and (31) below I show the relevant MAX-IO and DEP-IO constraints, taken from Yip (2002).

(30) MAX-IO (T)

Every input tone must have a correspondent tone in the output

(31) DEP-IO (T)

Every output tone must have a correspondent tone in the input

Bickmore provides an example of the interaction between MAX-IO (T) and *FLOAT, some of the data he chooses is nicely relevant to this study as it involves downstep in another Grassfields Bantu language, Aghem. In (32) below I show the relevant data. The distinction between the form in (32a) and (32b) is argued to be a floating low tone which downsteps the second high tone.

(32) Aghem downstep (Hyman, 1987)

a. fú - kín ‘this rat’

b. bê -‘kín ‘this fufu’

In the tableaux in (33), the interplay between MAX-IO (T) and *FLOAT is shown. The higher
ranked faithfulness constraint $\text{MAX-T}$ prevents the deletion of the marked floating low tone.

\[(33)\quad \text{Forms that cause downstep in Aghem} \quad \text{(Bickmore, 1996)}\]

\[
\begin{array}{|c|c|c|}
\hline
\mu & \mu & \text{MAX-T} & \ast \text{FLOAT} \\
\downarrow & \downarrow & & \\
H \underline{\text{L}} & H & & \\
\hline
\ast\ast\ a. & H \underline{\text{L}} H & & \ast \\
b. & H H & \ast! & \\
\hline
\end{array}
\]

We can see that in Aghem, it is less bad to allow a floating tone to cause downstep then to change the input string. We will see that this also holds for Ngamambo and Dschang.

The remainder of Bickmore (1996) is concerned with high tone spans (HTS) which are most relevant in Bantu languages with only high tone specified. By using constraints which penalize alignment of a span of high tones, and making sure that spans, i.e. a single H linked to multiple TBUs, are preferable to multiple H’s, Bickmore captures generalizations about how HTS function in Bantu languages that have them. I hypothesize that the key distinction between those languages and GB is that GB has lost a lot of segmental material and has both H and L tones specified under-lyingly; therefore, comparisons between the two types of Bantu languages is somewhat limited.

Yip (2002)

In this section I will elaborate on a few of constraints which Yip discusses, focusing on those which are relevant to the following analysis. In this section I will consider two constraints presented in Yip (2002), $\ast \text{ASSOCIATE}$ and IDENT-IO(T). In (34) I define these two constraints.

\[(34)\]

\begin{itemize}
  \item a. $\ast \text{ASSOCIATE}$ : 
    No new association lines may be added in the output.
  \item b. IDENT-IO(T) : 
    Corresponding tones in the input and output have the same identity.
\end{itemize}
*ASSOCIATE is the constraint which penalizes contour tone formation, essentially. It also penalizes spreading in languages where some TBUs are not specified for tone. In the data this study is concerned with, it will work to keep floating tones from associating to a TBU and forming contours; as we shall see this constraint needs to be refined a bit in order to work in conjunction with the tonal root node and tonal node. In languages where alignment is a concern, *ASSOCIATE is ranked lower than the alignment constraints in order to allow delinking and relinking of a tone to meet alignment requirements. This provides evidence that *ASSOCIATE is motivated outside of this study, but does not help in the analysis of GB.

IDENT-IO(T) does not do a lot of work for us, but it is important in keeping tones from arbitrarily switching from high to low and vice versa. This constraint is not worth listing in every tableau, but it does disallow a variety of illicit forms simply by being relatively highly ranked. Yip does not show any relative rankings, but we can assume that IDENT-IO(T) is probably one of the most highly ranked faithfulness constraints.

Having introduced some general constraints and mentioned approaches to dealing with tone processes not found in GB, we are ready to explore the data which will be analyzed in this study. In the next chapter I will present Grassfields Bantu data.
Chapter 3

Language Data

This chapter provides information on empirical data used in this study. The chapter is organized as follows. In section 3.1 I present genetic and typological data on Grassfields Bantu languages. In sections 3.2.1, 3.2.2 and 3.3 I describe characteristics of each of the languages examined in this study. In section 3.4 I provide a chart summarizing characteristics of the languages in question and discuss salient differences between how similar inputs are handled in the languages under investigation.

3.1 Grassfields Bantu

Grassfields Bantu (GB) languages are spoken in the North and Northwest provinces of Cameroon. According to Watters (2003), GB “may be one of the most linguistically fragmented of any region in Africa.” In addition, the lexical similarity between GB languages is quite high, between forty-one and sixty percent (Watters, 2003). Because of this, as well as the relatively large amount of descriptive work done across the language family, GB serves as an ideal testing ground for a narrow scope typological study. GB provides enough diversity within a closed set to still result in a variety of solutions to similar illicit strings of tones.

Within GB, I have chosen three languages to focus on, primarily based on availability and quality of descriptions. This study examines data from Medumba (Voorhoeve, 1971), Ngamambo
(Hyman, 1986) and Dschang (Hyman, 1985).

Below is a genetic schema of GB languages with the three languages under investigation in bold.¹ Medumba and Dschang are Bamileke languages belonging to the Mbam-Nkam subfamily; however they fall on opposite geographic ends of the Bamileke expanse, in fact Watters (2003) suggests they be sub-classified into Western and Eastern Bamileke, respectively. The third language of interest, Ngamambo is a Momo language, quite removed from the Eastern Grassfields subgroup to which Medumba and Dschang belong.

¹This figure is adapted from Watters (2003) with language isolates and specific languages (other than Medumba, Ngamambo and Dschang) omitted.
3.1.1 General Properties of Grassfields Bantu Languages

There are several characteristic behaviors of tone in GB languages, most importantly noun classes, which must be discussed before examining each in detail. After reviewing the data broadly, I will examine Mbam-Nkam language, and then focus on Medumba and Dschang individually. Finally I will examine Ngamambo. Each language specific section includes a chart summarizing properties of that language. In section 3.4 I combine all of the charts to give an overview of language properties.

While descriptively GB languages have many pitch heights, I follow previous work such as Hyman and Tadadjeu (1976); Hyman (1985, 1986); Voorhoeve (1971); Anderson (1980) which derive the multitude of surface tones from two underlying heights. I will analyze languages as having either two or three level tones. The specific representations of underlying tone structure will be discussed in chapter 2. Much of the challenge of the current project is in correctly mapping underlying forms with only high and low tones to surface forms with downstepped tones.

We now turn to the tone bearing unit (TBU). For the purpose of the analysis at hand, it is largely irrelevant if we consider the TBU to be the syllable or the mora. In chapter 2, I mentioned that Hyman (1993) proposed that the mora is the only available TBU, and in cases where it appears that a syllable is the TBU, the case is really that only the head mora of a syllable can be the TBU. Nevertheless, I will attempt to walk through possible arguments for various tone bearing units.

Since none of the languages in this study make use of length contrasts in vowels, we do not need to show that vowel length effects tone distribution. In general, it does not appear that units of weight below the syllable, such as morae, matter for the purpose of tone assignment. In example (36) below, I present data from Medumba and Dschang illustrating that both open and closed syllables host the same tone patterns².

²In the data below, and the data to follow, the acute diacritic, ´, over a vowel signifies high tone, the grave diacritic, `', signifies low tone. A list of additional diacritics is given in (1) at the beginning of this paper. These diacritics represent underlying tones and not surface pitch; surface pitch is represented here by a contour. The higher the line, the higher the pitch represented; breaks in the line represent syllable boundaries, thus, an unbroken sloped line represents a contour. In the examples below, the falling low pitch is a characteristic of GB languages, this will be discussed more in section 3.2.
(36) Syllable as TBU in Medumba (Voorhoeve, 1971)

a. Closed syllables

mén ndut mvàn

‘child’ ‘cloud’ ‘chief’

[—is] [—] [—]

b. Open syllables

fí kò njò

‘cold’ ‘spear’ ‘country’

[—] [—] [—]

Comparing the forms in (36b) and (36a) above, we note that the same tonal patterns, high, level low and falling low, are found on both types. Since the internal weight of the syllable does not affect which tones can surface, this distribution supports the claim that the syllable is the more relevant TBU. We would expect that heavy syllables may be able to host more than one tone in cases where there are floating tones; however, this is not observed. Moraic weight does not appear to condition formation of contour tones in the Grassfields Bantu languages under investigation.

One piece of evidence pointing toward the mora as a TBU is that historically, and synchronically in some GB languages such as Dschang and Ngamambo, tone can be either sponsored or realized on a nasal consonant. Examples of nasals sponsoring tone are shown in (37) below.

(37) Nasal consonants hosting tone

a. ṣ̱-ŋi

\[
\begin{array}{c}
\text{L} \\
\text{H} \\
\end{array}
\]

‘axe’

Dschang (Hyman, 1985)

b. ñ-ţím

\[
\begin{array}{c}
\text{L} \\
\text{L} \\
\end{array}
\]

‘back’

Ngamambo (Hyman, 1986)
In 2.1.2 I will slightly revise my conclusion for theoretical reasons, but I will evoke the fact that nasals can host tones to support the decision that the mora is the TBU. Even if this ends up being the incorrect conclusion, the rest of the analysis does not suffer for it.

Having made this basic observation about GB languages, I turn to the Mbam-Nkam subgroup in order to draw out further generalizations. Two of the languages under investigation in this paper belong to Mbam-Nkam, as shown in (35) above. Furthermore, Mbam-Nkam is quite well studied beyond Medumba and Dschang, letting us set a solid foundation for this investigation based on facts about Mbam-Nkam.

3.2 Mbam-Nkam Languages

The Mbam-Nkam subgroup has received possibly the most amount of attention of the GB languages. Hyman and Tadadjeu (1976) explore the nature of floating tones in this subgroup, reconstructing the proto-Mbam-Nkam tone patterns and tracing their reflexes through about twenty languages. I will briefly summarize some of the properties of Mbam-Nkam languages and present a more general argument for the necessity of floating tones, building on the work of Hyman and Tadadjeu (1976) and the Grassfields Bantu Working Group. The choice of presenting Mbam-Nkam is motivated by the fact that, compared to other GB languages, Mbam-Nkam languages are less segmentally conservative and have more floating tones.

The rest of this section provides evidence of the loss of segmental material and presence of floating tones, I then present the nominal paradigm of Medumba and Dschang in subsections.

Before examining floating tones, I must address their origins; the most simple conceptual explanation is that segmental material, i.e., consonants and vowels, can be deleted from a string while the suprasegmentals they hosted, in this case tone, is preserved (Hyman, 1986). The goal of the remainder of this section is to explain what segments were lost, what tones were left behind, and finally what happens to those floating tones.

Let us begin at the leftmost edge of a complete GB noun: the noun class prefix. Noun class
prefixes are mandatory morphemes which indicate the class of a noun. Noun class prefixes obligatorily appear with every noun, but sometimes with no segmental material. The prefix shapes are reconstructed as N-, V-, or CV-, with a low tone for all classes (Hyman and Tadadjeu, 1976). In the Mbam-Nkam languages nouns were historically bisyllabic with every possible combination of high and low tones on the root syllables (L-L, L-H, H-L, H-H). The chart in (38) below shows reconstructed Mbam-Nkam noun tone paradigms along with the reflexes in Dschang and Medumba, the leftmost low tone, common to each proto form, is the tone of the noun class prefix. On the line below each sequence, pitch contours are schematized: the higher a line is, the higher the pitch.

(38) Reconstructed Mbam-Nkam noun tone patterns (Hyman and Tadadjeu, 1976)

<table>
<thead>
<tr>
<th>Language</th>
<th>*L-LL</th>
<th>*L-LH</th>
<th>*L-HL</th>
<th>*L-HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dschang</td>
<td>L-L</td>
<td>L-L°</td>
<td>L-1H</td>
<td>L-H</td>
</tr>
<tr>
<td></td>
<td>[___]</td>
<td>[___]</td>
<td>[___]</td>
<td>[___]</td>
</tr>
<tr>
<td>Medumba</td>
<td>-L</td>
<td>-L°</td>
<td>-H-1L</td>
<td>-H</td>
</tr>
<tr>
<td></td>
<td>[___]</td>
<td>[___]</td>
<td>[___]</td>
<td>[___]</td>
</tr>
</tbody>
</table>

It is unambiguous that noun class prefixes are mandatory in GB languages. The case is less clear if we examine a language such as Medumba, as we shall see. Nevertheless, in the remainder of the section I provide some evidence for floating tones in Mbam-Nkam languages. I show that we can consider Medumba nouns to have a floating tone as a prefix, without any segmental material. For now, it is important to note the difference in how Dschang and Medumba resolve the proto *L-HL pattern. For Dschang, we obtain a lowered high tone, also known as a downstepped high tone; for Medumba, we obtain a high tone with a floating low, which is relevant in grammatical constructions, but neutralized in citation form. We will see a more complete analysis in chapter 4. Section 3.4 compares all of the languages described in this chapter.

3In the data in (38), the ° diacritic indicates a non-falling low tone. This can be thought of as a sequence of an attached low tone followed by a floating high tone, /…L[H]…/.
Hyman and Tadadjeu (1976) provide two key pieces of evidence for the presence of floating tones derived from the loss of noun class prefixes and the loss of the second syllable of nouns. The first piece of evidence is from the split between low pitch nouns. There appears to be two ways low pitch can be realized, one realization which begins low and falls in pitch utterance finally and another which begins low and remains at a low pitch utterance finally. This data is used as evidence for a floating tone on the right edge of a noun root, left by a degraded second syllable, as shown below4.

(39) Floating tones on the right edge of a noun root

\[
\begin{array}{c}
\text{σ}_1 \\
\text{T}
\end{array} \quad \rightarrow \quad \begin{array}{c}
\text{σ}_1 \\
\text{T}
\end{array}
\]

The behavior of the two low pitches are shown in example (40) below; all data is from Medumba. The first set of examples in (40) displays the behavior of nouns in isolation. The second set in (41) shows those same nouns in sentence final position. The final set in (42) shows them in non-final position.

(40) Low pitch

Voorhoeve (1971)

a. Level pitch

i. nà? ‘cow’

ii. ndùn ‘cloud’

iii. kò ‘spear’

b. Falling pitch

i. ŋôgō ‘country’

ii. tōŋ ‘ear’

iii. mvôn ‘cheif’

4The circled tone in (39), and elsewhere, represents an unattached, or floating, tone. See (1) for a comprehensive list of symbols and diacritics used in this paper.
We can observe that in non-final contexts the contrast between falling and level low pitch is neutralized; compare the pitch of the target nouns in (41) to those in (42). Since the surrounding material is identical for both the falling and level lows, it would not be a tenable position to say that they share underlying forms and have surface allomorphy. If we instead refer to the proto-tone patterns of noun roots, shown in (38) above, we have a much stronger option.

As Hyman and Tadadjeu (1976) suggest, the level low pitch is derived from the *-LH proto root where the second syllable, the one which bore the high tone, has been lost. The high tone has persevered, to surface only when the noun in question is word final, by preventing the pitch from falling. We are then left with the generalization that low tones utterance finally glide down in pitch
in Mbam-Nkam. This historical change is shown below in (43)\(^5\).

\[(43) \quad -*LH \quad \rightarrow \quad -L[H]\]

Proto form \quad Current form

The second piece of evidence that Hyman and Tadadjeu (1976) use to argue for floating tones in Mbam-Nkam comes from the associative construction. Though the present study is concerned only with the realization of tone on nouns in isolation, it is important to motivate the complex underlying structures which will be accounted for. Therefore, examining grammatical constructions becomes relevant even if an analysis of the constructions is outside the scope of this work.

The associative construction forms a relation between two nouns, schematized as \(N_1\) of \(N_2\) (Hyman and Tadadjeu, 1976; Voorhoeve, 1976). I show examples below in (44) using data from Dschang and Ngamambo. The relevant portion of this construction is the associative marker (AM), a morpheme inserted between \(N_1\) and \(N_2\).

\[(44) \quad \text{The associative construction} \]

a. Ngamambo

\[
\begin{array}{ccc}
N_1 & \text{AM} & N_2 \\
\hline
r\ddot{o}-b\acute{e}\acute{i} & r\ddot{e} & \text{wan} \\
H & H & \text{LH}
\end{array}
\]

knives AM child

‘knives of child’

The AM is reconstructed by Hyman and Tadadjeu (1976) as a CV morpheme which bears either a high or low tone and agrees with the noun class of \(N_1\). For the purpose of this discussion and the rest of this paper, the specifics of noun classes is unimportant; as was seen earlier in (38),

\(^5\)As Myles Leitch points out, this difference could be attributed to a phrasal low tone which attaches to the root low tone. For forms with a floating high tone to their right, the phrasal low would be blocked from attaching to the root low tone. Under this approach, the phrasal low needs to interact with the low tone root to form a structure which represents the falling low. I will not take this stance, since there does not appear to be a reason to think that this type of low tone needs to have an explicit structural configuration which differentiates it from its non falling counterpart when we can make reference to the environment in order to obtain this distinction.
every noun class prefix in Mbam-Nkam is low, though in other GB languages we do find high tone noun class prefixes.

The reflex of the associative morpheme is a floating tone in Medumba, while in Dschang it can be either an open or closed syllable bearing a high or low tone. In other Mbam-Nkam languages the full CV structure is preserved with a richer assortment of vowels. Since the nature of the associative morpheme varies with respect to segmental material (and therefore floating tones), I will examine the construction on a language by language basis in the following sections.

3.2.1 Medumba

Medumba is at once the most straightforward and most complicated language with which we are dealing. Because of the loss of segmental material, both in the prefix and second syllable of many nouns, Medumba is rife with floating tones which have been proposed to cause otherwise unexpected outputs. However, Medumba does not show effects of the hypothesized floating tones in citation forms. That is, though we have evidence for many floating tones due to grammatical construction, when dealing with nouns in isolation, most of the floating tones have no surface effect. In order to analyse Medumba we must obtain the correct underlying representation for every noun.

I have already presented data from Medumba as an exemplar of more widespread phenomenon, such as falling low tones in (40). In (45) I present the distinct surface forms we can observe for Medumba nouns. Note that there is neutralization in the citation form and we will see more underlying contrasts once we place nouns in various carrier phrases.
Surface nominal paradigm of Medumba nouns in citation form

a. High pitch

\[ \begin{align*}
\text{m\text{\textbar\textbar}u} & \quad \text{m\text{\textbar\textbar}e} \quad \text{\text{\textbar\textbar}i} \\
\text{\text{\textbar\textbar}d{o}} & \quad \text{\text{\textbar\textbar}t\text{\textbar\textbar}e} \\
\end{align*} \]

‘dog’ ‘child’ ‘blood’

\[ [\text{-}] \quad [\text{-}] \quad [\text{-}] \]

b. Low pitch

\[ \begin{align*}
\text{n\text{\textbar\textbar}a?} & \quad \text{n\text{\textbar\textbar}u} \quad \text{k\text{\textbar\textbar}o} \\
\text{\text{\textbar\textbar}o} & \quad \text{m\text{\textbar\textbar}v\text{\textbar\textbar}n} \quad \text{\text{\textbar\textbar}t\text{\textbar\textbar}e} \\
\end{align*} \]

‘cow’ ‘cloud’ ‘spear’

\[ [\text{-}] \quad [\text{-}] \quad [\text{-}] \]

c. Low falling pitch

\[ \begin{align*}
\text{n\text{\textbar\textbar}g\text{\textbar\textbar}o} & \quad \text{m\text{\textbar\textbar}v\text{\textbar\textbar}n} \quad \text{t\text{\textbar\textbar}e} \\
\end{align*} \]

‘country’ ‘chief’ ‘ear’

\[ [\text{\textbar\textbar}] \quad [\text{\textbar\textbar}] \quad [\text{\textbar\textbar}] \]

In order to tease apart the underlying tone patterns of Medumba nouns, we must place them in a variety of frames. The goal of these frames is to have every combination of high and low, floating and attached tones on the left and right of the target. We have already seen several frames given in (40) to show neutralization of low and low falling tones: the citation, or zero frame in (40a) and (40b), the sentence final frame in (41) and the sentence medial in (42). We expect nouns to fall into four patterns, given the proto-Mbam-Nkam forms, these are repeated below in (46), also see (38).

(46) Proto-Mbam-Nkam tone patterns & their Medumba reflexes (Hyman and Tadadjeu, 1976)

<table>
<thead>
<tr>
<th></th>
<th>*L-LL</th>
<th>*L-LH</th>
<th>*L-HL</th>
<th>*L-HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medumba</td>
<td>-L</td>
<td>-L\textdegree</td>
<td>-H-\textbar</td>
<td>-H</td>
</tr>
<tr>
<td></td>
<td>[\text{\textbar\textbar}]</td>
<td>[\text{-}]</td>
<td>[\text{-}]</td>
<td>[\text{-}]</td>
</tr>
</tbody>
</table>

Compare the patterns which are reflexes of the Mbam-Nkam forms, in (46), with the observed
surface forms in (45). Notice that we only see a three way surface contrast though we have reason to expect a four way contrast. The locus of the neutralization is the distinction between a high-low root and a high-high root; these are the last two columns in the chart in (46). Since there are no true surface contours, i.e., contours formed by concatenation of a high and low toneme on one TBU, we may think that the high-low proto-form has been collapsed into the high-high form. Having set up this question of what happened to the high-low and high-high proto-root patterns, we can turn to our frames in order to tease apart the potential difference.

In the examples below, I show high tone nouns in isolation in example (47a), then put these same high tone nouns into a frame containing a toneless particle ‘-ɔ’, in (47b). This frame provides a test for unattached tones to the right of the target noun; we notice that there are two pitches at which the particle ‘-ɔ’ can be produced: at the same pitch as the high tone noun, or lower than it.

(47) Disambiguating high pitch nouns

Voorhoeve (1971)

a. High pitch nouns in isolation

mβúi ʒú tʃúi nú

‘dog’ ‘thing’ ‘tree’ ‘snake’

[—] [—] [—] [—]

b. High pitch nouns in the frame ‘Who saw the ____?’

i. ȧ wó zà jǐn

mβúi ‘dog’

ʒú ‘thing’

[—] [—]

ii. ȧ wó zà jǐn

tʃúi ‘tree’

nú ‘snake’

[—] [—]

If we assume that floating tones will preferentially dock onto a toneless syllable, being agnostic about directionality in light of the lack of evidence, then we can use the frame in (47b), ‘Who saw
the ____?”, to test for floating tones on the right edge of a noun. The examples in (47) show that there is a split between high pitch nouns which are identical in the citation form. Given that we already have reconstructed evidence for both high-high and high-low roots, it seems like the best claim to make is that the nouns in (47b-i) are underlyingly the reflexes of the high-low root, while those nouns in (47b-ii) are underlyingly the reflexes of the high-high root. That is to say, those nouns in (47b-i) have the underlying shape given in (48a), while those in (47b-ii) have the underlying shape given in (48b). This analysis is also put forward by Voorhoeve (1971), albeit using slightly different frames to arrive to the same conclusions.

(48) Underlying forms of high pitch nouns

<table>
<thead>
<tr>
<th>a. Underlying H</th>
<th>b. Underlying H</th>
</tr>
</thead>
<tbody>
<tr>
<td>mβúú 5ú</td>
<td>tfúú nú</td>
</tr>
<tr>
<td>‘dog’ ‘thing’</td>
<td>‘tree’ ‘snake’</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

I will not spend much time motivating the choice to collapse proto-high-high roots to a simple high root, as in (48b), but the move seems well supported by the obligatory contour principal (Goldsmith, 1976). Hyman and Tadadjeu (1976) proposes a similar approach for other Mbam-Nkam languages. Furthermore, we do not have any positive evidence for a grounded high tone followed by a floating high tone. For similar reasons, I follow Hyman and Tadadjeu (1976) in simplifying the low-low proto-root pattern to a simple low, while the low-high pattern becomes a low followed by a floating high. This captures the observed surface split between falling low pitch nouns and level low pitch nouns, as seen in (40) above.

To continue our exploration of Medumba noun tone patterns, we must now look at the left edge. Having provided evidence for floating low and floating high tones on the right edge of nouns, we must motivate the floating low tone which is a reflex of the low tone noun class prefix. Because I assume that when a floating tone is identical to an adjacent grounded tone they fuse, we need only
concern ourselves with the $H$ and $H\text{L}$ tones when dealing with the floating low tone prefix. We will now return to the associative construction. Recall the generalized form given in (44), above.

In the examples in (49), the head noun, the noun on the left, is variable while the second noun is kept constant. This ensures that we are changing only material to the left. We expect that both the presence of a floating low tone and the identity of the floating tone contributed by the AM can effect the realization of the right most noun in the associative construction.

(49) High tone nouns in the associative construction

\[
\begin{array}{ccc}
N_1 & \text{AM} & N_2 \\
\text{mén} & \text{mén} & \rightarrow \\
\text{child} & \text{child} & [\text{\text{-}}] & [\text{\text{-}}] \\
\text{\text{3ú} mén} \\
\end{array}
\]

\text{a.} $\text{Zú mén}$

\[
\begin{array}{ccc}
\text{thing} & \text{child} & \rightarrow \\
\text{\text{\text{3ú} mén} [\text{\text{-}}] [\text{\text{-}}]}
\end{array}
\]

\text{b.} $\text{\text{3ú} mén}$

\[
\begin{array}{ccc}
\text{woman} & \text{child} & \rightarrow \\
\text{\text{\text{3ú} mén} [\text{\text{-}}] [\text{\text{-}}]}
\end{array}
\]

\text{c.} $\text{\text{\text{3ú} mén}$

\[
\begin{array}{ccc}
\text{tree} & \text{child} & \rightarrow \\
\text{\text{\text{3ú} mén} [\text{\text{-}}] [\text{\text{-}}]}
\end{array}
\]

\text{d.} $\text{\text{\text{3ú} mén}$

In the examples above we can see that there is no clear way to predict wether the floating tone introduced by the associative marker will be high or low since it appears with both $H$ and $H\text{L}$ roots. The identity of the floating tone is dependent on which noun class the noun belongs to and corresponds to the tone of the possessive pronoun used in conjunction with it (Voorhoeve, 1971).
Since the AM is part of a grammatical construction, a deeper analysis of the changes which occur will not be presented here. I only examine on the distinction between (49d) and (49b), where the second high tone is downstepped once in (49d) and twice in (49b). This distinction provides solid evidence for the necessity of a floating low tone prefix on high root tone nouns, as we shall see.

Focusing on (49d), I have reproduced just the string of tones in the input in (50) below. The box around the span \( \overline{H} - \overline{L}H \) indicates the environment for downstep; dashes indicate word boundaries.

\[
\begin{align*}
\text{(50)} & \quad L \overline{H} - \overline{H} - \overline{L}H \overline{L} \\
\end{align*}
\]

The only peculiar aspect of this span is that one of the triggering high tones is a floating tone. In general, downstep occurs when a floating low occurs between two grounded high tones; Medumba appears to be more permissive, allowing downstep to occur as long as a lowered high tone is already grounded. To complicate matters, consider the second case, (49b), in which the second high tone is realized lower than in (49d). I have reproduced just the string of input tones in (51) below.

\[
\begin{align*}
\text{(51)} & \quad L \overline{H}L - \overline{H} - \overline{L}H \overline{L} \\
\end{align*}
\]

In this case, we have two high tones which are in the environment for downstep. Surprisingly, one of those high tones is floating; this does not seem to effect its ability to be lowered. We can tell that it has been lowered because downstepped high tones lower the ceiling for succeeding high tones. Since the second realized high tone is actually lower than a single downstep (in comparison to the realized high tone in (49d)), it is proposed that there are two lowerings, resulting in a double downstep.

The significance of the above downstep phenomena lies in the necessity of the floating low tone prefix in triggering the lowering. Note that in (50), the prefix floating tone is the intervening between two high tones, the floating high tone introduced by the AM, and the grounded high tone of the noun root. Similarly in (51), the first downstep is triggered by the floating low tone of the noun root and the second by the floating low tone of the noun prefix. If we accept the story of
downstepping floating high tones, then we have a solid account for floating low tone prefixes as well as floating low tones on the right edge of nouns.

Having run through the relevant arguments for the underlying forms of Medumba nouns, I show the proposed forms as well as their realizations in citation form in the example below.

(52) Medumba tone patterns (Voorhoeve, 1971)

a. /L- H L/ → [H] or [—]
   ex. ți ‘thing’
   ex. mên ‘child’

b. /L- H / → [H] or [—]
   ex. ți ‘snake’
   ex. tî ‘tree’

c. /L H / → [L (H)] or [___]
   ex. ndun ‘cloud’
   ex. kô ‘spear’

d. /L / → [L] or [___]
   ex. mvèn ‘chief’
   ex. bàm ‘belly’

As we have seen, the relatively complicated underlying forms for Medumba nouns are neutralized at the surface. All floating tones are deleted from the input string save for the floating high tone in L(H). One of the persistent questions that arises for each language in this study is why this tone is preserved but not others. When comparing Medumba to other GB languages, we shall also see that there are other possibilities for floating tones, such as causing word internal downstep. The other languages under examination have fewer floating tones than Medumba, and therefore require less justification for their underlying forms. In examining Medumba, I have also provided a brief introduction to downstep, this issue will be further fleshed out in chapter 2.

3.2.2 Dschang

Dschang has long been known to have a complicated tone system. The initial analysis by Tadadjeu (1974) has been reworked many times over. I will attempt to stay away from the more complex supra-word level issues and focus simply on the realization of tones in citation forms. Though this sidesteps many of the more troubling issues, we must still motivate the tone patterns found on
nouns. I will follow the same general strategy that I used for Medumba, placing nouns in frames in order to motivate floating tones.

I have repeated from (38) the reconstructed proto-Mbam-Nkam tone patterns along with the Dschang reflexes in (53) below. In the same chart, I show the phonetic realizations of each Dschang form.

(53) Proto-Mbam-Nkam tone patterns & their Dschang reflexes (Hyman and Tadadjeu, 1976)

<table>
<thead>
<tr>
<th></th>
<th>*L-LL</th>
<th>*L-LH</th>
<th>*L-HL</th>
<th>*L-HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dschang</td>
<td>L-L</td>
<td>L-L ̈</td>
<td>L-^H</td>
<td>L-H</td>
</tr>
<tr>
<td></td>
<td>[─ ─]</td>
<td>[─ ─]</td>
<td>[─ ─]</td>
<td>[─ ─]</td>
</tr>
</tbody>
</table>

In contrast to Medumba, Dschang retains the segmental noun class prefix. This means that the number of tests necessary to motivate floating tones is reduced since we only need to motivate tones on the left word edge. Even more promising, we see a four way contrast between surface forms when nouns are produced in the citation form; this provides us a solid departure point for positing differing underlying representations.

Returning to the associative construction, we can first note that the associative marker (AM) has a segmental realization in Dschang. The segmental and tonal identity of the AM depends on the class of the head noun in the associative construction; for the sake of exposition I will focus only on the tone of the AM. In the example in (54), I show low tone roots, i.e., low-low-high and low-low, in the N₁ position followed by a low tone AM.

(54) Dschang low tone roots in the associative construction Hyman (1985)

a. Underlying L-L as N₁

\[ \text{'chief of leopards'} \]

b. Underlying L-L(\(\text{H}\)) as N₁
The examples in (54a) show that no tonal changes occur in a string that is all low. In contrast, the examples in (54b) show that the floating high tone of the root has some effect, since the tone of the AM is lowered. The exact mechanism is complicated, but still points towards a tonal distinction between L-L and L-L\(\text{H}\) roots.

Turning to the high tone roots, L-H and L-H\(\text{L}\), we have two pieces of evidence for the presence of a floating low tone. The first is simply that there is a surface distinction between the two roots, as seen in (55) below.

(55) High tone noun roots

a. Underlying -H\(\text{L}\)
   
   \[\text{m}^\text{bhtú} \quad ^\text{i}^\text{mó}\]
   
   ‘dog’ ‘child’

   \[\quad [\_\_\_] \quad [\_\_]\]

   L-H\(\text{L}\) -H\(\text{L}\)

b. Underlying -H

   \[\text{nts}^\text{óln}\]
   
   ‘thief’ ‘bird’

   \[\quad [\_\_\_] \quad [\_\_]\]

   L-H\(\text{L}\) -H\(\text{L}\)

Note that the L-H\(\text{L}\) root is not realized as a low pitch syllable followed by a high pitch, as the L-H root is, but rather a low pitch syllable followed by a mid pitch syllable. Knowing that the protoform had a low tone, we can hypothesize that this low is effecting the height of the realized high tone, effectively downstepping it. The striking feature of Dschang downstep is that it apparently can arise from sequences like the one exemplified in (56) below, and as mentioned previously in (14).

(56) Tone metathesis Pulleyblank (1986); Hyman (1985)

\[\text{ň} \quad \text{gya} \quad \rightarrow \quad \text{ň} \quad \text{gya} \quad \rightarrow \quad \text{ň}^\prime \text{gyá} \quad [\_\_\_\_] \quad \text{‘lepoard’}\]
As was mentioned previously, this has been analyzed as a metathesis of the final two tones by Hyman and Tadadjeu (1976); Pulleyblank (1986); the final low tone moves to the left of the high tone, obtaining the correct sequence for downstep. The mechanics of the analysis are not important, but the fact that the low floating tone has an effect on the output will be taken as evidence that there is indeed a distinction between the two high tone roots shown in (55), and that the difference is the presence of a floating low tone.

The second piece of evidence has us return to the associative construction once more. Comparing sequences like those in (57), we see that the two high tone roots behave differently. At this point, we expect differing behaviors; however, they pattern in seemingly erratic ways.

\[(57)\]

a. Underlying L-H as N₁

\[\begin{array}{ccc}
N₁ & AM & N₂ \\
\text{‘machete of leopards’}
\end{array}\]

b. Underlying L-H(□) as N₁

\[\begin{array}{ccc}
N₁ & AM & N₂ \\
\text{‘country of leopards’}
\end{array}\]

In (57a), we see that the low tone prefix has spread to the second syllable, forming a contour. This first pattern arrises from the spreading rule discussed in chapter 2. The other high tone root, in (57b), surfaces with a low pitch on the prefix and a lowered high pitch on the root syllable. Spreading of the associative marker’s high tone onto the low tone of N₂’s prefix occurs. This second unpredicted pattern arises from the metathesis mentioned previously and the spreading rule which operates inside N₁ in (57a) spreading over the AM and prefix of N₂ in (57b).

Finally, it is important to note that there are nouns which surface without a prefix in Dschang. That is to say, they take a null noun class prefix, without even a floating tone. Luckily, since there is no interaction between the low tone attached to the prefix and the root tones, there is no real
distinction between how the root tones surface. This can be seen in comparing the forms with
and without prefixes in the chart in (58) below.

(58) Dschang Tone Patterns (Hyman, 1985)

a. /L- H [1] → [L- ↑H] or [____ ]
   ex. àlè́ ‘country’

b. /L- H / → [L- H] or [____ ]
   ex. ì-̀dàz̀ ‘axe’

c. /L- L [1] → [L- L [1] or [____ ]
   ex. n-̀d`aż ‘axe’

d. /L- L / → [L- L] or [____ ]
   ex. m̀-̀n-dzẁ ‘leopard’

3.3 Ngamambo

The tone system of Ngamambo was first described by Asongwed and Hyman (1976), the data used
in the present project is drawn from Hyman (1986), which studies a slightly different dialect of the
same language. The dialect described in Hyman (1986) differs from that described in Asongwed
and Hyman (1976), according to Hyman, in that mid tones do not lower after low tones, as is
shown in (59) below.

(59) Ngamambo dialectal differences

Asongwed and Hyman (1976)  Hyman (1986)

   ex. ñ̀-̀dnd̀j [____ ]  ‘horn’  nd̀j [____ ]  ‘horn’

   ex. á̀-̀yú́’ [____ ]  ‘thing’  á̀-̀bom [____ ]  ‘eggs’

This results in slightly different data; however, this is only reflected in two tone patterns, as shown
in example (59) above. Note that this difference only applies for one type of high tone prefix in
(59b), these will be described shortly. Essentially, mid tone lowering can apply in more cases in
the variety of Ngamambo reported on in Asongwed and Hyman (1976) than it can in the variety
Ngamambo, unlike Dschang and Medumba, has three contrastive levels that can appear without lowering. It does maintain the lowering processes common to GB languages. In example (60) below, I show the four level pitches that a noun can be realized at in isolation. In the example below and following Ngamambo examples, a dash is used to separate the noun prefix from the noun root, the relevant pitch is that of the root.

(60) Ngamambo pitch levels (Hyman, 1986)

<table>
<thead>
<tr>
<th>Pitch Level</th>
<th>Noun</th>
<th>Pinyin</th>
<th>Transcription</th>
</tr>
</thead>
<tbody>
<tr>
<td>High pitch</td>
<td>‘knives’</td>
<td>r̥-bêí</td>
<td></td>
</tr>
<tr>
<td>Mid pitch</td>
<td>‘salt’</td>
<td>f̥-ŋgwâŋ</td>
<td></td>
</tr>
<tr>
<td>Lowered mid pitch</td>
<td>‘pots’</td>
<td>r̥-kiŋ</td>
<td></td>
</tr>
<tr>
<td>Level low pitch</td>
<td>‘birds’</td>
<td>r̥-nâⁿ</td>
<td></td>
</tr>
</tbody>
</table>

Asongwed and Hyman (1976) claim that the four levels presented in (60) are enough to account for all surface phenomenon in Ngamambo, though they still limit themselves to two underlying tones, high and low. For this reason, Ngamambo is much more complicated to analyze in the same way as the Mbam-Nkam languages, the large variety of surface outputs must be derived from the same number of underlying contrasts.

The second feature which sets Ngamambo aside from Mbam-Nkam languages is the presence of contour tones on nouns in isolation. In both Dschang and Medumba tones that would form contours are either deleted or cause lowering in the citation form, though contours do arise in phrasal frames; however, in Ngamambo, nouns without prefixes and those with a prefix can bear a contour tone. In (61) below I show monosyllabic nouns, i.e., noun roots that do not take a segmental noun class prefix, with contour tones.
Tone patterns of monosyllabic nouns without a prefix (Asongwed and Hyman, 1976)

<table>
<thead>
<tr>
<th>noun</th>
<th>pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>fɔn</td>
<td>L</td>
</tr>
<tr>
<td>nâm</td>
<td>HL</td>
</tr>
<tr>
<td>wán</td>
<td>H</td>
</tr>
</tbody>
</table>

‘chief’ ‘animal’ ‘child’

L  HL  H

[–]  [–]  [–]

Though the high-low contour is phonetically realized as a mid-low contour, Asongwed and Hyman (1976) treat it as underlyingly HL. This follows from assumptions about the historical nature of Ngamambo noun roots, specifically that they have the same proto-patterns that were found in Mbam-Nkam.

Unlike for the Mbam-Nkam languages where reconstructed proto-tone patterns are available, no such work has been done for the Momo subgroup. Nevertheless, because of proto-Mbam-Nkam, we expect to find reflexes of the same underlying root patterns, namely: high-high, high-low, low-low and low-high. Asongwed and Hyman (1976) take this position, following the work of Hyman and Tadadjeu (1976). This accounts for the presence of contours on monosyllables, which are simply the reflex of bisyllabic noun roots which either never took a noun class prefix or have lost that marking, along with losing the second syllable, leaving a second unattached tone which can form a contour. The same argument for the distinction between falling low pitch and level low pitch which was made for Medumba and Dschang can be applied to Ngamambo, where we assume that the surface level monosyllabic low nouns are underlyingly low tone with a floating high tone on their right edge.

As was shown above in (61), not all noun roots in Ngamambo take a prefix; we will now look at the more common noun roots which do take prefixes. Noun class prefixes fall into three types in Ngamambo, a high tone on a /Cɔ-/ segment, a high tone on a /V-/ segment and a low floating tone with an /NC-/ segment. The two high tone prefixes are differentiated from each other in that the high tone prefix that exists on a vowel is always lowered to a mid tone in the citation form. The shapes of the noun prefixes are systematized in (62) below. These three noun prefixes are shown in combination with every underlying noun pattern identified by Hyman (1986) in the chart in (63)
at the end of this section.

(62) Noun class prefixes (Asongwed and Hyman, 1976)
   a. High tone noun prefix /\C\-/- + ROOT
   b. Mid tone noun prefix /\V\-/- + ROOT
   c. Low tone noun prefix /\`/-/- + ROOT beginning with a nasal

The reason why /\V\-/- noun prefixes are consistently lowered to a mid tone is mysterious. Asongwed and Hyman (1976) suggest that the high tone on a vowel prefix is simply lowered to a mid tone; though ad hoc, this solution captures the fact that the same root patterns are seen following both mid and high tone noun prefixes, as well as the strong analytical desire to maintain two underlying tones.

In addition to historical evidence, which is lacking for Ngamambo, we have tonal alternations which can help us justify the tone patterns found in Ngamambo. These frame are much like those used to justify floating tone in Medumba and Dschang; therefore, I will not spend a great deal of time elaborating on them.

As Asongwed and Hyman (1976) point out, once the monosyllabic roots which take prefixes are accounted for, the bisyllabic roots with prefixes and the monosyllabic roots without prefixes are simple to account for. For this reason, and in order to allow for easier comparison between the three languages in this study, I will not analyze forms other than the monosyllabic noun roots. I show the relevant data in (63). I have omitted the mid pitch prefixes since they pattern the same was as the high pitch prefixes. For this reason, I will assume that a morphotonemic process systematically lowers the pitch of a high tone on a noun prefix with the shape /\V\-/- Asongwed and Hyman (1976); Hyman (1986). This means that I can analyze both mid and high pitch prefixes as the same pattern.

In the examples below, we can observe two common patterns, in (63a) we see downstep and in

\[\text{\textsuperscript{6}}\text{In (63g), I am treating the sequence } 'CV\text{ as equivalent to the diacritic } C\hat{V}\text{. See (1) for a comprehensive list of symbols used in this paper.}\]
(63d) we see a final low tone falling in pitch. The first pattern, in (63a) contrasts with the same input in Medumba where we do not see downstep occurring. Additionally, we see contour formation in (63b) and (63h). The generalizations to be drawn from (63b) and (63h) differ though both result in a contour at the surface; (63b) shows that Ngamambo strives to preserve floating tones at the cost of associating multiple tones to one TBU. (63h) shows that Ngamambo prefers to have a high tone on the noun root; note that only the /L/. L/ root surfaces without some effect of high tone. Also note that in (63e), the floating low tone is deleted, showing the preference for high tones in another way. Similarly, (63g) displays an odd pattern which is open to interpretation. Either the associated root low tone is raised by the floating high, or we could posit a phenomenon like the tonal metathesis proposed for Dschang in which case the high tone associates to the TBU of the root low tone, displacing it, and is then lowered by the floating low (Hyman, 1985). Whichever option we choose, the observation that high tones will have more of an effect on noun roots remains true.

(63) Ngamambo Tone Patterns (Hyman, 1986)

a. / /H/ → [M] or [—]  
ex. n-dɔŋ ‘horn’

b. / /L/ H/ → [L ^H] or [—]  
ex. ñgwí ‘cloth’

c. / /L/ L H/ → [L H] or [—]  
ex. mbàp‘house’

d. / /L/ L/ → [L] or [—]  
ex. nthim ‘back’

e. / H- H / → [H- H] or [—]  
ex. rå-bëi ‘knives’

f. / H- H/ → [H- H] or [—]  
ex. rå-kôn ‘beds’

g. / H- L H/ → [H- ^M] or [—]  
ex. rå-k{i} ‘pots’

h. / H- L / → [H- H{L} or [—]  
ex. rå-bëm ‘bellies’
### 3.4 Summary

In this section I will return to the tone patterns shown for each language and compare them. Since we have taken each language to only make use of underlying high and low tones, it makes sense to compare their input forms, which will be similar because of this, with their outputs, which are quite varied. An additional fact which allows a comparison to be drawn is the common tone patterns shown below.

(64) Shared tone patterns

<table>
<thead>
<tr>
<th></th>
<th>Medumba</th>
<th>Dschang</th>
<th>Ngamambo</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. L-L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. L-LH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. L-HL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. L-H</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since the proto-forms in (64) appear to be shared throughout the GB languages under investigation, we have a good base of comparison. The only mismatch between languages is the presence of high tone prefixes in Ngamambo; however, all three have low tone prefixes, we can still look at this set of data in a straightforward manner. In (65) below I have shown how every common tone pattern is realized in the languages under investigation. The underlying patterns are given in the first row, the realizations are given in following rows, preceded by the name of the language. Keep in mind that while Dschang has segmental noun prefixes with low tone, Medumba and Ngamambo only have floating low tone prefixes.

(65) Realization of common underlying tone patterns

<table>
<thead>
<tr>
<th></th>
<th>Medumba</th>
<th>Dschang</th>
<th>Ngamambo</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. L-L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. L-LH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. L-H</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. L-HL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examining the patterns above, we can compare the presence of three processes: lowering,
deletion and contour formation. Lowering refers to the realization of a high tone at a pitch lower than at the top of the pitch. Deletion refers to the presence of absence of a tone in the output, for now, if a tone appears to be lowered or prevented from falling, as in the case with floating low and high tones in some cases, we will consider it to not be deleted, since it effects the output. Contour tone formation refers to allowing multiple tones to attach to one TBU, resulting in a pitch rise or fall on one TBU. These effects are summarized in (66) below with cross-reference to the outputs shown in (65).

(66) GB tone properties

<table>
<thead>
<tr>
<th></th>
<th>Medumba</th>
<th>Dschang</th>
<th>Ngamambo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering</td>
<td>No lowering (65c)</td>
<td>Lowering of H tones (65d)</td>
<td>Lowering of M tones (63g)</td>
</tr>
<tr>
<td>Deletion</td>
<td>ﯧ tones deleted (65d)</td>
<td>No tone deletion (65b, d)</td>
<td>ﯧ tones deleted (65d)</td>
</tr>
<tr>
<td>Contours</td>
<td>No contour tones</td>
<td>No contours</td>
<td>Rising contour (65c)</td>
</tr>
</tbody>
</table>

We can observe that each language permits at least one of the processes and that Ngamambo exhibits all three. In terms of allowing an underlying tone to effect the surface form, Medumba is the least concerned with allowing every tone to effect the output while Dschang is the most stringent about preserving underlying tones in some way. No one property listed seem to entail another, that is, they are all independent. Having compared the three languages, we can see that though they do share common features, such as low tone pitch falling, floating tones, and only deleting low floating tones, they differ in other aspects. The contrasts shown above will become useful in formulating a proper analysis of these noun patterns.
Chapter 4

Analysis

This section contains tableaux making use of the constraints explained in the previous chapter. In section 4.1, I return to Optimality Theory and layout the constraints used in this analysis. In section 4.2, I will layout the full nominal paradigms of Medumba, Dschang and Ngamambo. Following the tableaux I provide a discussion of constraint rankings and possible alternative analysis in section 4.3.

4.1 Constraints

This section will return to the constraints necessary to account for the nominal paradigms of Grassfields Bantu languages. The core set of constraints, SPECIFY, *ASSOCIATE, *FLOAT, MAX-T, DEP-T and IDENT-IO(T) are taken from the analysis in Yip (2002) and Bickmore (1996). I will reproduce the definitions of these constraints from section 2.3 below.
(67)  

a. **DEP-ELEMENT**

Every tone must have a correspondent TBU

=**FLOAT**

b. **MAX-ET** (McCarthy and Prince, 1995)

Every tone-bearing element have a correspondent tone

=**SPECIFY** (T)

c. **MAX-IO** (T)

Every input tone must have a correspondent tone in the output

d. **DEP-IO** (T)

Every output tone must have a correspondent tone in the input

e. **ASSOCIATE** :

No new association lines may be added in the output.

f. **IDENT-IO(T)** :

Corresponding tones in the input and output have the same identity.

We will first need to relativize **ASSOCIATE** to the structures we have adopted to represent tone. This will give rise to two new constraints: **ASSOC-TBU** and **ASSOC-TRN**. In (68) I define these two constraints.

(68)  

a. **ASSOC-TBU**:  

No new association lines may be added to the output between a tone and the tone bearing unit.

b. **ASSOC-TRN**:  

No new association lines my be added to the output between a tone and the tonal root node.

These two constraints penalize both the creating of contour tones as well as the creation of downstep, respectively. One of the key interactions for GB is between **ASSOC-TRN** and
*FLOAT. While *ASSOC-TRN penalizes the creating of a downstep (or upstep), *FLOAT penalizes tones for being unattached. Of course, MAX-T prevents the deletion of floating tones. Therefore, the solution relies on the ranking of these three constraints. The possible rankings are given in (69) below.

(69)  a. *ASSOC-TRN>>*FLOAT>>MAX-T: Delete floating tones.
    b. *FLOAT>>*ASSOC-TRN>>MAX-T: Delete floating tones.
    c. *ASSOC-TRN>>MAX-T>>*FLOAT: Don’t downstep, let floating tones surface as contours.
    d. MAX-T>>*ASSOC-TRN>>*FLOAT: Don’t downstep, let floating tones surface as contours.
    e. *FLOAT>>MAX-T>>*ASSOC-TRN: Downstep.
    f. MAX-T>>*FLOAT>>*ASSOC-TRN: Downstep.

We can observe three outcomes of the rankings of these constraints. The first option is to simply delete floating tones, which is quite straightforward violation of faith to avoid markedness.

The second option is probably the most difficult to handle; in this option, we allow floating tones to remain unattached and surface in the output string. The issue here is that it’s not really clear what a floating tone in the output string means without stipulation. As we saw in chapter 2, floating high tones will prevent an otherwise word final low tone from falling. I will adopt this as a stipulation, since other geometry based approaches to preventing low tone fall are unavailable, see section 2.1.2 for a discussion of these options. This option must exist in all three languages since all have both level and falling low tones contrasting in utterance final position.

The third option is to simply allow a floating tone to attach to the TRN, causing downstep. This option is pretty straightforward and clearly must exist in Ngamambo and Dschang since we see downstep in the nominal paradigms of those two languages.

In order to allow for both downstep and floating high tones to exist in a single language, I have made a slight refinement to the *FLOAT constraint. Namely, I have relativized it to H and L tone;
this is based on the observation that \( \mathbf{H} \) tones are less marked than \( \mathbf{L} \) since floating high tones have been argued to exist for all non-falling low tones in GB. This suggests that at the very least the identity of the tone effects how marked it is for it to float. In (70) I show these two relativized constraints.

\[(70)\]
\[\begin{align*}
\text{a. } & \text{*FLOAT-H:} \\
& \text{Every high tone must be attached to a TBU (at the TN or TRN).} \\
\text{b. } & \text{*FLOAT-L:} \\
& \text{Every low tone must be attached to a TBU (at the TN or TRN).}
\end{align*}\]

With these two constraints in place we can make sure that downstep occurs thanks to a high ranked *FLOAT-L while the distinction between level and falling low is preserved due to a very low ranked *FLOAT-H. The evidence for the split between these two constraints comes from the very clear difference in how floating low and floating high tones are treated. Both Yip (2002) and Bickmore (1996) use markedness constrains against high and low tones separately to capture that fact that in some languages high tones should not be inserted and other nuances in the treatment of highs and lows.

One final modification, which will allow our analysis to be more fine-grained is splitting the MAX-T constraint into a relativized pair, as we did with *FLOAT. I show this in (71) below.

\[(71)\]
\[\begin{align*}
\text{a. } & \text{MAX-L:} \\
& \text{Every low tone in the input must have a corresponding low tone in the output.} \\
\text{b. } & \text{MAX-H:} \\
& \text{Every high tone in the input must have a corresponding high tone in the output.}
\end{align*}\]

These two constrain are motivated by the same observations that motivated the split in (70). Having both *FLOAT and MAX-T relativized allows to capture more fine-grained distinctions in the behaviors of high and low tones.

In this section I have introduced most of the constraints necessary to account for the Grassfields Bantu data presented in chapter 2. I have gone over the basic interactions between constraints and
given internal motivation for why we should use these constrains. In the next section I will utilize these constrains to account for the nominal paradigms of Medumba, Dschang and Ngamambo.

4.2 Analyses

In this section I will present an analysis of Medumba, Dschang and Ngamambo nouns in their citation forms. At the beginning of every section I will provide the ranking of crucial constraints. The tableaux in this section are presented in the same order that the languages were in chapter 2; that is, Medumba, Dschang and Ngamambo. Tableaux for each language are ordered by prefix tone (for Ngamambo), L then H, and then by root tone pattern, HL, H, LH then L. Where relevant I give specific structures for inputs and outputs. Otherwise I use short hand and omit the tier structure. Optimal candidates are indicated with the $\ast$ symbol. Candidates which should have won but didn’t, i.e., the constraints didn’t choose them but they are the attested surface form, are indicated with a ⊗.

4.2.1 Medumba

As I noted in chapter 3, Medumba is at once very complex and very simple. Determining the underlying tone patterns and providing motivation for them is the complicated half; accounting for what the tones do in citation forms is quite simple. Since the outputs are universally high, level low or falling low, we really only need to account for the distinction between the two low tones.

Recall from chapter two that we adopt the stance that all low tones fall when they are utterance-final. This means that a level low is followed by a high floating tone. In (72) below I schematize the difference between level low, (72a) and falling low (72b) tones.
This means that we want to preserve floating high tones while getting rid of floating low tones (since they never have any discernible effect on outputs in the citation form). We can achieve this by ranking *FLOAT-L above MAX-T. In (73) I show the ranking of constraints for Medumba.

(73) Ordering of constraints for Medumba:

*ASSOC-TBU >> *FLOAT-L >> *ASSOC-TRN >> MAX-T >> *FLOAT-H

High Tone Roots

The first form we examine will be the [HŁ] root. Recall that every form has a Ł prefix in Medumba. The string [Ł-HŁ] surfaces with a high pitch on the only syllable, [Ł-Ł]. This means that the two floating low tones must be deleted. Presumably they could surface as floating tones and there would be no change in the surface pitch.

I have included the non-essential constraints SPECIFY and IDENT-IO(T). The candidates in (74 a-c) show that violations of either of these two constraints immediately rules out a candidate. The winning candidate ultimately violates MAX-T twice; however, since *FLOAT-L is more highly ranked, any candidate that did not delete a floating low tone from the output string would be worse.

I will discuss each candidate presented in this first tableaux. The first candidate in (74a) disassociates the root high tone, leaving the syllable underspecified for tone, therefore violating SPECIFY. The candidates in (74b-c) change the value of the L tone to H and H to L, respectively, meaning that the outputs are not identical to the input, and therefore violate IDENT-IO(T). The candidate in (74d) attaches the root low tone, forming a falling contour; this violates *ASSOC-
TBU as well as markedness constraints against contours. The candidate in (74e) similarly forms a complex contour, violating *ASSOC-TBU and markedness constrains which are not shown. The candidate in (74f), which is identical to the input form, has two violation of *FLOAT-L, which is worse than violating MAX-T. The candidate in (74g) only violates *FLOAT-L once, but the form in (74h), which does not violate *FLOAT-L at all, is the best output.

(74) See (52a) for examples.

<table>
<thead>
<tr>
<th>3u</th>
<th>SPECIFY</th>
<th>IDENT-IO(T)</th>
<th>*ASSOC-TBU</th>
<th>*FLOAT-L</th>
<th>MAX-T</th>
<th>*ASSOC-TRN</th>
<th>*FLOAT-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-H L</td>
<td>!</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H H L</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L L L</td>
<td>!</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L H L</td>
<td>!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L H L</td>
<td>**!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L H L</td>
<td>**!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- H</td>
<td>!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In (75) I have removed the non-essential constraints. In this case we are considering the input root [H] with a low prefix [L-]. The winning candidate, as in (74) must delete the floating low tone prefix. Since MAX-T is below *FLOAT-L this option is automatically the lest marked choice.
(75) See (52b) for examples.

|   | \textit{\text{mu}} | \textit{\text{ASSOC-}
\text{BU}} | \textit{\text{FLOAT-L}} | \textit{\text{ASSOC-}
\text{TRN}} | \textit{\text{MAX-T}} | \textit{\text{FLOAT-H}} |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. \textit{L H}</td>
<td>\textit{\text{!}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. \textit{L H}</td>
<td>\textit{\text{!}}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. \textit{- ʰH}</td>
<td></td>
<td></td>
<td>\textit{\text{!}}</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. \textit{- H}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>\textit{\text{!}}</td>
<td></td>
</tr>
</tbody>
</table>

**Low Tone Roots**

Moving on to low tone roots, the floating low tone prefix, \([\text{L-}]\) is no longer a concern since we assume that it is has historically fused with the low tone root, as discussed in chapter 3. Even if we do not accept this historical explanation we could propose the same solution as in the two cases above, where deleting a floating low is better than letting it float.

The first tableaux in (76) shows the root \([\text{LH}]\) which surfaces as a level low tone \([\text{—}]\). Since we assume that a low tone falls utterance- (and therefore word-) finally, we know that there must be some floating material following the low tone; given the underlying form above, the solution is clearly to allow the floating high tone to surface. Since \*\text{FLOAT-H} is more lowly ranked than \text{MAX-T} any deletion of the floating high tone will make the output worse than another output which preserved the floating tone.
(76) See (52c) for examples.

<table>
<thead>
<tr>
<th>( \text{ndun} )</th>
<th>( \text{*ASSOC-TBU} )</th>
<th>( \text{*FLOAT-L} )</th>
<th>( \text{*ASSOC-TRN} )</th>
<th>( \text{*MAX-T} )</th>
<th>( \text{*FLOAT-H} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>L ( \text{H} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. L H</td>
<td>( \ast )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ( \dagger ) L</td>
<td></td>
<td>( \ast )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. L</td>
<td></td>
<td></td>
<td>( \ast )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. L ( \text{H} )</td>
<td></td>
<td></td>
<td></td>
<td>( \ast )</td>
<td></td>
</tr>
</tbody>
</table>

The second low tone root tableaux in (77) shows a simple \([L]\) root without any prefix. Since there is nothing marked about a low tone, it can surface as identical to the input form. No material may be inserted due to a highly ranked \(\text{DEP-T}\), not shown in the tableaux. One of the properties of low tones is that they fall at an utterance boundary, and therefore it is expected that the pitch of (77 a) is a falling low \([\_\_\_\_\_\_\_]\). Additional candidates are included in order to demonstrate that any modification of existing material would be less acceptable than having the output be identical to the input. We may also assume that the output does violate a low ranked markedness constraint such as \(\ast L\), which penalizes low tones.

(77) See (52d) for examples.

<table>
<thead>
<tr>
<th>( \text{\textit{mvzn}} )</th>
<th>( \text{SPECIFY} )</th>
<th>( \text{*IDENT-IO(T)} )</th>
<th>( \text{*ASSOC-TBU} )</th>
<th>( \text{*FLOAT-L} )</th>
<th>( \text{*ASSOC-TRN} )</th>
<th>( \text{*MAX-T} )</th>
<th>( \text{*FLOAT-H} )</th>
<th>( \ast L )</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. ( \text{L} )</td>
<td>( \ast )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. H</td>
<td>( \ast )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

59
4.2.2 Dschang

In contrast to Medumba, Dschang allows floating low tones to effect the output. Specifically, floating low tones may attach to the tonal root node, causing downstep. Also note that unlike Medumba, the tone prefixes are not floating, and we do not need to worry about deleting or associating them. In (78) below I have shown the ranking of crucial constraints for Dschang.

(78) Ordering of constraints for Dschang:

*AASSOC-TBU>>*FLOAT-L>>*ASSOC-TRN>>MAX-T>>*FLOAT-H

We can allow for downstep by ranking *ASSOC-TRN below MAX-T, which captures the observation that floating tones would rather attach to a TRN than be deleted. Of course, ranking *FLOAT-L above both *ASSOC-TRN and MAX-T will assure that only floating low tones are forced to attach to a TRN while floating high tones are fairly acceptable. This last point is captured by the low ranking of *FLOAT-H. Recall from section 2.2.3 that a downstepped high tone is represented by a high tone with a low attached to the tonal node (TN) from either direction, as shown in (79), reproduced as (79) below.

(79) Structural representation of downstep

a. Regressive downstep

\[
\begin{array}{c}
\mu \\
\circ \\
\circ \\
\circ \\
H & \text{L}
\end{array}
\]

b. Progressive downstep

\[
\begin{array}{c}
\mu \\
\circ \\
\circ \\
\circ \\
\text{L} & H
\end{array}
\]

High Tone Roots

The first tableaux in (58a) shows the [H\text{L}] root with the [L-] prefix. Since the prefix has its own segment, we do not really need to concern ourselves with its behaviour; it does not spread from the
TBU that sponsors it. The string \([L-H\,\underline{L}]\) surfaces as a low tone followed by a slightly lowered high tone, \([\underline{\underline{L}}\underline{L}]\). This means that the floating low tone is not deleted, but rather lowers the high tone by attaching to the tonal root node. Note that we know the floating low does not attach to the tonal node and generate a mid tone because of the contextual behaviour of nouns of this shape. Namely, high tones following this noun will not surface with a pitch higher than it, meaning it sets the high tone ceiling. The highly ranked \(*FLOA T-L\) necessitates that the winning output will not let the floating low surface. Since \(MAX-T\) dominates \(*ASSOC-TRN\), it is a better solution to attach a low tone to a TRN than to delete it.

\[(80)\] See (58a) for examples.

<table>
<thead>
<tr>
<th></th>
<th>*ASSOC-TBU</th>
<th>*FLOAT-L</th>
<th>*ASSOC-TRN</th>
<th>*FLOAT-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>(L-H,\underline{L})</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b.</td>
<td>(L-H)</td>
<td>*!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>(L-\underline{\underline{H}})</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

The output of the second high tone root is more predictable as the input itself is well formed. As show in the tableaux in (81), the input \([L-H]\) does not violate any constraints if left unmodified. Attempting to spread the prefix low tone to either the TBU, as in (81a), or to the TN, as in (81b), would violate the relevant association constraints.
(81) See (58b) for examples.

<table>
<thead>
<tr>
<th>η-η̃i</th>
<th>ASSOC-TBU</th>
<th>MAX T</th>
<th>ASSOC-TRN</th>
<th>FLOAT-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-H</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| a. L-LH | *! | * |    |   |
| a. L-⁴H |  | *! |    |   |
| b. L-H  |  |    | * |   |

**Low Tone Roots**

The low tone roots in Dschang behave exactly like the low tone roots in Medumba. The simple [L] root surfaces as it, with the phonetic realization being a low falling pitch [__ __]. The [L̃H] root surfaces as a level low. Of course both roots appear before the level low prefix. I show the tableaux for [L-L̃H] in (82) below and for the sake of completeness, the tableaux for [L-L] in (83).

(82) See (58c) for examples.

<table>
<thead>
<tr>
<th>n-daz</th>
<th>ASSOC-TBU</th>
<th>MAX T</th>
<th>ASSOC-TRN</th>
<th>FLOAT-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>L-L̃H</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| a. L-L̃H | * | * | * |   |
| b. L-L  |  | *! |   |   |
| c. L-⁴L |  |    | *! |   |

Note that like the Medumba case, only a markedness constraint on low tones could be violated by the input in (83). However, this form would also violate an obligatory contour principal constraint, termed OCP here, since adjacent syllables bear identical tones.
(83) See (58d) for examples.

<table>
<thead>
<tr>
<th>mon-dzwi</th>
<th>L-</th>
<th>L</th>
<th>IDENT-IO(T)</th>
<th>*ASSOC-TBU</th>
<th>*FLOAT-L</th>
<th>MAX-T</th>
<th>*ASSOC-TRN</th>
<th>*FLOAT-H</th>
<th>OCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>L-</td>
<td>H</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>L-</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

4.2.3 Ngamambo

In addition to the familiar low tone prefixes, Ngamambo has high and mid tone prefixes. Regarding the mid tone prefixes, the argument set forth by Hyman (1986) is simply that a high tone on a vowel prefix will surface as a mid tone. This is slightly problematic since to obtain a mid tone we must link a low tone to the TN of the prefix high tone, as in (84) below where the inserted low tone is shown in bold.

(84) Structure of a mid tone

\[
\mu \\
\circ \\
\circ \\
H \quad L
\]

This insertion will clearly violate DEP-T. We therefore need a highly ranked constraint that penalizes high tones attached to a single vowel syllable; even this will not be enough since a simple deletion of the high tone will be a better repair than an insertion of a low tone and association to the tonal node. One solution available is to stipulate that toneless syllables in Ngamambo surface as mid but have a different underlying representation. I show this surface neutralization of distinct

\[1\]Keep in mind that tones attached to the Tonal Node are unordered; that is, the structure in (84) is equivalent to one in which the high tone is on the right and the low tone is on the left.
underlying forms in (85) below.

(85)  Mid pitch from two underlying structures

a. \[\mu \mid \circ \mid \circ \mid = [\_] \]
   \[H \quad L\]

b. \[\mu \mid \circ \mid \circ \mid = [\_] \]

Before attempting to account for Ngamambo, there are a few observations to set forth, these will motivate a further refinement of our constraints. Having relativized two constraints so far, the process should not be unfamiliar, and the facts that motivate it seem to form a conspiracy that separates both tone identity, and process directionality. First, consider the fully specified set of inputs and the corresponding outputs, shown in (86) below.
The first observation regarding Ngamambo is that there are no sequences of syllables with high followed by low tone, as shown in (87) below.
This suggests that the structure above is marked, and a constraint such as *HL, defined in (88), should be ranked relatively high.

(88) *HL:

A high tone mora may not be followed by a low tone mora.

The second observation is that no mid tones are downstepped or upstepped, no low tones are upstepped or downstepped and no high tones are upstepped or downstepped. This translates neatly into *ASSOC-TRN being very highly ranked. In Ngamambo, attaching to the TRN is not an option.

The third observation is that no output ever has a floating low tone in it. See forms in (86), specifically [H-H L] and all of the floating low tone prefix nouns. This means that, since many inputs have floating lows, *FLOAT-L is very highly ranked and MAX-L is relatively low.

The fourth observation is that every input high tone surfaces in the output. This translates very easily into a very high ranking of MAX-H.

The fifth observation is that it is better to form a mid tone than delete a floating low tone, and better to delete a floating low tone than downstep a mid. See the form [L-H L] for illustration of this fact; for now we will not address which low tone is attaching to the TN, but it is clear that the best solution is to attach one tone and delete the second, and not to attach one low to the TN and the other to the TRN or TBU. This fact motivates ranking *ASSOC-TRN (which is never violated) above *ASSOC-TN, above MAX-L. All three constraints of course are dominated by *FLOAT-L which drives the repair(s), essentially.
The final observation concerns a directionality effect. For both *ASSOC-TBU and *ASSOC-TN, one direction seems to be better than the other. Unfortunately, since attaching to the TRN is not as common, we cannot decide if there is a directional preference; presumably attaching to the TRN would pattern more like attaching to the TN than attaching to the TBU. In (89), repeated from (86a) and (86h), I show that there are only cases of progressive, i.e., left to right, attachment to the TBU.

(89) Progressive association to TBU

\[
\begin{array}{c}
a. \quad \mu \quad \mu \\
\circ \quad \circ \\
\circ \quad \rightarrow \\
\underline{\circ} \quad H \quad L \quad H \\
\end{array}
\begin{array}{c}
b. \quad \mu \quad \mu \quad \mu \quad \mu \\
\circ \quad \circ \quad \circ \quad \circ \\
\circ \quad \rightarrow \\
H \quad L \quad H \quad L
\end{array}
\]

Compare the above to (90), where I show analogous data for the TN, which suggests that regressive attachment is more preferred.

(90) Regressive association to TN

\[
\begin{array}{c}
\mu \quad \mu \\
\circ \quad \circ \\
\circ \quad \rightarrow \\
H \quad L \quad \underline{H}
\end{array}
\begin{array}{c}
\mu \quad \mu \\
\circ \quad \circ \\
\circ \quad \rightarrow \\
H \quad L \quad \underline{H}
\end{array}
\]

This leads us to conclude that in the otherwise ambiguous case of \([\underline{L}-H\underline{L}]\), the root floating low tone ought to be the one attaching to the TN and forming a mid tone. This is shown in (91) below.
(91) Regressive association to TN in \([\underline{\text{L-\text{H}}}]\) (to be revised)

\[
\begin{array}{ccc}
\mu & \mu & \mu \\
\circ & \circ & \circ \\
\circ & \rightarrow & \circ \\
\underline{\text{L}} & \text{H} & \underline{\text{L}} & \text{H} & \text{L}
\end{array}
\]

As a final complication, there is a tendency to preserve the prefix tone. This is evident by the fact that the prefix has not been segmentally deleted, as in Medumba, but still preserves in the cases of high and mid tone prefixes. For the low tone, the situation is a bit more nuanced. In one of the four cases it does appear that the prefix tone has survived. This cases are shown in (92) below with the prefix underlined.

(92) Prefix tone survives in output

\[
\begin{array}{c}
\mu \\
\circ \\
\circ \\
\underline{\text{L}} & \text{H}
\end{array}
\quad \rightarrow 
\begin{array}{c}
\text{L} \\
\circ \\
\text{H}
\end{array}
\]

We are now left to wonder if regressive association is actually occurring in the form shown in (91). Consider the second option in (93) below, where it seems that if the mid tone is formed using the prefix floating low tone, less violations are incurred; that is, it is better to preserve the prefix than to associate to the TN progressively.
Progressive assimilation to TN in $[\underline{\text{L}}-\text{H}\underline{\text{L}}]$ .

In the two cases where the prefix tone low does not appear in the output, it seems as if a high ranked constraint preventing a tone from linking to the root if the root tone is identical has caused the low tone to be left floating, and ultimately be deleted. This suggests that a constraint such as *ASSOC-IDENT, defined in (94a), dominates a faithfulness constraint like MAX-PREFIX, defined in (94b). This constraint will also prevent forming the contours $[\text{LM}], [\text{HM}], [\text{H}^+ \text{H}], [\text{H}^+ \text{L}], [\text{L}^+ \text{H}]$ and $[\text{L}^+ \text{L}]$ in any order, as well as preventing upstepping high tones and downstepping low tones.

(94)  

a. *ASSOC-IDENT:

A tone cannot associate to a mora that bears the an identical tone at any tier.

b. MAX-PREFIX:

A prefix tone in the input must have a corresponding tone in the output.

Having covered the observations, I show the ranking of constraints necessary for Ngamambo in (95). Comparing this order to Dschang and Medumba, there are far more constraints, which have been discussed above. *FLOAT-L still remains more highly ranked than *FLOAT-H, but is also more highly ranked than *ASSOC-TBU, which is the highest constraint for both Medumba and Dschang. All three languages have MAX-H as the lowest crucially ranked constraint. Like Dschang, *ASSOC-TRN is ranked above both MAX-H and MAX-L in Ngamambo (MAX-T in Dschang), allowing for downstep.
(95) Ordering of constraints for Ngamambo

*FLOAT-L>>*ASSOC-IDENT>>*ASSOC-TN(PROG)>>*RISE>>
*ASSOC-TRN>>MAX-PREFIX>>*ASSOC-TBU(REG)>>*HL>>
MAX-H>>*ASSOC-TBU(PROG)>>*ASSOC-TN(REG)>>MAX-L>>*FLOAT-H

There are two final points to be made regarding phonetics. Though Hyman (1986) claims that [L-H] surfaces as LM, I will propose that it is phonologically LH, but for co-articulatory purposes, produced as LM. Similarly, I propose that [H-LH] does not surface as [H-^M], but rather as [H-M] and for the purpose of dissimilation surfaces as [H-^M].

I will address the issues posed by mid tone prefixes after working through low and high tone prefixes, which have their own issues. I will begin with low tone prefixes, since these will have the most overlap with Medumba and Dschang where the only tone on a prefix is low. Then I will address high tone prefixes and finally mid tone prefixes.

**Low Tone Prefixes**

The first case, [L-HL], in (96) is the most unpredictable. It does not yield the observed output form given the constraint set I have proposed. The crux of the issue is that there is no principled way to decide when forming a mid tone is appropriate and when forming a contour, as in (97), is the correct output. Due to the fact that it is also sometimes better to delete floating tones that to form a mid tone, as in (100), we are left with the best option being a high tone. This prediction seems to make sense given what we have seen in Medumba and Ngamambo; however, Ngamambo apparently forms a mid tone in this situation. Another expected outcome may have been a down-stepped mid tone, given that we have two low tones. This option actually occurs only when we have a mid tone preceded by a high tone, which I claim is phonetic dissimilation. I will discuss the issues with this form in more depth in the next section.
The tableaux in (97) shows the form [\(\text{L}-\text{H}\text{L}\)]. This tableaux illustrates that \text{MAX-PREFIX} and \text{MAX-L} need to be separate. If \text{MAX-PREFIX} were actually just \text{MAX-L}, then it would have to be ranked below \(*\text{ASSOC-TN(\text{REG})}\) since we see cases, such as in (100), where it is better to delete a low tone than to create a mid tone. Note that this is one of the two cases where I claim that the optimal output is further modified by phonetic factors; though the output is a low-high contour, it surfaces as a low-mid contour. As there are no surface low-high contours in Ngamambo that I know of, I feel that this is an adequate explanation.
(97) See (63b) for examples.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>L-</td>
<td>H</td>
<td>*!</td>
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<td></td>
</tr>
<tr>
<td>a.</td>
<td>L- H</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>b.</td>
<td>LM</td>
<td>*!</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>M</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>d.</td>
<td>'H</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>H</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
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<tr>
<td>f.</td>
<td>LH</td>
<td></td>
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<td></td>
<td></td>
<td>*</td>
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</tr>
</tbody>
</table>

In the tableaux in (98), we see the [L[H]] root with a [(L-)] prefix. This surfaces much like other [L[H]] roots, as a level low tone, as in Medumba and Dschang, [——]. As we can see, the undominated *FLOAT-L prevents the floating prefix tone from existing in the output since *ASSOC-IDENT prevents spreading, therefore MAX-PREFIX must be violated. Even if a mid tone is created by associating the floating high tone regressively to the TN, and then the low tone prefix attached to the TBU, *ASSOC-IDENT would penalize the resulting output since it has a low tone associated to a mora with a low tone already on it (at the TN, as part of the mid tone).
(98) See (63c) for examples.

<table>
<thead>
<tr>
<th>m-bap</th>
<th>FLOAT-L</th>
<th>ASSOC-IDENT</th>
<th>ASSOC-TN(PROG)</th>
<th>RISE</th>
<th>ASSOC-TRN</th>
<th>MAX-PREFIX</th>
<th>ASSOC-TBU(REG)</th>
<th>MAX-H</th>
<th>ASSOC-TBU(PROG)</th>
<th>ASSOC-TN(REG)</th>
<th>MAX-L</th>
<th>*FLOAT-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{L}-\text{L} \text{H})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- a. \(\text{L}-\text{L} \text{H}\) *!
- b. \(\text{L}\text{M}\) *! * *
- c. \(\text{L}\text{L}\) *! * *
- d. \(\text{L}\text{M}\) *
- e. \(\text{L}\text{H}\) * *

The tableaux in (99) shows the form \([\text{L}\text{L}]\), which trivially surfaces as a falling low tone, \(\text{[L]}\). The winning candidate does violate both \text{MAX-PREFIX} and \text{MAX-L}, but both options are needed in order to avoid a violation of \(*\text{FLOAT-L}.*

(99) See (63d) for examples.

<table>
<thead>
<tr>
<th>n-jim</th>
<th>FLOAT-L</th>
<th>ASSOC-IDENT</th>
<th>ASSOC-TN(PROG)</th>
<th>RISE</th>
<th>ASSOC-TRN</th>
<th>MAX-PREFIX</th>
<th>ASSOC-TBU(REG)</th>
<th>MAX-H</th>
<th>ASSOC-TBU(PROG)</th>
<th>ASSOC-TN(REG)</th>
<th>MAX-L</th>
<th>*FLOAT-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{L}-\text{L})</td>
<td>*!</td>
<td></td>
<td></td>
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</tbody>
</table>

- a. \(\text{L}-\text{L}\) *!
- b. \(\text{L}\text{H}\) *

73
High Tone Prefixes

The high tone prefixed nouns are substantially easier to deal with since there will not be any violations of MAX-PREFIX, in fact, looking only at the high tone prefix nouns, we would think that MAX-PREFIX is not necessary. The first form in (100) involves a simple deletion of a floating tone, but does motivate the ordering of *ASSOC-TN(REG)>>MAX-L.

(100) See (63e) for examples.

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>H- H LL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>H- H LL</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>H- Ž H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>!*</td>
</tr>
<tr>
<td>c.</td>
<td>Žř H- H</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>*</td>
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</tbody>
</table>

The [H-H] form in (101) already satisfies all constraints on outputs and therefore surfaces identical to the input; nevertheless, this form, like the Dschang form in (1c), violates a low ranked OCP constraint.
(101) See (63f) for examples.

<table>
<thead>
<tr>
<th></th>
<th>IDENT-IO(T)</th>
<th>*FLOAT-L</th>
<th>*FLOAT-PROG</th>
<th>*ASSOC-IDENT</th>
<th>*ASSOC-TN(Prog)</th>
<th>*RISE</th>
<th>*ASSOC-TRN</th>
<th>MAX-PREFIX</th>
<th>MAX-TBU(Reg)</th>
<th>*ASSOC-TBU(Reg)</th>
<th>MAX-L</th>
<th>*ASSOC-TN(REG)</th>
<th>*FLOAT-H</th>
<th>OCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>H- L</td>
<td>*</td>
<td></td>
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<tr>
<td>b.</td>
<td>H- H</td>
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</table>

The form in (102), [L(H)] with a [H-] prefix, is interesting when compared to it’s [L-] prefix counterpart in (98). Recall that [L-] surfaced as a level low tone, [---]. In contrast, [H-L(H)] surfaces as a high tone followed by a lowered mid tone, [_____]. This is the second form which I have claimed is modified by phonetic factors after the phonology has chosen the best output. Note that the winning candidate is [H-M] and not [H-1M]. I have less solid ground for claiming this, but the description of phrasal interactions between M and 1M in Ngamambo is unclear; that is, it is unclear if a downstepped mid tone actually lowers the mid tone ceiling. If it does indeed, then I would need to refine this stance. Otherwise, it seems to be acceptable to claim that the mid tone is lowered slightly following a high tone in order to make this output distinct from [H-H] and in order to make the distinction between high and mid tones more salient.
The form in (103), [H-L] necessitated its own constraint in order to drive the spreading of the prefix high tone onto the root syllable. *HL forces the input to be modified and the least marked change is simply to spread the prefix tone over one syllable. This captures the very common process of perseveratory spreading.
4.3 Discussion

In this section I will review the analysis per language and across languages. Before doing so, I would like to return to one of the goals of this paper, namely, using OT to get at typological information about Grassfields Bantu languages. The primary method of comparison that OT allows is through contrasting constraint rankings; in the case of GB languages, we can show that Medumba and Dschang are more similar to each other than either is to Ngamambo in a qualitative manner. Ngamambo requires splitting and ranking a variety of *ASSOCIATE constraints which are more collapsed in the Mbam-Nkam languages. Likewise, the difference between Medumba and Dschang is a simple reranking of two constraints. I will explore the details of each ranking below.

Since the analysis of Ngamambo has issues of its own, I will begin by comparing the constraint orderings for Medumba and Dschang, the two Mbam-Nkam languages. The rest of this section is laid out as follows. In subsection 4.3.1, I compare and contrast Medumba and Dschang. In subsection 4.3.2, I discuss the issues raised by Ngamambo and what they mean for the typology of...
Grassfields Bantu languages. Finally, in section 4.3.3 I will discuss further avenues of research.

4.3.1 Comparing and contrasting Medumba and Dschang

There are several notable distinctions between Medumba and Dschang. Medumba has only floating tone prefixes, while Dschang has only segmentally attached prefixes; however, both only have low tone prefixes. Medumba does not allow downstep inside of a prosodic word, while Dschang appears to. This is shown in (104).

\[(104) \text{ Dschang: } /L-H|\rightarrow [L-^iH]\]
\[\text{Medumba: } /\underline{L}-H|\rightarrow [H]\]

These two distinctions are relevant in how floating tones are resolved. For Medumba, deleting a floating tone is more acceptable than attaching it to any node, TN, TRN or TBU. In contrast, attaching a floating tone to the TRN is more acceptable than deleting it (and incurring a penalty of MAX-L). Of course, this pertains to low floating tones, as high floating tones are not marked in comparison. I show the constraint rankings for Medumba and Dschang again in (105) and (106), respectively.

\[(105) \text{ Ordering of constraints for Medumba:}\]
\[^\star\text{ASSOC-TBU}>^\star\text{FLOAT-L}>^\star\text{ASSOC-TRN}>^\star\text{MAX-T}>^\star\text{FLOAT-H}\]

\[(106) \text{ Ordering of constraints for Dschang:}\]
\[^\star\text{ASSOC-TBU}>^\star\text{FLOAT-L}>^\star\text{MAX-T}>^\star\text{ASSOC-TRN}>^\star\text{FLOAT-H}\]

Other then the difference in ordering between MAX-T and ASSOC-TRN, there is no distinction in Dschang and Medumba. This is partially because part of the onus was set upon the underlying representations. Nevertheless, the two are closely related and we did not expect to find wildly different rankings given that their surface forms, degraded segments aside, look very similar.
4.3.2 Issues with Ngamambo

I will begin by addressing what did not work in my analysis. I believe this is as interesting as what did work. The form which I was unable to account for, \([\text{L}\text{-H}\text{-L}]\), surfaces with a mid tone, see (96). The underlying form of this mid tone is ambiguous. If we follow Hyman (1986), then the root floating low attached to the tonal node forming the mid tone. I have also adopted this option, though for different reasons. I motivate my account primarily from the limited observation that association of a tone to the tonal node occurs regressively, and if \([\text{L}\text{-H}\text{-L}]\) follows this trend, it should be the root floating low which combines with the root high to form the mid tone.

This decision is problematic because it predicts that mid tone formation should also occur in \([\text{H}\text{-H}\text{-L}]\); however, in this case we have a deletion of the low tone. There are two possible answers to this dilemma. First, in the case of \([\text{L}\text{-H}\text{-L}]\), the prefix floating low tone is actually attaching to the TN and the root floating low is being deleted. Second, we may have two sets of constraint rankings, one for high tone prefixes and one for low. The second option is less preferable, and the first has some secondary benefits. Among these benefits is that I have already proposed a MAX-PREFIX constraint, which has other motivation. If the prefix tone were the one responsible for the mid tone formation, then MAX-PREFIX would be satisfied as well. This solution bears further investigation; however there are other remnant issues which should be readdressed.

The two most difficult to accept stipulations I made in my analysis of Ngamambo are the phonetic rules which transform outputs. I show them in (107).

(107) Ngamab sto stipulations

a. /\text{LH}/ \rightarrow [\text{LM}]: high tones in rising contours are lowered to mid due to perseveratory coarticulation.

b. /\text{H.M}/ \rightarrow [\text{H}^4\text{M}]: mid tones are lowered when preceded by a high tone due to paradigmatic pressure and phonetic dissimilation.

The first of these two stipulations is not terribly difficult to accept. The alternative analysis, presented by Hyman (1986) involves spreading the low tone and then introducing a second low tone
to account for register lowering. This is clearly problematic when I have assumed a high ranked DEP-T constraint in this analysis. That aside, an analysis that does not require insertion of a tone to an otherwise licit string seems to be less attractive than one which accounts for these facts at the phonetic level.

We could test this stipulation if we could place the contour in question after a downstepped high or a downstepped mid. The problem is that there are no downstepped high tones in Ngamambo, and the status of downstepped mid tones is unclear. Regarding downstepped mid tones, it does seem that they exist in Ngamambo, and they seem to lower the mid tone ceiling from what has been described by Asongwed and Hyman (1976) and Hyman (1986); however, it’s not clear that they occur within a prosodic word. This would follow with the observation that Medumba does not allow downstep inside of a word, but does allow it at the phrasal level. This point requires further research and remains a weak point in the analysis of Ngamambo.

There are several conclusions to draw from the ranking of constraints in Ngamambo. I reproduce the ranking below.

(108) Ordering of constraints for Ngamambo


The first striking difference between Ngamambo and the Mbam-Nkam language is that contour tones are more permissible. In both Medumba and Dschang, *ASSOC-TBU is undominated. Furthermore, association to the tonal root node is far more acceptable in Dschang where we see MAX-T>*ASSOC-TRN in contrast to *ASSOC-TRN>MAX-T in Medumba and Ngamabo, albeit the MAX family is split in Ngamambo.

The other key difference between Ngamambo and the Mbam-Nkam languages is the evidence for directionality which is captures by the split in *ASSOC-TN and *ASSOC-TBU constrains. It would be interesting to find further evidence for directionality of tone effects, perhaps in other Momo languages; as far as I know this has not been explored.
We can also observe the common split ranking of FLOAT-T constraints, with *FLOAT-H lower than any other, capturing the fact that floating high tones are permissible. This is probably due to the rarity with which we find evidence for them underlingly.

### 4.3.3 Extending the paradigm

There are a few caveats to this analysis. The first is that I have only looked at words in isolation, following the assumption that lexical and phrasal phonology are not always identical (Pulleyblank, 1986). The second is that I have not allowed for any possible input to pass through the constraint sets presented in this paper.

Regarding the first, the goal of this study is to compare and contrast closely related languages; therefore, the data we are comparing must be somehow delimited. I assume that prosodic words are constituent units in each of these languages and therefore, whatever phonological process applies to them should be comparable to prosodic words in other languages, even if there is a distinction between word level and phrase level phonology.

Regarding the second, if we were to more seriously consider GEN, the aspect of OT which generates inputs, then the ranking of *FLOAT-H may need to be changed since it’s low ranking is partially successful due to the few number of forms which have floating high tone. On the other hand, there is only one context in which floating high tones are permissible, when preceded by an attached low tone at the edge of a word. I have neglected to really address the fact that only attested inputs have been evaluated in this study; for instance, all inputs satisfied SPECIFY and no inputs contained downstepped tones. For now, I will motivate this by elevating the importance of underlying forms, specifically the arguments formulated by Voorhoeve (1971), Hyman (1985) and Hyman (1986); nevertheless, the full extent of the predictions made by these constraint rankings should be more seriously be explored.

There are several directions to proceed from this point. The first is to more closely examine the tonal phonology of Ngamambo, drawing on other Momo languages for clarification and pursuing the apparent directionality effects noticed in this work. Additionally, more Grassfields Bantu lan-
guages can be examined with the same scope, making the typological generalizations of the study more robust. Finally, the paradigm could be expanded from only monosyllabic noun roots to all noun roots or even to the phrasal level. This last option would probably be the most time consuming as it would involve teasing apart phrasal and word level processes. In any case, the work to be done on Grassfields Bantu languages is far from over.
Chapter 5

Conclusion

In this paper I have looked at the nominal paradigm of three Grassfields Bantu languages. Two of those languages, Medumba and Dschang, are members of the Mbam-Nkam subgroup and exhibited very similar constraint rankings. The third language, Ngamambo, belongs to the Momo subgroup, and while it has some similar characteristics and rankings of constraints, the fact that it has synthetic mid tones made it quite different. Nevertheless, the analysis of Ngamambo revealed that directionality can be utilized in the association of tones to the tone bearing unit and tonal node. The prevalence of directionality based restrictions remains unclear, but further work on Momo languages may help expand our view of the situation.

In concluding this analysis, I first showed evidence for the complex underlying tones found in Grassfields Bantu. This important step let us see how underlying forms are similar historically, and then contrast how they are realized synchronically across languages.

As a representational tool, I adopted the hierarchical model of Hyman (1993), which makes use of nodes to capture different effects of tones on the mora, namely contour tone formation, level tone synthesis and register shift. The constraints employed in the analysis therefore made use of these nodes.

I finally concluded that, while there are some common Grassfield Bantu trends, the variation between languages is quite great. Where Dschang allows downstep inside of a word, neither
Ngamambo nor Medumba allow it. On the other hand, neither Dschang nor Medumba form mid tones, where Ngamambo does. Finally, Ngamambo allows contour tone formation where neither Medumba nor Dschang do.

Though some conclusions were drawn, the primary success of this paper is in identifying the diversity of tone processes in just Grassfields Bantu. Furthermore, the potential for directionality effects in tone is a rather unexplored area which seems to be available to use via Ngamambo and other Momo languages.


