Prosodic phonology in Nata

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Abstract

This dissertation describes primary data illustrating phonological alternations in Nata, a Lacustrine Bantu language spoken in the Mara region of Tanzania. The data presented in this work was elicited from native speakers of Nata, both in Canada, and in Tanzania. The primary focus of the dissertation is in describing and analyzing patterns of tone and vowel harmony in nominal forms. These particular phenomena were chosen because they are bounded by prosodic domains. I propose that these types of phonological patterns can be analyzed in an emergent framework, Lexical Allomorphy (Archangeli & Pulleyblank, 2015, 2016, 2017). This framework allows for phonotactic restrictions that apply globally in the phonological grammar, but also morpheme specific conditions which characterize the distribution of particular sounds with respect to that morpheme. Throughout the dissertation I demonstrate that such a framework is sufficient to account for a variety of forms.

Lay Summary

This dissertation discusses sound patterns in Nata, a minority language of Tanzania. The data in this dissertation is largely novel. The primary focus of this work is the restrictions on which syllable has high pitch (tone) within a word and which types of vowels can occur together within a word. The theoretical contribution of this dissertation is to demonstrate that an emergent approach to a phonological grammar yields a satisfactory analysis, while identifying puzzles in the system and challenging some notions of the dependency between parts of a word. The empirical contribution of this dissertation is an extensive description of the variety of ways a single unit of meaning (morpheme) can be pronounced in Nata.

Preface

Portions of chapter 4 were published as Anghelescu, Gambarage, Lam, and Pulleyblank (2017). I was responsible for primary data collection on nominal forms and assisted in writing sections relevant to that data in the aforementioned article. Gambarage was a linguistic consultant, assisted in the conceptual development, writing, and editing of the article. Lam was responsible for the primary data collection on verbal forms and assisted in the conceptual development of that section, as well as the writing and editing of the article. Pulleyblank assisted with the conceptual development, writing, and editing of the article. The fieldwork reported on in chapters 4 and 5 was covered by UBC Ethics Certificate # H16-01726.

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Abbreviations

AUG	augmentative
ASSOC	associative
COM	comitative
CM	class marker
DET	determiner
DIM	diminutive
EVAL	evaluative
LOC	locative
PL	plural
RT	root
SG	singular
ST	stem
TBU	tone bearing unit

Symbols

-	morpheme separator
( )	optional
*	unattested or unacceptable
!	fatal constraint violation
☞	optimal candidate
☹	actual form but non-optimal
ι	intonational phrase
ϕ	phrase
ω	word
C	consonant
G	glide
H	high tone
L	low tone
N	nasal
V	vowel

Acknowledgements

This dissertation is a culmination of efforts on the part of a number of people. Foremost among them are my committee, Douglas Pulleyblank, Gunnar Ólafur Hansson, and Rose-Marie Déchaine, who tirelessly helped guide me through this project, from fieldwork to conference presentations, to editing the final document. Besides them, my colleague and consultant, Joash Gambarage, provided endless hours of expertise and assistance. It has truly been a joy to contribute to the scholarship on Nata.

Before I ever arrived in British Columbia, my fascination with linguistics and African languages was fostered at Boston University by Professor Cathy O'Connor. Her field methods course with Ariane Ngabeu on Medumba set me down a path focused on phonology and tone in particular. My experience at BU was shaped for the better by working alongside Anna Belew, Nick Danis, and Katie Franich. Between UBC and BU, I had the pleasure to complete a MA at The University of Toronto. Thank you to my cohort, who endured endless presentations on tone, and to my advisor Professor Alexei Kochetov.

At UBC, I was lucky enough to work with many other talented students, within my own cohort, and many who followed. I wish I could explain how each of you kept me enthused and energized to keep working, but that would near certainly compose an entire volume; in lieu of that, I will say thank you to Michael Schwan, Blake Allen, Kevin McMullin, Stephanie Williams, James Crippen, Adriana Osa, and Oksana Tkachman; I could not have sustained myself without your contagious excitement for linguistics.

In addition to my peers and supervisors at UBC, I learned a tremendous amount about teaching and sharing information from being a TA for Kathleen Currie Hall. Eric Vatikiotis-Bateson was a good spirited source of criticism and wisdom who shaped much of my thought about language and academia early on in my stay at UBC; he is missed.

This work would be for naught without the many people who speak Nata and welcomed me to their land. Winyanya, his wife, and their family, along with Wasato and her husband made my stay comfortable and entertaining, not to mention keeping me well fed. Baunsa, Sarota, Peter (Mtabiri), Sabiti, Mugesi, and Wasato gave countless hours of their time to help myself and Joash Gambarage untangle patterns in Nata; for this I am eternally humbled and grateful.

I have been fortunate enough to share much of my academic journey at UBC with Natalie Weber and Ella Fund-Reznicek; they kept me sane for a good portion of it, and were constant listeners. My partner Nikki Martin has graciously shown patience without end for my work. Our dog Molu has contributed small breaks of sanity, as well as tangential frustrations. Besides them, my mother Doralina Anghelescu has been my most fervent cheerleader and supporter, not only in this project, but throughout life. Thanks mom!

My deepest thanks to every one listed and unlisted who has supported me, commented on my work, or been excited to discuss it with me.

Chapter 1

Introduction

1.1 Goals

This dissertation has three goals: documenting a variety of grammatical constructions in Nata, developing an analysis of tone and vowel harmony in Nata using lexical allomorphy, and suggesting further work.

Since work on Nata is relatively sparse, this dissertation presents the findings of a number of recent studies conducted with the same primary consultant (see Section 1.3 for more details on language consultants). The focus of this description is on phonology and morphology, particularly of nouns. Verbal tone and morphology is a notoriously complex issue in Eastern Bantu languages and while the data presented in this thesis sheds light on many aspects, it is not exhaustive.

1.1.1 Documentation

This work represents a unique collection of data gathered through collaborative work with a speaker-linguist, a wide array of students, and an excellent group of native speakers. The body of this work includes representative data sets which illustrate some core properties of nominal tone. In addition, the introduction and discussion chapters present smaller datasets on a variety of phenomena. Appendixes include a large set of elicitation based data points for reference.

1.1.2 Analysis

I employ a surface oriented theory of morpho-phonology: Lexical Allomorphy (Archangeli & Pulleyblank, 2015, 2016, 2017, 2021). This approach has at its core the idea that alternations can be described solely in terms of the relationships between the morphemes' surface forms. I have chosen to use this model to analyze Nata in order to offer a new approach to understanding tonal and vowel quality alternations, which are relatively well studied in generative phonology.

1.2 Organization

The remainder of this chapter covers the research methods employed and demographic information on Nata. I discuss where the language is spoken, the speakers of the language, and its endangerment.

Chapter 2 provides background on the phonological and morphological properties of Nata as well as theoretical framing for the analysis found in later chapters. In Chapter 3 I describe the model of grammar I adopt and how it relates syntax and phonology; I then examine how this is applied to relevant syntactic and morpho-phonological structures in Nata. In Chapter 4 I examine a variety of contexts which condition tonal alternations. In Chapter 5 I review the basic properties of vowel harmony and extend the analysis proposed by Gambarage and Pulleyblank, 2017 to additional morpho-syntactic constructions. Finally, in Chapter 6 I discuss a number of issues regarding Lexical Allomorphy, tone, and the morpho-phonology of Nata.

1.3 Methods and Materials

The majority of the data presented in this dissertation was collected during fieldwork in Nata Village, Tanzania from July to August of 2016; this fieldwork was supported by a SSHRC grant to Douglas Pulleyblank. The success of this research would not have been possible without the immense hospitality and friendship of the Winyanya family in Nata and the Gambarage family in Mugeta. Prior to this period, extensive elicitation was conducted with a single speaker, Joash Gambarage. This period began in May 2012, and was supported by graduate student grants from UBC as well as a SSHRC research grant to Douglas Pulleyblank. The following subsections describe the methods used in elicitation as well as the preparation and materials.

1.3.1 Preliminary work and NaWoG

The first stage of research that would become part of this work was conducted at the Linguistics Department in the University of British Columbia. In this stage I was extremely fortunate to be working with a consultant who was also a trained linguist.

I began by investigating nouns in isolation. The goal of this stage was to collect vocabulary items and begin to understand the basic phonotactics of Nata. Two structures were targeted: word shape and tone location.[1]

It was quickly determined that closed syllables (those with a coda consonant: CVC, CVVC) are non-existent in Nata.[2]. The possible position for each syllable in a word was determined by asking the consultant to generate forms that fit the structure. This process was repeated over the course of early elicitations until both the consultant and I felt certain that the syllable canon and restrictions on it were comprehensive over a large enough data set (200 nouns). In addition to generalizations about syllable shapes, it became clear that nouns had restrictions on their minimum size; this restriction is influenced by morphology, crucially flagging noun class 5 and 9 as exceptional (Lafon, 1994; Maho, 1999).[3]

Tone location was checked in parallel with word shape. Possible word shapes generated for the initial elicitation included high tones in all possible combinations across all syllable types. Within a short time it became clear that words contain at most one high in isolation; therefore we abandoned the search for words with multiple high tone syllables. Likewise, it became clear that short vowels never had contour tones and long vowels with high tone only had falling high tones or level high. The possible tone shapes for nouns was pared down to three types after eliciting a large enough dataset.

My research on Nata was greatly supplemented by a field methods course taught by Professor Rose-Marie Déchaine. The course began several months after the initial stage of research and filled in many gaps in my knowledge of the language. Research that began in the field methods course eventually transformed into the Nata Working Group (NaWoG), whose members have created (and published) a number of materials without which this dissertation would not have been possible.

1.3.2 Fieldwork

During the field methods and NaWoG stages, a great deal of data was collected. This included an extensive amount of verbal forms and many recorded utterances. A database of 200 nouns elicited by the author was supplemented with a word list from the Tanzanian Language Survey (Nurse & Philippson, 1975) and an Ikoma word list drawn from Higgins (2012). A database of 236 frames was created to target nouns in different syntactic structures; these frames drew heavily from data gathered by NaWoG. The frames crossed

[1]For a more extensive exploration of research methods on verbal tone, see Marlo (2013)

[2]See 2.1.2 for discussion on exceptional syllable structure, notably nasal syllables as in *Mma* 'mother' and the reduction of the first person subject marker *ni*

[3]See Section 3.4.2 for the forms of class 5 and 9 class markers. Further discussion and analysis of class 5 can be found in Section 4.4.2, Section 4.5.2, and Section 4.6.2 with respect to tone; discussion of and analysis of class 9 can be found in Section 4.4.2, Section 4.5.2, and Section 4.6.2 with respect to tone.

with the nouns created a script with more than 100,000 data points; therefore, the databases were used as a checklist to ensure an extensive set of combinations were investigated.

At some points the frames were altered in order to encompass novel data (adjectives, adverbs, proper names).[4]

Participants for fieldwork were selected from a pool of Nata speakers identified by a trusted council of elders as 'good speakers of traditional (without Swahili) Nata.' This was done partially in order to maintain an impartial status as the author was closely affiliated with the Winyanya family. As Nata is a highly multi-lingual community (people travel from across Tanzania for work), it is important that speakers were raised primarily speaking Nata as opposed to having married a Nata speaker and having some knowledge of lexical items, but, for instance, poor control of the tone patterns (*i.e.* replacing them with Swahili stress.) The council served to select such individuals. As a result, the age range of consultants is limited, reflecting only the speech of those 40 years and older. This is not to say that the Swahili-influenced speech of younger speakers is unworthy of investigation; however such an investigation goes beyond the scope of this project.

Meetings were conducted at the Winyanya homestead, where the author resided from July to August 2016. Due to the organization of Nata village, this location was known and easily accessible for participants. Elicitations lasted several hours in the morning and several hours in the evening, usually with a different speaker for each session. This schedule avoided speaker fatigue, researcher fatigue and did not require meetings to take place during mid-day heat.

The script for elicitation was generated from the aforementioned databases which allowed for rapid transcription of speakers' production. The script acted as a prediction to which annotations were made. Every elicitation session was recorded. Recording was done using an iPhone 6 with an Apple headset mic clipped near the neck of the consultant (either to a lapel or other piece of clothing). As the primary purpose of this work is not detailed phonetic study, this recorder was more than sufficient.

Elicitation was done in a number of ways: Nata-to-Nata (N-N) elicitation, where the author would present a sentence in Nata and ask for the speaker to produce a 'correct' pronunciation. English-to-Swahili-to-Nata (E-S-N), where the author would present a sentence or context to a translator (a native speaker of Nata, and Swahili who was also fluent in English); the translator would then present the material in Swahili and consultants would reply in Nata. Finally, English-to-Nata elicitation (E-N), where the author

[4] This is largely due to the fact that elicitation was done in conjunction with a native speaker, which allowed for on the fly modification; for instance, if a speaker preferred a particular adjective as a gloss for Swahili *kubwa* 'big', it was straightforward to admit variants on the expected Nata *mokóro* 'big, best'.

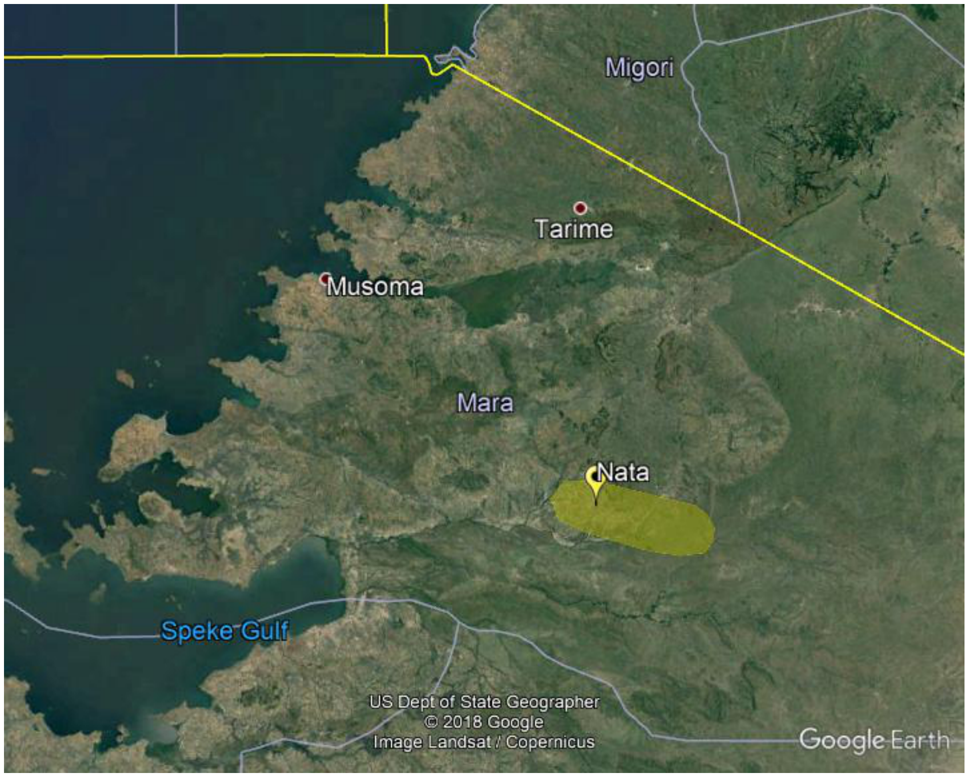


Figure 1.1: Nata and NTK area

would present material in English to a translator and the translator would then present that material in Nata. N-N elicitation is useful to checking paradigms. E-S-N is useful for contextual elicitation, as was often required for cases where the preprefix is omitted. E-N elicitation is useful for conversational elicitation, such as question-answer pairs. Beyond these three approaches to scripted elicitation, speakers often provided narratives or particular cultural knowledge.

1.4 Nata Demographics

Nata[5] is a Lacustrine Bantu language (JE45); it is mainly spoken in Nata Mbiso, Nata Motukeri, and Makondose (Serengeti District, Mara Region, northwestern Tanzania), with some speakers in Mugeta and Kyandege (Bunda District). The map in Figure 1.1 indicates Nata Mbiso, as well as a yellow highlighted area indicating where Nata, Ikoma, and Isenye, are spoken.

[5]Here and throughout, I refer to Bantu languages without prefixes, as this text is rendered in English. In Nata, the language is *ekináata*, and it's speakers *aβánaata*. In this text, the language is referred to as Nata, its speakers as Nata (people/speakers), and the name of the area in which primary fieldwork was conducted as Nata (village). Likewise (Ki)Swahili is referred to without a prefix, as are Ikoma and Isenye (among others.)

Nata is bordered to the east by the Ikoma language, to the west by the Isenye language, to the northwest by the Ngoreme language, and to the south by the Sukuma language. According to Muzale and Rugemalira (2008), there are 7,050 of speakers of Nata, based on 2002 population statistics from the National Bureau of Statistics, and fieldwork done in 2006. Aunio et al., 2019 reports 11,500 speakers, based on the same census data and independent fieldwork. In either case, Nata has slightly less speakers than Ikoma.

Nata is classified as JE45 by Maho (2009) in his update of Guthrie classification of Bantu languages. Nata is classified along with Ikoma and Isenye as a dialect continuum (with the ISO code NTK); however, recent research indicates that at least Nata and Ikoma differ significantly in their phonology (Anghelescu et al., 2017; Aunio, 2010, 2013, 2015; Gambarage & Pulleyblank, 2017; Higgins, 2012). Despite this, there is a high level of lexical similarity between the three dialects (Hill et al., 2007). Shetler (2007) presents two possible accounts of the migration of people into the Mara region. One account posits a common ancestry for Haya (JE22), Kerewe (JE24), Jita JE(25), Loogori (JE41), Kuria (JE43), Nata (JE45), Ikoma (JE45), and Isenye (JE45); the subgroup containing the ancestors of the Kuria, Loogori, Nata, Ikoma and Isenye migrated eastward, splitting again into the Kuria and Loogori north of the river Mara and the Nata, Ikoma and Isenye south of it. The second account posits a common ancestor for the Ngoreme (JE401), Nata (JE45), Ikoma (JE45), Isenya (JE45), and Sonjo (E41). This account states that the ancestors of these groups travelled westward to Lake Victoria.

Nata children acquire Swahili as their L1 (Mekacha, 1993). This shift has been recent and rapid. Within the same family, siblings in their 30s have Nata as L1, while siblings in their late teens have Swahili as L1. When parents address children in Nata, children respond in Swahili. Hill et al., 2007 note that Nata "has a certain amount of prestige attached to it by its speakers, but [...] its functional value and use are declining, possibly signalling the death of the language variety in the coming generations." Children exposed to Nata commonly make mistakes in prosody, assigning prominence (length, increased pitch) to penultimate syllables, presumably under influence from Swahili.

Speakers identify at least four varieties of Nata, based on clan and geography.[6] In the north, the Ekimasaabha dialect is spoken by the Abhamoriho clan. In the south, the Ekibhachuuta dialect is spoken by the Abhaghikwe clan. These varieties differ, for instance, in the amount of vowel devoicing, and morphology of the locative prefix. The Abhangirate clan and Abhusai clan have their own dialects, which differ, for

[6] Here, I use the Nata orthography to indicate the names of dialects/clans. These can be rendered in IPA as follows: Ekimasaabha [ekimasáaβa], Abhamoriho [aβamorihó], Ekibhachuuta [ekiβatʃúuta], Abhaghikwe [aβaɣíkwe], Abhangirate [aβaŋgiraté], and Abhusai [aβusái].

instance, in vowel harmony of prefixes. Where it is relevant in this work, I will mention distinctions in form and offer analyses to capture such variation.

Chapter 2

Background

2.1 Nata Phonology

This section describes the inventory of segments in Nata, as well as some phenomena which create alternations that are either relevant to prosodic domains, or else prevalent enough in the data at hand to be worth explaining. Throughout this section, I avoid delving too deeply into the prosodic domains themselves; instead, I use labels like prefix and stem, whose formal status I am not directly concerned with in this work. In Chapter 3 I discuss the syntactic constituents and their relation prosodic constituents, detailing the forms that are presented in the current section.

2.1.1 Segments

Vowels

Nata has seven vowel qualities which can all be either long or short; the fourteen contrastive vowels of Nata are shown in the chart below. Minimal pairs, pairs of words with distinct meanings that differ in only one segment, are provided as evidence of contrast between segments.[1]

[1]The notion of contrast is at least a century old. Sapir, 1925 describes the distinction between phonetic facts and phonological contrast, as does Saussure in his Course in General Linguistics (deGorog et al., 1959). See Dresher, 2011 for a modern treatment of contrast with a significant review of the concept of contrast in the history of phonology.

Table 2.1: Phonemic Vowel Inventory

		Front		Back	
		Short	Long	Short	Long
High	ATR	i	ii	u	uu
Mid	ATR	e	ee	o	oo
	RTR	ɛ	ɛɛ	ɔ	ɔɔ
Low	RTR	a	aa		

In Table 2.1, the horizontal lines separate the vowels into three heights: the high vowels [i, u]; the mid vowels [e, ɛ, o, ɔ] and the low vowel [a]. Note that the low vowel [a] does not share any patterned behaviour with either front or back vowels; for the sake of the chart, it is shown in the same column as front vowels.

Table 2.2 illustrates the contrastive relationship, based only on vowel quality (and not length), for each pair of vowels; for seven vowels, there are 21 combinations to consider (given that ordering and identical vowels are uninformative for this comparison).

Table 2.2: Vowel minimal pairs

	Form	Gloss	Form	Gloss
a.	kír-a	'be quiet!'	kér-a	'skip over s.o!'
b.	sír-a	'get finished!'	sɛ́r-a	'despise!'
c.	kír-a	'keep quiet!'	kúr-a	'burrow!'
d.	kír-a	'keep quiet!'	kór-a	'grow up!'
e.	kír-a	'keep quiet!'	kɔ́r-a	'do!'
f.	sír-a	'finished!'	sár-a	'snatch!'
g.	rér-a	'cry!'	rɛ́r-a	'raise s.o.!'
h.	kér-a	'skip over s.o!'	kúr-a	'burrow!'
i.	rér-a	'cry!'	rór-a	'be bitter!'
j.	rér-a	'cry!'	rɔ́r-a	'see!'
k.	kér-a	'skip over s.o!'	kár-a	'trick!'
l.	hɛ́r-a	'multiply!'	húr-a	'wash!'
m.	rɛ́r-a	'raise s.o.!'	rór-a	'be bitter!'
n.	rɛ́r-a	'raise s.o.!'	rɔ́r-a	'see!'
o.	mɛ́r-a	'germinate!'	már-a	'finish!'
p.	kúr-a	'burrow!'	kór-a	'grow up!'
q.	kúr-a	'burrow!'	kɔ́r-a	'do!'
r.	kúr-a	'burrow!'	kár-a	'trick s.o!'
s.	βór-a	'get lost!'	βɔ́r-a	'deteriorate!'
t.	βór-a	'get lost!'	βár-a	'count!'
u.	βɔ́r-a	'deteriorate!'	βár-a	'count'

Table 2.3: Vowel pairings with reference to examples in Table 2.2

	i	e	ɛ	u	o	ɔ	a
i	-	3 a.	3 b.	3 c.	3 d.	3 e.	3 f.
e	-	-	3 g.	3 h.	3 i.	3 j.	3 k.
ɛ	-	-	-	3 l.	3 m.	3 n.	3 o.
u	-	-	-	-	3 p.	3 q.	3 r.
o	-	-	-	-	-	3 s.	3 t.
ɔ	-	-	-	-	-	-	3 u.
a	-	-	-	-	-	-	-

All vowels can occur as short or long. A variety of morpho-phonological contexts involve long vowels (in generative terms: glide formation, prenasal lengthening, hiatus resolution).

There is no evidence that the low vowel interacts with either front or back vowels in a particular way; this distinction does not appear to be relevant for the low vowel.[2]

Ladefoged, 1964 illustrates that the position of the tongue root is relevant in making distinctions in the vowel systems of some African languages. The vowels [e] and [ɛ] differ in tongue root, and the phonological specification for tongue root; [e] is ATR, or advanced tongue root, while [ɛ] is RTR, or retracted tongue root. The same distinction separates [o] and [ɔ], respectively. The high vowels [i, u] pattern with advanced mid vowels in harmony alternations. The low vowel [a] patterns with retracted mid vowels. The relationship between these vowels, and the sense in which [i, u] pattern like advanced vowels, and [a] like a retracted vowel will be explored in Chapter 5.

Consonants

Nata has the inventory of consonants shown in Table 2.4. Sequences of two characters in the chart below, such as <nd> or <rw>, represent a single sound; in these cases a voiced prenasalized alveolar plosive and a labialized approximant, respectively. I will overview some alternations found in Nata; however, this is not an exhaustive study of consonant alternations or the contexts which condition them.

[2]The low vowel could be considered to lack any feature specification for front or back. In the terms of Dresher, 2009, the back/front dimension is not contrastive for the low vowel.

Table 2.4: Surface Consonant Inventory

	Labial	Alveolar	Palatal	Velar	Glottal
Plosive					
Voiceless Plain		t		k	
Voiceless labialized		tw		kw	
Voiceless palatalized				kj	
Voiced Pre-nasalized	mb	nd		ŋg	
Fricative	β	s	ʃ	ɣ	h
Labialized	βw	sw		ɣw	
Palatalized	βj			ɣj	
Affricate			tʃ		
Pre-nasalized			ɲtʃ		
Nasal	m	n	ɲ	ŋ	
Labialized	mw				
Palatalized	mj				
Approximant		r			
Labialized		rw			
Glide	w		j		

Nata has a small set of voiceless plosive consonants, [t, k]. Plosives surface voiced when prenasalized. The voiceless [t, k] alternate with [nd] and [ŋg], respectively. Likewise, the fricative [β] alternates with [mb], patterning like the plosives. See §2.1.4 for a brief discussion of alternations involving prenasalized segments. Voiceless velar plosives alternate with the voiced velar fricatives; see section 2.1.3 for additional data regarding 'voicing' alternations between segments.

The rhotic [r] is realized in a variety of ways, depending on speech rate and phonological context. It may be more trill like or more approximant like. This status is not uncommon in other Bantu languages, for instance Downing, 1990 reports a similar situation in Jita.

Two classes of conditions exist: speech rate and morphological context. An example of a speech rate conditioned alternation occurs in sequences of r-vowel-r where the intermediate vowel is elided in fast speech compared to careful speech and the resulting rhotic is a trill; take for instance the careful production [ɔmɔ́**ɹ**ɔ**ɹ**ɔ] ‘fire’ (c3) and the fast speech variant (with a trill) [ɔmɔ́**r**ɔ] ‘fire’ (c3).

An example of a morphologically conditioned alternation is found in at least one r-vowel-r stem: *rɔr* ‘see’; when followed by the final vowel -a, the stem surfaces with an r-V-r shape: [aka**ɹ**ɔ́**ɹ**a] ‘they (sg.) saw’; however, when followed by the extensional affix -*ire*, the stem surfaces with a palatal affricate: [taa**ɹ**ɔ**tʃ**ɛ́] ‘they (sg.) aren’t seeing’. Note that throughout this dissertation, these types of alternations will not be presented, and therefore a single symbol will be used to indicate these sounds: <r>.

The lateral approximant [l] is found in Swahili borrowings (*eg*. [omuwali] ’rice’ (c3)) and ethnonyms (*ex*. [omulagoori] ’Ragoori person’ (c1)). This issue is ripe for detailed acoustic and articulatory study, as it seems unlikely that simply ascribing free variation captures the nuances of the situation.

In this work, I interpret consonants with a vocalic offglide (*i.e.* labialized and palatalized consonants) as a singular segment, similar to prenasalized consonants. As we shall see in the following section, these two classes of segments also interact with syllable structure; when they occur in non-final position, they are followed by long vowels.

2.1.2 Syllables

Nata has two unambiguous syllable shapes: CV and CVV. This simple inventory relies on interpreting two types of potential sequences as complex segments; i) ^{N}C are treated as prenasalized consonants as opposed to a sequence of a nasal segment and consonant; ii) consonants followed by glides (C^{G}) are treated as consonants with either labial or palatal secondary articulation. An alternate analysis of these sequences would result in the following syllable shape inventory: CV, ^{N}CV, C^{G}VV, CVV.

Table 2.5: CV and CVV syllable shapes

Shape	Example	Gloss
CV	o**mo**té	‘tree’ (c3)
	o**βú**saro	‘beads’ (c14)
CVV	u**mwaa**ná	‘child’ (c1)
	a**ngwíi**na	‘crocodile’ (c9)
	eɣe**tee**té	‘spine’ (c7)
	oɣu**rée**sa	‘beard’ (c7)

Long vowels are found following consonants with secondary articulation ($C^{G}VV$) and preceding pre-nasalized consonants ($VV^{N}C$); short vowels are not found in these environments. This distribution is expected given patterns of vowel length in these positions, as Choti, 2015 documents in a variety of Bantu languages.

Table 2.6: Distribution of vowel length with respect to segmental context

Context	Example	Gloss
$C^{G}VV$	a**twíi**ga	‘giraffe’ (c9)
	i**kjɔ́ɔ**ndɛ	‘honey badger’ (c9)
$VV^{N}C$	orotʃ**uumb**é	‘cattle pen’ (c11)
	oroh**éend**e	‘lentils’ (c11)
$C^{G}V$	*a**twi**ga	
$V^{N}C$	*orotʃ**umb**e	

In utterance-final position, only short vowels, and not long vowels, are found. In all other positions, either long or short vowels are possible. If a syllable in utterance-final position has a C^{G} onset, it will not have a long vowel; in other words, the prohibition on long vowels in utterance-final position supersedes the general pattern in Table 2.6. In the example below, brackets represent phrase edges and hash marks represent utterance edges. The forms in Table 2.7 are single phrase utterances.

Table 2.7: Distribution of long vowels with respect to prosodic position

Position	Example	Gloss
Phrase Initial	[**tʃáa**ka]#	'lion' (c9)
	[**rii**simá]#	'pond' (c5)
Phrase Medial	[o**muu**kí]#	'girl' (c1)
	[omu**náa**ta]#	'Nata person' (c1)
Phrase Final	[a-ma-**rwá**]#	'beer' (c5)
Utterance-final	*[tʃáa**kaa**]#	
	*[riisi**máa**]#	
	*[ama**rwáa**]#	

In addition to these two syllable types, onsetless syllables occur phrase-initially in careful speech and utterance initially in both careful and rapid speech. In rapid speech vowel coalescence readjusts syllables to be either CV or CVV. Consider the nominals in Table 2.8: when they are utterance initial, they begin with an onsetless short vowel syllable; when they occur in rapid speech, this short vowel coalesces with the preceding verb *ni-*.

Table 2.8: Onsetless syllables utterance initially, and medially (in rapid and careful speech)

Example	Gloss
ikjaará	'finger' (c7)
niikjaará	'it's a/the finger' (rapid speech)
ni **i**kjaará	'it's a/the finger' (careful speech)
omoɣóondo	'farm' (c3)
noomoɣóondo	'it's a/the farm' (rapid speech)
ni **o**moɣóondo	'it's a/the farm' (careful speech)
amakára	'charcoal' (c6)
naamakára	'it's a/the charcoal' (rapid speech)
ni **a**makára	'it's a/the charcoal' (careful speech)

There are two types of onsetless syllables: those with short vowels and those with long vowels, V and VV. Onsetless syllables with long vowels are highly restricted: in addition to the utterance-initial restriction common to long and short onsetless syllables, onsetless syllables with long vowels only occur when they are part of a prosodic phrase that is bisyllabic. In terms of morphology, onsetless syllables with long vowels are strictly found as class 9 prefixes on nouns with monosyllabic roots.

Table 2.9: Utterance-initial onsetless syllables

Shape	Example	Gloss
V	**o**mukári	'woman' (c1)
V	**a**βakári	'women' (c2)
VV	**aa**swé	'fish' (c9)
VV	**áa**ngwe	'leopard' (c9)

2.1.3 Dahl's law

In Nata, voiceless velar obstruents, [k, kw, kj], alternate with voiced velar fricatives, [ɣ, ɣw, ɣj]; though only the plain series are used for illustration. This type of alternation is commonly observed in Eastern Bantu languages and referred to as Dahl's Law (Davy & Nurse, 1982; Lombardi, 1995; Odden, 1994). This alternation can be observed by focusing on the form of class prefixes which contain a velar obstruent; among these are classes 7, 12, and 15. These prefixes can occur with different stems; some stems begin with voiced consonants, while others with voiceless consonants. When occurring with a stem beginning with a voiced consonant, the prefix velar is voiceless.

Table 2.10: Voiceless velars in prefixes before stems with initial voiced consonants

Form (DET-CM-ST)	Gloss
e- **k**é -riβitʃi	'girdle' (c7)
a -**k**á -rɔrɔ	'fire (DIM)' (c12)
o- **k**ó -ɣoro	'leg' (c15)

Table 2.11: Voiced velars in prefixes before stems with initial voiceless consonants

Form (DET-CM-ST)	Gloss
e -**ɣ**e -kúβa	'chest' (c7)
a -**ɣ**á -tʃoɣu	'elephant (DIM)' (c12)
o- **ɣ**o -twé	'ear' (c15)

The result of this alternation is that sequences of voiceless velars followed by voiceless obstruents are not attested in Nata. This is not true of sequences of voiced velars followed by voiced obstruents, as the c20 prefix illustrates.

Table 2.12: Class 20 velar prefix

Form (DET-CM-ST)	Gloss
ɔ -**ɣ**ɔ́ -rɔrɔ	'fire AUG' (c20)
*ɔ -**k**ɔ́ -rɔrɔ	'fire AUG' (c20)
u -**ɣ**u -taaró	'river AUG' (c20)

Stems can be preceded by more than one prefix. In cases where multiple velar prefixes precede a stem, they will alternate in voicing. If the last (right-most) prefix is voiced, the second-to-last will be voiceless.

Table 2.13: Sequences of velar prefixes

Form (C15-(OM)-ST)	Gloss
ko -ɲw -á	'to drink'
ɣo -**k**í -ɲw -a	'to drink it' (c7)
ɣo -súkur -a	'to dump out'
ko- **ɣ**é -sukur -a	'to dump it out' (c7)

2.1.4 Prenasalized consonants

When nasals surface before other consonants they agree in place with the following obstruent consonant; this property of nasals is common to many Eastern Bantu languages, as Choti, 2015 catalogues. Additionally, nasals never act as tone bearing units. For these reasons, I treat sequences of nasals and homorganic consonants as a single prenasalized segment (as opposed to a distinct syllable, or a coda consonant). Downing, 2005b presents a coherent case for such a treatment for a number of Bantu languages.

In this section we investigate the realization of two morphemes which include nasals: the class 9 prefix, and the 1SG person prefix. Nata has the following prenasalized consonants: [mb, ŋg, nd], and [ntʃ], as illustrated in Table 2.14, focusing on noun stems.

Table 2.14: Prenasalized obstruents within morphemes

Form (DET-CM-ST)	Gloss
a-ma-ɲee**mb**é	'mango'
u-βw-oo**ŋg**ó	'brain'
o-ku-ɣee**nd**a	'traveling'
e-ɣe-sóo**ntʃ**o[3]	'plate'

[3]Prenasalization of the affricate [tʃ] is transcribed with an alveolar nasal : [ntʃ]. This transcription is at odds with a homorganic

Class 9

When the nominal stem begins with a vowel, the class 9 prefix surfaces as a postalveolar nasal, [ɲ]. When the stem begins with a consonant, the stem consonant is prenasalized.

Some stems begin with with [β, r, ɣ] when preceded by a non-nasal class marker; these same stems begin with a prenasalized stop [mb, nd, ŋg] when they are used in the c9 context. In other words, the segmental reflex of the c9 prefix is prenasalization of the initial stem consonant in such cases; this is indicated with morpheme breaks.

Table 2.15: Stems alternate between plain and prenasalized initial consonants

	Form (DET-CM-ST)	Gloss
[β]∼[mb]	a -ka -**β**órete	'goat (DIM)' (c12)
	a -**m** -**b**oréte	'goat' (c9)
[r]∼[nd]	a -ká -**r**oro	'pancreas (DIM)' (c12)
	a -**n** -**d**óro	'pancreas' (c9)
[ɣ]∼[ŋg]	a-ka -**ɣ**úβo	'hippopotamus (DIM)' (c12)
	a -**ŋ** -**g**uβó	'hippopotamus' (c9)

2.2 Theoretical Background

In this section I will describe the general model of grammar which I assume for the remainder of this work. I will then look in some detail at the phonological framework adopted in this dissertation. In the following chapter I will consider details of the syntactic framework.

Grammatical knowledge can be organized into a number of distinct modules which are separate but communicating systems. There are three modules: the syntactic, phonological, and semantic; the second of these is considered in depth in this work. Roughly, the three modules are organized in a Y shape, such that the output of syntax is available to both the phonological and semantic modules (Chomsky, 1995) .[4]

theory of prenasalization; however, it is not clear that this is an accurate rendering of the articulation. This topic requires further instrumental investigation; in this work I use the symbol <n> for the sake of consistency with other work published on Nata

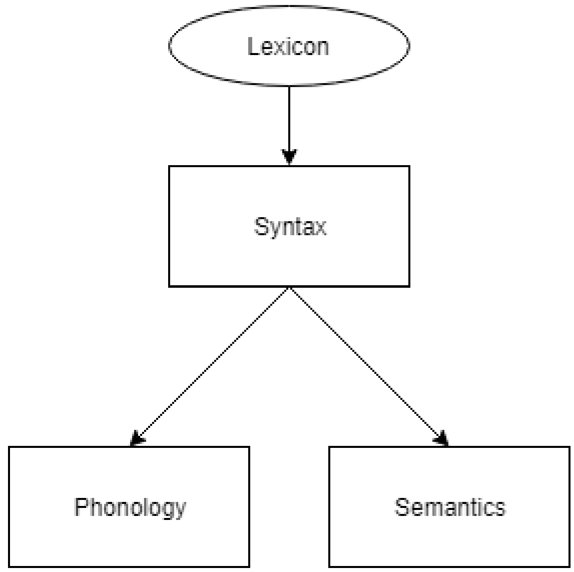


Figure 2.1: Y model of grammar

There is a restricted number of relations possible between the syntactic and phonological modules. Data that is not accounted for by such relations would point toward a modification of this modular approach.

The separation between syntax and phonology allows us to ask the question of what sort of interface the two modules have.[5] Crucially, observe that the phonological module cannot influence the syntactic module; the relationship is unidirectional such that the output of syntax must be the input of the phonology module.

The Lexicon exists in addition to the modules of grammar; it is involved with every module. I assume that the lexicon contains a set of lexical items. These items are pairs of sets of allomorphs and syntactic information. This model of the lexicon shares some features with Distributed Morphology (Marantz, 1997); specifically that there is no prelexical component of the grammar that forms "words". Instead, structures like words and phrases are composed by a singular syntactic mechanism. I return to this topic in the next chapter

In the next section, we will investigate the machinery of the phonological module of grammar. Though we will cover a range of phonological processes, the goal of this section is to understand the general mechanisms which will model both the mapping from syntax to prosody as well as the restrictions on how phono-

(Anghelescu, 2012; Anghelescu et al., 2017; Gambarage, 2012; Gambarage & Pulleyblank, 2017; Johannes, 2007).

[4]For an alternative approach to modelling language, consider (Jackendoff, 1997) proposed parallel model. Generally, the Y-model has less descriptive power, but is more concise in explanation (Irurtzun, 2009)

[5]One possible result would be that, in fact, the two modules are not separate and require direct interaction. I do not find strong evidence for such a claim.

logical elements interact with prosodic structures. I begin by reviewing constraint-based phonological grammars with a focus on alignment and indexed constraints. I supplement this approach by introducing Lexical Allomorphy, a surface-oriented theory of morpheme representation. I then outline a theory of prosodic domains and describe how it is instantiated in Nata.

2.2.1 Phonological Modelling

I adopt a constraint-based approach to modelling the phonological grammar of Nata. In this approach, phonological restrictions are encoded as constraints which are ranked and violable. Potential output forms are compared based on their violations of constraints, with the winning output being the one which violates the least highly ranked constraints.

In this section I review the classical architecture, propose a modification to lexical inputs, and detail alignment constraints, which are crucial for relating prosodic domains to segmental material (and vice versa), and indexed constraints, which essentially define classes of morphemes which differ in phonological implementation.

Optimality Theory

Optimality Theory formalizes phonological grammars as four major components: LEXICON, which contains all of the underlying forms for a language; CONSTRAINTS, which are a universal set of phonotactics[6]; GENERATOR, which creates the candidate output forms to be evaluated; and EVALUATOR, which assesses the violations of the candidate set in order to determine the optimal form (McCarthy & Prince, 1993; Prince & Smolensky, 1993/2004). These components function to choose a single optimal output form given a lexical input and a language specific ranking of constraints. For this dissertation, I make a different assumption about the nature of the lexicon and generator; therefore I will focus on the universal constraint set and their evaluation.

The universal constraint set represents the full range of statements (i.e. functions that evaluate the well-formedness of a phonological element) possible in a phonological grammar; the ranking of these constraints represents the phonological grammar of a particular language.[7] This follows the generative tradition of

[6]Classical OT constraints are not only phonotactics; they encompass a much broader range of functions over inputs and outputs. For the purpose of this exposition, I will not delve into the distinction between MARKEDNESS and FAITHFULNESS, nor will I consider the properties of inputs and outputs. This is because I do not adopt these properties from the classical model (Prince & Smolensky, 1993/2004).

[7]Rankings between constraints are referred to as crucial when the domination relationship makes a difference in selecting the optimal output over some other form. When the relationship is not crucial, the constraints are not crucially ranked; in tableaux this

parsimony and modularization in grammar; however, the specific form of these restrictions is a continually open question.

Evaluation functions as follows: for each candidate violations are assigned for each constraint. Beginning with the most highly ranked constraint, if a candidate has more violations of a constraint than some other candidate, it is eliminated from consideration. For each constraint this is repeated until a single form remains. This is the optimal output form.

In this dissertation, I adopt many of the familiar notation conventions found in Optimality Theory. A form is evaluated in a tableau, as shown in example (1). The anatomy of a tableau is as follows: the input is in the top left cell; arranged along the top row in descending order of rank are (a subset of) constraints; dashed vertical lines indicate no crucial ranking, while solid vertical lines indicate that the left constraint crucially dominates the right; in the left column, under the input, are the output candidates; the optimal candidate is indicated with a 👍 (thumbs up) symbol; in each row to the right of the candidate form and separated by a double vertical line is the evaluation for that candidate; violations are indicated with an * (asterisk); violations which remove a candidate from consideration are called 'fatal' and represented with an ! (exclamation point) following the violation mark.

(1) Anatomy of a tableau

[INPUT]	CON$_1$	CON$_2$	CON$_3$
👍 a. WINNER			*
b. LOSER$_1$	*!		
c. LOSER$_2$		*!	

In the tableau in (1), CONSTRAINT$_1$ (CON$_1$) crucially dominates (>>) CON$_2$, and CON$_2$ crucially dominates CONSTRAINT$_3$ (CON$_3$). In this tableaux, (1a.) is the winning candidate but still violates CONSTRAINT$_3$. Candidates in (1b. & c.) both violate more highly ranked constraints than CON$_3$. The candidate in (1b.) fatally violates CON$_1$, which is not violated by either of the other candidates; this removes (1b.) from consideration. The candidate in (2c.) fatally violates CON$_2$, which is not violated by the candidate in (1a.); this eliminates the candidate in (1c.), leaving (1a.) as the optimal output.

is indicated with a dashed line. Conceptually, non-crucially ranked constraints represent an analytical indeterminacy between two potential grammars for some languages. In an actual learned OT grammar for some language, constraints are all ranked.

2.2.2 Lexical Allomorphy

Input forms are phonological elements to be evaluated by the grammar. In the theory of Lexical Allomorphy (LA), input forms are represented by sets of observed (or inferred) surface forms for each morpheme. This approach contrasts with traditional approaches to generative phonology in which abstract underlying representations serve as the base for deriving surface forms for each morpheme (Archangeli & Pulleyblank, 2015, 2016, 2017). Furthermore, inputs include syntactic structure containing allomorph sets. In this section I motivate a surface based approach and demonstrate how this model is applied to allomorphs in Nata.

Allomorph sets are sets containing all of the surface forms of a particular morpheme and any morphs generated by redundancy (which we will turn to shortly). For example, in Nata, noun class prefixes with non-low vowels alternate between high, mid advanced, mid retracted vowels, and glides; consider class 3: {mu, mo, mɔ, mw}. These allomorphs are shown in Table 2.16.

Table 2.16: Noun class 3 prefixes

Form	Gloss
o-**mo**-té	'tree'
o-**mú**-nwa	'mouth'
ɔ-**mɔ**-tɔ́ɔŋg-ɔ	'string'
u-**mw**-aatɨ́	'medicine'

This set is not yet complete, as noun class prefixes may be either high or low toned. Combining these possibilities, the resulting allomorph set for class 3 is: {mu, mú, mo, mó, mɔ, mɔ́, mw}.

(2) Noun class 3 prefix allomorph set:

{mo, mó, mu, mú, mɔ, mɔ́, mw}

One difference between Lexical Allomorphy in contrast to traditional Optimality Theory is that the number of candidates is strictly defined by the shape of the lexicon (and not by GEN). Because morphemes are simply sets of all surface forms, the total candidate set for any form is the product of all of the allomorph sets. For example, consider the form [o-mo-té] 'tree' (c3); this form is composed of three morphemes. The allomorph sets for these morphemes are given below.

(3) Allomorph sets for the morphemes in [o-mo-té]

DET: {o, oo, óo, ɔ, ɔɔ, ɔ́ɔ}

C3: {mo, mó, mu, mú, mɔ, mɔ́, mw}

TREE: {té, te}

In order to generate the candidate forms, we generate the product of these three sets. In terms of number, this is equal to $6 * 7 * 2 = 84$ candidates. The full list of candidates is given below.

(4) Candidate set for the form [{o, oo, óo, ɔ, ɔɔ, ɔ́ɔ}+{mo, mó, mu, mú, mɔ, mɔ́, mw}+{té, te}]:

o-mu-té
o-mú-té
o-mo-té
o-mó-té
o-mɔ-té
o-mɔ́-té
o-mw-té
o-mu-te
o-mú-te
o-mo-te
o-mó-te
o-mɔ-te
o-mɔ́-te
o-mw-te
oo-mu-té
oo-mú-té
oo-mo-té
oo-mó-té
oo-mɔ-té
oo-mɔ́-té
oo-mw-té
oo-mu-te
oo-mú-te
oo-mo-te
oo-mó-te
oo-mɔ-te
oo-mɔ́-te
oo-mw-te
óo-mu-té
óo-mú-té
óo-mo-té
óo-mó-té
óo-mɔ-té
óo-mɔ́-té
óo-mw-té
óo-mu-te
óo-mú-te
óo-mo-te
óo-mó-te
óo-mɔ-te
óo-mɔ́-te
óo-mw-te
ɔ-mu-té
ɔ-mú-té
ɔ-mo-té
ɔ-mó-té
ɔ-mɔ-té
ɔ-mɔ́-té
ɔ-mw-té
ɔ-mu-te
ɔ-mú-te
ɔ-mo-te
ɔ-mó-te
ɔ-mɔ-te
ɔ-mɔ́-te
ɔ-mw-te
ɔɔ-mu-té
ɔɔ-mú-té
ɔɔ-mo-té
ɔɔ-mó-té
ɔɔ-mɔ-té
ɔɔ-mɔ́-té
ɔɔ-mw-té

ɔɔ-mu-te	ɔ́ɔ-mú-té	ɔ́ɔ-mo-te
ɔɔ-mú-te	ɔ́ɔ-mo-té	ɔ́ɔ-mó-te
ɔɔ-mo-te	ɔ́ɔ-mó-té	ɔ́ɔ-mɔ-te
ɔɔ-mó-te	ɔ́ɔ-mɔ-té	ɔ́ɔ-mɔ́-te
ɔɔ-mɔ-te	ɔ́ɔ-mɔ́-té	ɔ́ɔ-mw-te
ɔɔ-mɔ́-te	ɔ́ɔ-mw-té	
ɔɔ-mw-te	ɔ́ɔ-mu-te	
ɔ́ɔ-mu-té	ɔ́ɔ-mú-te	

As an analyst, it is possible to rapidly limit the problem space just by reducing the number of relevant determiner allomorphs. It is clear that the forms beginning with long vowels are never optimal in phrase-initial position; this cuts the candidate set in half, removing the forms that begin with long vowels: DET: {o, ɔ}. The long vowel allomorphs regularly occur when there is an additional nominal prefix preceding the determiner. It is also clear that the retracted determiner only occurs in a special harmony context, again cutting the set in half: DET: {o}. The resulting fourteen candidates (1*7*2=14) represent a more manageable and informative problem space, particularly for the account of high tone placement and (general) vowel harmony.

Practically, this procedure is undertaken regardless of the model of the lexicon; however, adopting an allomorphy based approach allows this procedure to be formalized in terms of a finite number of candidates. In other words, any formal analysis in OT shows only a relevant subset of forms for evaluation. No one considers the infinite set; therefore everyone must use some partitioning algorithm, likely similar to the one described above.

Throughout the remainder of this dissertation I will use abbreviated candidate sets; however, I will spell out allomorph sets, allowing the full candidate set to be generated for the interested reader. Generally, I will follow the same set of simplifying steps laid out above: removing candidates which have properties which never surface in the context under consideration.

Selectional Restrictions

In addition to phonotactics restricting the combinations of allomorphs, some morphemes require that an allomorph appear in a particular context. These restrictions generally require specific phonological content to precede or follow an allomorph. From the perspective of a learner these patterns are the first type of inference to be made; further learning then generalizes to account for phonotactics in place of morpheme specific restrictions. Nevertheless, grammars contain both the higher level generalizations, as well as morpheme specific restrictions.

Selectional restrictions are modelled as a condition on each morpheme which is either satisfied or not satisfied, following Archangeli and Pulleyblank, 2017. For example, the c9 prefix would be represented as in (5).

(5) Lexical entry for class 9/10 prefix

Sel:_L: This allomorph must be followed by a syllable associated with a low tone.

$\{N, \emptyset\}_{\_L}$ C9

The satisfaction of these restrictions is represented by the constraint SELECT. If a morpheme's selectional restriction is satisfied, then SELECT is not violated; however, if the morpheme appears in a context that does not satisfy its selectional restriction, then SELECT is violated.

In contrast to other theories, Lexical Allomorphy places all allomorphy inside of phonology in the sense that there is no pre-processing of forms based on syntactic contexts. Embick, 2010 describes Vocabulary Insertion as a process which inserts phonological structure at the syntactic level based on the local (syntactic) context. Consider the example of the English plural vocabulary items.

(6) Vocabulary items for tense (English) (adapted from (4) in (Embick, 2010))

T[past] ↔ [-t]/{LEAVE, BEND ...}_

T[past] ↔ [-∅]/{HIT, SING ...}_

T[past] ↔ [-d]

In contrast, the three allomorphs of T[past] would be modelled as members of the set of allomorphs for the T[past] morpheme; each of these would either select or be selected for (or both) by particular types of roots. For instance, the root HIT would select for a following [-∅] allomorph, as illustrated below. Note that there are some details about how present tense morphology would work out that are being omitted here.

(7) Lexical entries for English past tense construction

{d, -t, -∅} T[PAST]

$\{\text{hit}_{\text{Sel:\_T[past]}\emptyset}\}$ HIT

Another type of allomorphy exists, which is computed inside of the phonology. This type of allomorphy would be at play in the decision between English plural morphs like [-z, -s, and -əz]. The approach adopted in this paper collapses all allomorphy into the same type, computed inside of the phonology. Lexical allomorphy is not the only approach which places the onus of allophonic variation inside the phonological grammar. For a similar approach applied to Seenku tone sandhi, see McPherson, 2019.

Redundancy Relations

The lexicon is not entirely arbitrary. Learners are capable of forming generalizations over types of allomorphs for a given morpheme such that they can predict allomorphs they have not encountered by generalizing from similar morphemes. Following Archangeli and Pulleyblank, 2016 I refer to these as morph set relations (MSR) because they formalize which allomorphs can be predicted given a particular observation. These relationships capture patterned regularity found in a phonological grammar; in particular, similar morphemes share similar allomorph sets.

Let us consider a simple case of tone allomorphs. The prototypical Nata class marker prefix can be either high or low tone. We will see in detail the cases in which these allomorphs surface in Chapter 4. For a learner, this means that if they observe any class marker, they can predict at least one other allomorph than the observed one: if they observe a H allomorph, they may assume an L allomorph and vice versa.

(8) Systematic class marker relations (tone)

CV́	$\leftrightarrow$	CV̀
$[\text{mó}]_{C1}$	$\leftrightarrow$	$[\text{mò}]_{C1}$
	$\vdots$	

While this relation is straightforward, other allomorphs have more complicated redundancy relationships. In particular, stems have a more elaborate system of tonal allomorphs, and in general vowel harmony allomorphs are more nuanced. We will consider these cases in Chapter 4 and Chapter 5 respectively.

2.2.3 Alignment Constraints

The material in this dissertation is largely concerned with prosodic domains and their edges. ALIGNMENT constraints were developed to account for, among other things, relationships between morpheme edges (McCarthy & Prince, 1993); however, this mechanism has been extended to tone Cassimjee and Kisseberth,

1998. In this section I will explain the function of alignment constraints and illustrate the set of mapping constraints which reference syntactic structure.

Although we are specifically discussing alignment, more generally all constraints are formally expressible with the same schema in (9).

(9) General constraint schema (Zoll, 1996)

$\forall x(\mathrm{P}(x))$ where P is the phonological statement to be judged true or false

Alignment is a particular type of phonological statement that requires two elements to stand in the same relative position (i.e. an edge). Alignment constraints have the general form in (10a.); the Edge function is defined in (10b.)

(10) General form of an alignment constraint McCarthy and Prince (1993)

a. Align(Cat_1,Edge_1;Cat_2,Edge_2): $\forall$ Cat_1 $\exists$ Cat_2 such that Edge(Cat_1, Edge_1) and Edge(Cat_2, Edge_2) coincide.

b. Edge(x,{L,R}): The left/rightmost element in x

Zoll (1996) demonstrates that alignment should formally be composed of two functions: coincidence and precedence. Informally, COINCIDENCE evaluates if two elements are standing in the same position relative to some edge[8]; INTERVENTION returns violations for each element which occurs between two edges. In the definitions below, $y > x$ is read as 'y occurs after x'.

(11) COINCIDENCE and INTERVENTION (Adapted from Zoll (1996)[9])

COINCIDENCE(x,y): x and y coincide *iff* Edge(x,{L,R})=Edge(y, {L,R})

INTERVENTION(x,y): x (left-)intervenes between y and edge E *iff* $y > x >$E and $x \neq \emptyset$

Following McCarthy (2003), I model alignment using just the coincidence relation. The general motivation is simply that constraints which only compute coincidence are more restrictive than admitting constraints which consider precedence. More importantly, the data presented in this dissertation does not crucially require it evaluating precedence.

Consider the constraint below, a specific instance of the schema in (10a). Throughout this work, constraints are presented in an example with a full name, followed by a short name (used in tableaux and other

[8]The formulation of COINCIDENCE in terms of EDGE is essentially McCarthy and Prince, 1995's ANCHOR.

[9]Zoll, 1996 further distinguishes between left and right intervention, of which only left intervention is relevant for the Nata data.

environments where space saving is necessary) and definition. Formal evaluation statements will be provided for most constraints along with a prose description. When defining alignment constraints, **C** stands for the coincide relation.

(12) ALIGN(PHRASE, LEFT; HIGH, LEFT)
AL(ϕ,H): $\forall\phi\exists$ H **C**(Edge(ϕ,L), Edge(H,L))
For every phonological phrase, assign a violation mark if the left edge of that phrase does not coincide with the left edge of some high tone.

2.2.4 Morph preference conditions

In lexical allomorphy, phonological properties such as high tone, or vowel features are referenced in phonotactics prohibiting configurations (globally or contextually, as we shall see in particular cases). In addition, some constraints can reference a particular morphological property.

Archangeli and Pulleyblank, 2016 propose that for any allomorph of a morpheme that is labelled for a particular morpho-syntactic feature, there exists a preference condition that favours the marked morph in the context of the particular morpho-syntactic context. They claim that such a condition exists in the case of English irregular plurals.

In English, the regular plural morphology fails to surface in cases where a noun has an allomorph specified for the PLURAL feature, such as the form [fit] FOOT.PL (*[fʊt-s]FOOT-PL). The morph set for the noun FOOT is {fʊt, $\text{fit}_{\text{PLURAL}}$}. Because the morph $[\text{fit}]_{\text{PLURAL}}$ is marked for the PLURAL context, there automatically exists a preference condition, as shown below.

(13) English plural preference condition
fit>fʊt|PLURAL : The morph [fit] is preferred to the morph [fʊt] in the plural morphological context.

In English, another component of the irregular plural pattern has to do with the economy of morpho-syntactic feature expression by the phonology. Specifically, morphs like $[\text{fit}]_{\text{PLURAL}}$ is marked for the PLURAL feature, therefore a form which also includes an independent plural morpheme such as [fit-s] would violate a condition on morpho-syntactic features having a one-to-one correspondence with morph. In [fit-s], there are two morphs that correspond to plural]. Archangeli and Pulleyblank, 2016 refer to this condition as MANIFEST.

In the case of Nata, morph preference is relevant because some root forms are marked to occur only with particular class feature contexts. Unlike the English case in which MANIFEST penalizes multiple phonological elements which corresponding to a single morpho-syntacic feature, these cases involve multiple phonological elements being marked for matching class features. In a sense, MANIFEST is orthogonal to the Nata cases, because each individual morph does correspond to a distinct bundle of class features; what is crucial is that the distinct feature bundles of the root and pre-root morphemes have the same value. The effect of morph preference in the Nata cases is that morphs which are marked for a particular class context are preferred in the presence of that class marker prefix over unmarked morphs.

In general, MORPHPREF (MP) constraints evaluate a morpheme in a given morpho-syntactic context and assign a violation if the properly specified morph is not selected. We shall see the function of these constraints when we examine nominal tone. Consider the example below, which requires that class markers and roots match in class feature.

(14) MorphPref constraint

MORPHPREF:RT-DET: For a root morpheme, if it has an allomorph specified for a class feature, assign a violation mark if that allomorph is not used when in a ϕ preceded by a determiner with a matching class feature.

Note that not all allomorphs have a particular indexing for a particular class feature. In the case of Nata, most roots do not have any class indexing; only a particular subset of roots have a particular allomorph marked for a particular class, as we shall see in Section 4.4.

2.3 Summary

In this chapter we have looked at some crucial aspects of Nata: the sound inventory of the language, possible syllable shapes, and common alternations. In addition, we considered the theoretical underpinnings of this work: the complementary work of the syntactic and phonological modules, the basics of Optimality Theory, and of Lexical Allomorphy. In the following chapter I will consider in more detail the structure of Nata words and utterances, as mapped from syntactic structure to phonological structure.

Chapter 3

Syntax to Prosody Mapping

In this chapter I make a proposal for mapping syntactic structures to prosodic structures. I assume that prosodic (i.e. phonological) processes apply to prosodic domains, not directly to syntactic ones. Nevertheless, there is a correspondence between syntactic structure and prosodic structure. Studies with a similar perspective on how syntax and phonology interface include: Dobashi, 2003; Elfner, 2012; Hsu, 2016; Itô and Mester, 2009, 2012, 2013; Marvin, 2003; Newell, 2008; Pak, 2008; Poletto, 1998; Ross, 2011; Sande, 2017; Sandy, 2017; Varis, 2012; Šurkalović, 2015; Wang, 2014.

I begin by describing some properties of the syntactic module of grammar: how syntactic structures are built, what they are composed of, and how phonological forms are related to them. I then consider the mapping of nominal expressions: what is their syntactic structure, what are the constraints that relate that structure to a prosodic one, and how are optimal prosodic outputs chosen.

3.1 Syntactic Structures

The syntactic module of grammar is, in generative terms, designed to predict all and only the grammatical sentences of some language.[1] I adopt a variant of syntactic theory known as Minimalism. In a minimalist approach the function MERGE combines two elements and produces a labelled structure containing them (Adger, 2003; Chomsky, 2001).

(15) $\text{MERGE}(X,Y) \rightarrow \{X,\{X,Y\}\}$

[1]See Boeckx and Hornstein, 2010 for a conceptual history of syntax.

The formal definition in (15) illustrates that MERGE applied to the elements X and Y, results in a set with label X (though it could have been Y) containing the pair (X,Y). This can be represented using a tree, as in Figure 3.1.

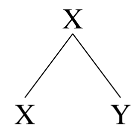


Figure 3.1: Output of MERGE(X,Y)

Syntactic elements are composed of features that encode information like category, person, number, gender, and tense. Features have values, for instance a number feature may be valued singular or plural, a category feature may be valued noun, and so on.

The lexicon contains sets of allomorphs and syntactic information, these are similar to ‘vocabulary items’ in terms of Marantz, 1997. The lexicon functions as a sort of dictionary which transforms the terminal nodes in syntactic structures into corresponding phonological material. As we saw in the previous chapter, this phonological material is modelled as a set of surface forms, of which the phonological module selects the single optimal form for the particular context.

Consider the categorized root *kári* WIFE, and two class markers which could potentially merge with this root; these are shown in Table 3.1, with an explanation following.

Table 3.1: Lexical entries

Label	P-Form[2]	S-Features
CLASS 1	mu	{Num:Sg ...}
CLASS 2	βa	{Num:Pl ...}
WIFE	kári	{*u*Num, Cat:n ...}

Before considering the specifics of the morphemes in (15), I will discuss some relevant aspects of syntactic features. Syntactic features drive the MERGE operation. Features come in two basic types: interpretable and uninterpretable. Uninterpretable features are notated with a ‘*u*’ preceding them. MERGE is motivated by the checking of uninterpretable features (Adger, 2003; Svenonius, 2006). In order to fill the value of an un-

[2] ‘P-Form’ is standing for the set of allomorphs for a particular morpheme.

interpretable feature, it must be adjacent to another feature bundle that has a value for that feature. Crucially, a syntactic derivation will fail if it contains uninterpretable features. Therefore, a successful derivation must result in the checking of all uninterpretable features.

Returning to the morphemes in (15), the root WIFE has an uninterpretable Number feature '*u*Num. This feature can be valued by applying the MERGE operation to the root and a class marker. Consider Class 1, which has a value Singular (Sg) for Number. The merger of WIFE and CLASS 1 is shown in Figure 3.2. I will discuss the syntactic labelling of such structures later in this chapter.

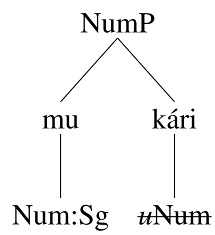


Figure 3.2: Output of MERGE(WIFE,CLASS 1)

3.2 Prosodic Structures

Prosodic domains are hierarchically organized units which the phonological grammar can reference. The conceptual development of these domains can be traced through several major works, beginning with Nespor and Vogel (1986) and Selkirk (1986).

The lowest level of the prosodic hierarchy is the mora, which is dominated by the syllable, which is in turn dominated by the foot. This dissertation focuses primarily on domains larger than the syllable and foot.

I adopt a relatively streamlined model which contains only three domains larger than the foot: word, phrase, and intonational phrase; this contrasts significantly with models which allow for sub-word domains, such as the prosodic macrostem and the prosodic stem.

It is crucial at this point to disambiguate some technical terms. 'Words' are technical in the sense of the prosodic word, as well as informal, in the sense of the string of segments which occur between white spaces. I refer to the Prosodic word as a ω-word, or simply ω. Informally, I sometimes refer to morphological words, prosodic words, and typographical words as 'words'. When the distinction is important, I specify the type of word; crucially, the prosodic unit is identified by the ω.

Likewise, linguistic theory is rife with many types of phrases; this dissertation is concerned with phonological and syntactic phrases. Following the convention of using Greek letters to label prosodic structures, I

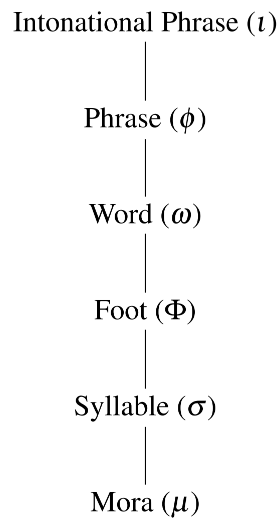


Figure 3.3: Prosodic hierarchy

refer to the Prosodic phrase as a ϕ-phrase, or simply ϕ. When referring to syntactic phrases, I will use the familiar 'XP' schema, where X stands for some type of phrase, for instance, DP, stands for a Determiner Phrase, nP stands for nominalizer Phrase.

Table 3.2: Key to prosodic constituents

Name	Short hand	Symbol
Prosodic Word	ω-word	ω
Prosodic Phrase	ϕ-phrase	ϕ
Intonational Phrase	ι-phrase	ι

The literature on Bantu languages often includes additional prosodic domains, such as the Prosodic Stem (Downing, 1999; Downing & Kadenge, 2020; Hyman, 2009b; Mudzingwa, 2010). Such a domain could be relevant in Nata, for example in reduplication; however, for the study at hand, the distinction between an inner domain (ω) and outer domain (ϕ) is sufficient to characterize the behaviour of nominal tone and vowel harmony.

3.3 Mapping

In this section I describe the syntactic structure of nouns and how that structure is related to prosodic domains. I will review the syntactic structure of nominal phrases (nPs), determiner phrases (DPs) and prepositional phrases (PPs); throughout this discussion I will provide a description of the forms involved in the structures.

I follow approaches like Selkirk, 2011 in assuming that the syntactic and prosodic hierarchies have a default mapping which is modulated by phonological constraints. Categorized phrases, nP and vP, map to prosodic words; this domain has a unique minimal size restriction which has been a topic of much work in Bantu languages (Downing, 1994, 1998, 1999, 2005a, 2006). Above the nP and vP, phrases such as NumP, DP, and PP, correspond to phonological phrase (ϕ-phrases).

Constraints which map from syntax to prosody are given in the example below. Note that analysis of more languages may suggest that these constraints represent a more general constraint relating classes of syntactic structures to specific prosodic structures. I do not take up the issue of morpho-syntactic natural classes in this work.

(16) Core Syntax to Prosody mapping constraints

Al(nP,ω): $\forall$ nP $\exists$ ω **C**(Edge(nP,L), Edge(ω,L))

For every nP, assign a violation mark if the left edge of that nP does not coincide with the left edge of some ω-word.

Al(NumP,ϕ): $\forall$ NumP $\exists$ ϕ **C**(Edge(NumP,L), Edge(ϕ,L))

For every NumP, assign a violation mark if the left edge of that NumP does not coincide with the left edge of some ϕ-phrase.

Al(DP,ϕ): $\forall$ DP $\exists$ ϕ **C**(Edge(DP,L), Edge(ϕ,L))

For every DP, assign a violation mark if the left edge of that DP does not coincide with the left edge of some ϕ-phrase.

Al(PP,ϕ): $\forall$ PP $\exists$ ϕ **C**(Edge(PP,L), Edge(ϕ,L))

For every PP, assign a violation mark if the left edge of that PP does not coincide with the left edge of some ϕ-phrase.

The optimal mapping generated by these constraints is illustrated in Figure 3.4. These structures satisfy each of the constraints given in (16) above.

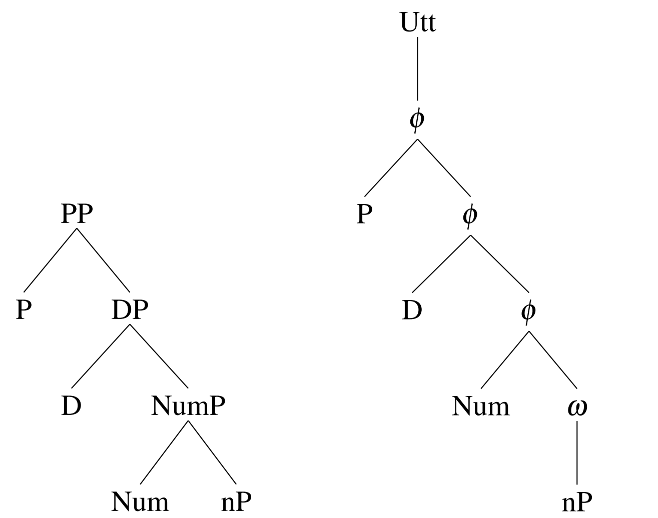


Figure 3.4: Syntactic structure of a prepositional phrase and default prosodic mapping

The prosodic structure shown in Figure 3.4 involves the recursion of ϕ in the sense that there are two ϕs that are dominated by other ϕs. In Nata, only the maximal ϕ is relevant; therefore, I assume a non-recursive structure. In the remainder of this work, I will only indicate the maximal ϕ.

To be explicit, there remains an open question of whether a constraint prohibiting the recursion of ϕ, *RECUR(ϕ), is ranked above or below the constraints in (16). If *RECUR(ϕ) is ranked above these constraints, then there will be no ϕ left edges corresponding to the DP or NumP in the cases when a PP exists, because there will only be one ϕ corresponding to the PP. If *RECUR(ϕ) is ranked below the constraints in (16), then there will be nested ϕs as illustrated in (16). In Nata, there is no evidence to support a low ranked *RECUR(ϕ); therefore, I rank it above the mapping constraints.

In Section 3.4 I will consider the internal constituents of the nominal, starting from the inside (nominal phrase), and moving up to the determiner phrase. In Section 3.5 I will consider prepositional prefixes, which are external to the nominal; I examine the associative, locative, and comitative.

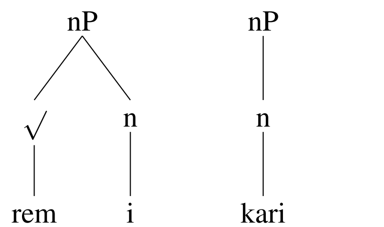
3.4 Internal nominal syntax

In the following subsections I describe the nominal Phrase (nP), Number Phrase (NumP), Determiner Phrase (DP). I list the types and forms of morphemes in these syntactic domains and illustrate how these domains are mapped to prosodic phrases.

The nP is either an a-categorical root merged with a categorizer (e.g. *rem* 'cultivate' + *i* 'agentive nominalizer'), as in (17a.); or an inherently categorized root (e.g. *kari* 'woman'), as in (17b.).[3] The structure in (17a.) is referred to as a derived or complex nP, while the structure in (17b.) is referred to as a simplex nP.

(17) Two types of nPs

a. Complex nP b. Simplex nP



Categorizers merge with a-categorical roots in order to satisfy an uninterpretable category feature on the roots. For categorized roots, there is no uninterpretable category feature and thus a categorizer cannot merge.

3.4.1 nP=ω

I will now focus on the internal syntax of the nP. There are four categorizing stem suffixes in Nata: -i, -ɔ, -u(/-βu), and -a. In the chart below I provide examples of stems in a variety of contexts.

Table 3.3: The root **ɣaamb** with different nominalizers

Form	Gloss
o-mú-**ɣaamb**-i	'speaker' (c1)
e-kí-**ɣaamb**-ɔ	'saying' (c7)
o-kú-**ɣaamb**-a	'to speak' (c15)

Déchaine et al., 2017 identify two compatible usages for the -i suffixes. The first is stative nominals with class 14 prefixes; these forms roughly have the meaning 'some state/quality of being X', where X is the

[3] There are several ways to model these two types of roots. The approach I suggest distinguishes a-categorical and categorical roots based on the presence or absence of the n feature. Nominal categorizers are distinguished from roots by lacking the non-category (n) features which both types of roots presumably contain. In other words, I assume that categorized roots have a category feature, plus some other features which define nominals that the categorizer lacks.

action denoted by the stem. These cases are all examples of nominals that do not have singular and plural forms. The second case is compatible with agent nominals with class 1/2 prefixes; these forms roughly have the meaning ‘some person who performs X’, where X is the action denoted by the stem.

Table 3.4: Stem suffix -i in the nominal domain

Form	Gloss
o-mó-ɣor-**i**	‘buyer’ (c1)
a-βá-ɣor-**i**	‘buyers’ (c2)
o-βó-ɣor-**i**	‘job of buying’ (c14)
o-mú-sɔm-**i**	‘educated person’ (c1)
a-βá-sɔm-**i**	‘educated people’ (c2)
o-βú-sɔm-**i**	‘literacy’ (c14)

The -ɔ suffix is compatible with instruments with either class 3/4 prefixes, or 7/8 prefixes; additionally, some examples are found in c11. These forms roughly have the meaning ‘some object used to perform X’, where X is the action denoted by the stem.

Table 3.5: Stem suffix -ɔ in the nominal domain

Form	Gloss
o-mó-tir-**ɔ**	‘ladder’ (c3)
e-mé-tir-**ɔ**	‘ladders’ (c4)
o-mó-tum-**ɔ**	‘seam’ (c3)
e-mé-tum-**ɔ**	‘seams’ (c4)
e-βí́-ɣaamb-**ɔ**	‘sayings’ (c8)
o-rú-ɣɛɛnd-**ɔ**	‘journey’ (c11)
o-ro-huuŋgur-**ɔ**	‘key’ (c11)

The -u suffix is compatible with patient nominals with either class 1/2 prefixes, or 7/8 prefixes; these forms roughly have the meaning 'some entity which undergoes X', where X is the action denoted by the stem.

Table 3.6: Stem suffix -u in the nominal domain

Form	Gloss
o-mu-sɛ́k-**u**	'person who is laughed at' (c1)
a-βa-sɛ́k-**u**	'people who are laughed at' (c2)
e-ke-mér-**u**	'thing which is swallowed' (c7)
e-βe-mér-**u**	'things which are swallowed' (c8)

Déchaine et al., 2017 identify two compatible readings for the -a suffixes. The first is compatible with event nominals with class 15 prefixes; these forms roughly have the meaning 'some X event', where X is the action denoted by the stem. The second is compatible with manner nominals with class 5/6 morphology; these forms roughly have the meaning 'the manner of performing X', where X is the action denoted by the stem.

Table 3.7: Stem suffix -a in the nominal domain

Form	Gloss
o-ko-mér-**a**	'act of swallowing' (c15)
r-ii-βin-**á**	'musical performance' (c5)

Turning to the mapping between nP and prosodic domains, I propose that the left edge of the noun stem (nP) is mapped to the left edge of a prosodic word (ω). The relevant constraint is reprinted from (16) above.

(18) nP to ω-word mapping

Al(nP,ω): $\forall$ nP $\exists$ ω **C**(Edge(nP,L), Edge(ω,L))

For every nP, assign a violation mark if the left edge of that nP does not coincide with the left edge of some ω-word.

This constraint is sufficient for the behavior of stems that begin with consonants and include two syllables or more. Consider the chart in (19) which illustrates how various forms are evaluated against Al(nP; ω). In the example below, the leftmost column shows syntactic bracketing, the second from the left shows prosodic bracketing and the third shows violation or satisfaction of AL(NP; ω)

Table 3.8: Al(nP; ω) and the ω-word: C-initial nP

Syntactic Form	Prosodic Form	Al(nP,ω)	Gloss
omó[$_{nP}$remi	omó[$_{\omega}$remi	✓	'farmer' (c1)
aβá[$_{nP}$remi	aβá[$_{\omega}$remi	✓	'farmers' (c2)
rii[$_{nP}$βurí	rii[$_{\omega}$βurí	✓	'feather' (c5)
amá[$_{nP}$βuri	amá[$_{\omega}$βuri	✓	'feathers' (c6)
oro[$_{nP}$síri	oro[$_{\omega}$síri	✓	'rope' (c11)
tʃaa[$_{nP}$sirí	tʃaa[$_{\omega}$sirí	✓	'ropes' (c10)

3.4.2 NumP

Bantu languages, including Nata, are well known for their extensive class systems, manifested by concordial prefixes on nouns, adjectives, and verbs, among others. I follow Déchaine et al., 2014 in analysing class as a feature which can be realized on Num, among other heads. I follow Carstens, 2008; Kramer, 2015, and Déchaine et al., 2014 in characterizing the class marker morphemes as the exponent of Num. Generally, Num merges with nP in order to satisfy an uninterpretable Number feature on the nP.[4]

Table 3.9 presents canonical singular and plural pairings of the noun classes[5], in Myers's (1987) terms, the genders.[6] Pairs are separated by a horizontal line. Plural classes are shaded for each pair.[7] The class prefix is in bold; for classes 9 and 10, where there are no bolded segments, the prefix is phonologically null.

[4]Because I treat Class as a feature hosted on syntactic heads, it is also the case that class is associated with inner nominal aspect/sort (to account for the mass reading of c14), Eval (to account for evaluative uses of the class prefixes, which notably never stack in Nata, as they do in Shona (Déchaine et al., 2014)), or Det (to account for honorifics.)

[5]I only consider noun class prefixes used in nominal classification. The locative prefixes in Nata occur before the determiner and class prefixes. I consider them separately in §3.5.2.The locative classes have been numbered 16 (ha), 17 (ko), and 18 (mo). The latter two function as prepositional prefixes while the former acts as the noun class for locations. Gambarage, 2019 points out that the locatives do not have the same agreement pattern with verbs and adjectives that other nouns do, supporting their separation.

[6]This subsection draws heavily from Johannes, 2007 with additional work from Gambarage and Pulleyblank, 2017 and my own field notes and elicitation with that author.

[7]Class 14 does not have a plural counterpart as it largely consists of mass nouns (and characteristics.)

For each noun class prefix, I illustrate each of its vowel quality allomorphs (ignoring tonal differences.)

Table 3.9: Noun class prefixes (=Num)

Class	Form	Gloss
c1	o-**mo**-súβe	'man'
	o-**mu**-kári	'woman'
	o-**mw**-íika	'killer'
c2	a-**βa**-súβe	'men'
	a-**β**-íika	'killers'
c3	o-**mo**-té	'tree'
	o-**mú**-nwa	'mouth'
	ɔ-**mɔ**-tɔ́ɔŋg-ɔ	'string'
	u-**mw**-aatí́	'medicine'
c4	e-**me**-té	'trees'
	e-**mi**-nwá	'mouths'
	ɛ-**mɛ**-tɔ́ɔŋg-ɔ	'strings'
	i-**mj**-aatí́	'medicines'
c5	ri-**i**-βurí́	'feather'
	e-**r**-iinɔ́	'tooth'
c6	a-**má**-βuri	'feathers'
	a-**m**-inɔ́	'teeth'
c7	e-**ɣé**-seku	'door'
	e-**ɣi**-saré	'twin'
	ɛ-**kɛ́**-mɛr-ɔ	'throat'
	i-**kj**-ɔ́ɔndɛ	'honey badger'
c8	e-**βé**-seku	'doors'
	e-**βi**-saré	'twins'
	ɛ-**βɛ́**-mɛr-ɔ	'throats'
	i-**βj**-ɔ́ɔndɛ	'honey badgers'

Class	Form	Gloss
c9	aa-swé	'fish'
	a-sáato	'tilapia'
	a-**m**-βáata	'duck'
	a-**n**-tʃɛ́ra	'path'
	a-**ŋ**-gokó	'chicken'
c10	tʃáá-saato	'tilapia'
	tʃáá-**m**-βaata	'duck'
	tʃáá-**n**-tʃɛra	'path'
	tʃaa-**ŋ**-gokó	'chicken'
c11	o-**ro**-sí́ri	'rope'
	o-**rú**-saro	'bead'
	ɔ-**rɔ**-hɔ́ɔŋg-ɔ́	'sieve'
	u-**rw**-aambé	'vapor'
c10	tʃaa-sirí́	'ropes'
c14	o-**βú**-saro	'beads'
c14	o-**βo**-kí́ma	'ugali'
	ɔ-**βɔ**-tɔ́ɔr-ɔ	'loads'
	u-**βw**-aaná	'childhood'
c15	o-**kó**-ɣoro	'leg'
	o-**ku**-βɔkɔ	'arm'
	o-**ɣw**-iitʃoreru	'flood'
c6	a-**má**-ɣoro	'legs'
c16	a-**ha**-ɣɛ́rɔ	'location'

3.4.3 DP=ϕ

We will now consider the Determiner Phrase. Determiners merge with NumP in order to satisfy a semantic requirement that entities have definiteness specified; to remain consistent, this can be modelled by an uninterpretable definiteness feature on nP being valued by merging nP and Det. Generally, the determiner is a vowel preceding the class marker prefix, as we shall see shortly; however, classes 5 and 10 occur with determiners that are consonant initial. We shall discuss the consonant initial forms here.

There are two types of determiners: i) a segmental allomorph (generally a vowel) preceding the class marker prefix, as we have seen already, and ii) a phonologically null determiner. The phonologically null determiner occurs in contexts where the speaker is not committing to existence of the nominal entity. In contrast, a speaker commits to the existence of an entity referred to by a nominal with a phonologically overt determiner (Gambarage, 2019). These constitute separate determiner morphemes, the selection of which is dependant on the intended meaning.

Table 3.10: Overt and phonologically null determiners

Example (DET-CM-STEM)		Gloss
o-	mo-sirikaré	'the/a policeman' (c1)
	mo-sirikaré	'no policeman' (c1)
o-	mó-rem-i	'the/a farmer' (c1)
	mó-rem-i	'no farmer' (c1)
o-	mu-kári	'the/a woman' (c1)
	mu-kári	'no woman' (c1)

I propose that the left edge of the DP is mapped to the left edge of a prosodic phrase (ϕ). The relevant constraint, in (19), is reprinted from (16) above.

(19) DP to ϕ-phrase mapping

Al(DP,ϕ): $\forall$ DP $\exists$ ω **C**(Edge(DP,L), Edge(ϕ,L))

For every DP, assign a violation mark if the left edge of that DP does not coincide with the left edge of some ϕ-phrase.

This constraint is sufficient for the behavior of DPs with determiners that begin with consonants: class 5 and class 10.

We will begin by considering class 5. Generally, class 5 nominals will have a CV-V-CV(CV…) shape. The interpretation of [ri-] as a DET is supported by alternations between ri- and ∅- which are parallel with the (semantic) alternations found with other determiners; specifically, the ∅-form determiner is used in non-existential contexts.

Table 3.11: ri-i-CV(CV...)

Form	Gloss
rí-í-βuri	‘feather’ (c5)
ri-i-sosó	‘lung’ (c5)
rí-i-to	‘leaf’ (c5)
ri-i-βú	‘ashes’ (c5)

The complementary distribution of overt and non-overt determiners acts as a diagnostic for identifying determiners. The overt determiner can be identified by contrasting a nominal in a positive frame (‘I saw X’) with that same nominal in a negative frame (‘I didn’t see any X’); the phonological material that occurs in the positive, but not negative frame, is the determiner.

Table 3.12: ri- is a determiner: ri-i-CVCV ∼ i-CVCV

Form	Gloss
omukári aɣatwá **rí-i-to**	‘the/a woman took **the/a leaf**’
omukári taagwiiré **i-to**	‘the/a woman didn’t take **any leaf**’

Class 5 nominals satisfy the DP to ϕ alignment phonotactic, as shown in Table 3.13.

Table 3.13: Al(DP; ϕ) and the ϕ-phrase: C-initial DP (c5)

Syntactic Form	Prosodic Form	Al(DP,ϕ)	Gloss
[$_{\text{DP}}$rííβuri	[$_{\phi}$ríí[$_{\omega}$βuri	✓	‘feather’ (c5)
[$_{\text{DP}}$riisosó	[$_{\phi}$rii[$_{\omega}$sosó	✓	‘lung’ (c5)

Class 10 forms have a determiner with the form tʃaa-. The same diagnostic which identifies the class 5 determiner can be applied to class 10. Compare the forms in Table 3.14 with those in Table 3.15.

Table 3.14: c10: tʃaa-[n, m, ŋ, ɲ, ∅]-CV(CV…)

Form	Gloss
tʃaa-swé	'fish' (pl.)
tʃáá-saato	'tilapias'
tʃáá-n-duɣi	'rats'
tʃáá-m-βaata	'ducks'
tʃaa-ŋ-gokó	'chickens'
tʃaa-ɲ-akwaahá	'armpits'

Table 3.15: tʃaa- is a determiner: tʃaa-(N-)… ∼ (N-)…

Form	Gloss
omukári aɣatwá **tʃaa-swé**	'the/a woman picked **some/the fish(pl)**'
omukári taaɲí **swé**	'the woman doesn't have **any fish**'
omukári aɣatwá **tʃaa-m-βorí**	'the/a woman picked **some/the goats**'
omukári taaɲí **m-βorí**	'the/a woman doesn't have **any goats**'

Class 10 nominals satisfy the alignment phonotactic, as shown in Table 3.16.

Table 3.16: Al(DP; ϕ) and the ϕ-phrase: C-initial DP (C10)

Syntactic Form	Prosodic Form	Al(DP,ϕ)	Gloss
[$_{\mathrm{DP}}$tʃáánduɣi	[$_\phi$tʃáá[$_\omega$nduɣi	✓	'rats' (c10)
[$_{\mathrm{DP}}$tʃáámβaata	[$_\phi$tʃáá[$_\omega$mβaata	✓	'ducks' (c10)
[$_{\mathrm{DP}}$tʃaaŋgokó	[$_\phi$tʃaa[$_\omega$ŋgokó	✓	'chickens' (c10)

Table 3.17: Alignment of ϕ-phrase edge in c1 with non-overt determiner

Syntactic Form	Prosodic Form	Al(DP,ϕ)	Al(NumP,ϕ)	Gloss
$[_{DP}\emptyset$ móremi	$[_{\phi}$mó$[_{\omega}$remi	✓	✓	'no farmer' (c1)
$[_{DP}\emptyset$ mukári	$[_{\phi}$mu$[_{\omega}$kári	✓	✓	'no woman' (c1)
$[_{DP}\emptyset$ mosirikaré	$[_{\phi}$mo$[_{\omega}$sirikaré	✓	✓	'no policeman' (c1)

We will return to the vowel-initial determiners when we consider the distribution of tone across nominals; as we shall see, the vowel-initial determiners are subject to a phonotactic which leads to misalignment between syntactic domains and prosodic ones.

3.5 External nominal syntax

In this section I will consider a set of cases that involve structures built on top of the nominal DP which we have seen thus far. The relevant morphemes are the associative, the comitative, and the locative. I treat these three as a single position class labelled Preposition, or Prep; these morphemes head preposition phrases (PP). The general structure for these phrases is given in Figure 3.5.

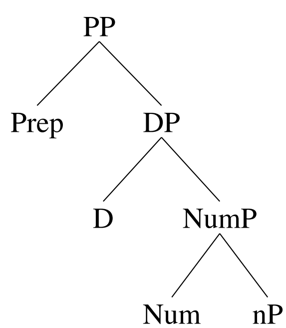


Figure 3.5: Syntactic structure of a prepositional phrase

3.5.1 Associative Prefix

The associative prefix marks a relationship between two nouns, which can range in meaning from possession to general association (Gregersen & Welmers, 1974; Van de Velde, 2013). The first of these nouns is the head noun. The associative prefix occurs on the second (non-head) noun and reflects the noun class of the head noun. The second noun is also referred to as the modifier. In this context, the head noun is the noun which which the verb agrees. The associative marker can occur with and without the DET.

Table 3.18: Associative construction

Form		Gloss
(DET-)CM$_1$-NSTEM$_1$ Head noun	ASSOC$_1$-(DET-)CM$_2$-NSTEM$_2$ Modifier noun	‘N$_1$ of N$_2$’

The tree representation of the full associative construction is given in Figure 3.6, with the Associative substituted for the generic preposition from the structure in Figure 3.5. Crucially, note that the head noun is merged with the PP headed by the associative-marked modifier noun.

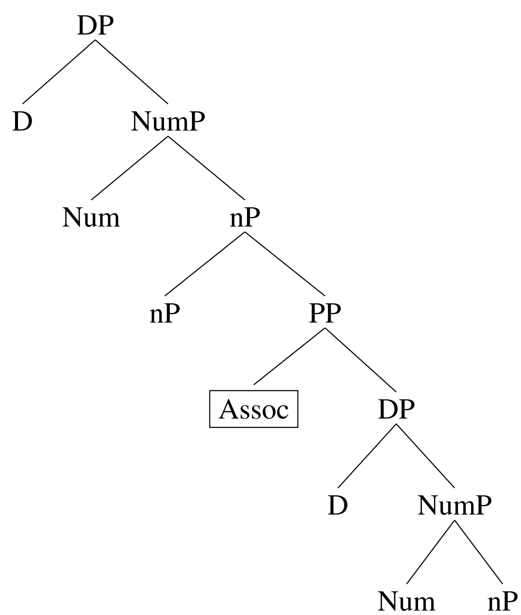


Figure 3.6: Syntactic structure of Associative Construction

The associative marker has two possible shapes for each class: CV- and C- shapes. The CV- forms for the associative can be deduced from examining consonant initial DPs. Class 5 and 10 DPs are special in that they begin with a consonant, as shown in Table 3.19.

Table 3.19: Consonant initial DPs

Form	Gloss
r-íí-βuri	'feather' (c5)
r-íí-to	'leaf' (c5)
tʃáá-n-tʃ ogu	'elephants' (c10)
tʃaa-ŋ-gokó	'chickens' (c10)

The data in Table 3.20 illustrates associative prefix forms corresponding to classes 1-11 heads with a class 5 modifier. The associative prefixes are displayed in bold.[8]

Table 3.20: Associative prefixes on c5 nouns

Context: DET-NUM-N **ASSOC**-rii-βuri

'N.c# of a feather.c5'

o-mu-kári	**wá**-r-ii-βuri	'woman.c1 of feather.c5'
a-βa-kári	**βá**-r-ii-βuri	'women.c2 of feather.c5'
o-mo-sís̍i	**wó**-r-ii-βuri	'tamarind tree.c3 of feather.c5'
e-me-sís̍i	**ɣé**-r-ii-βuri	'tamarind trees.c4 of feather.c5'
r-íí-βuri	**ré**-r-ii-βuri	'feather.c5 of feather.c5'
a-má-βuri	**ɣá**-r-ii-βuri	'feathers.c6 feather.c5'
e-ɣe-kúβa	**ɣé**-r-ii-βuri	'chest.c7 of feather.c5'
e-βe-kúβa	**βé**-r-ii-βuri	'chests.c8 of feather.c5'
a-kúru	**jé**-r-ii-βuri	'turtle.c9 of feather.c5'
o-ro-síri	**ró**-r-ii-βuri	'rope.c11 of feather.c5'

I propose that the left edge of the PP is mapped to the left edge of a prosodic phrase (ϕ). The relevant

[8]These forms are well formed utterances but are essentially word games insofar as there are not common or even specific items to which they refer. In other words, the concept of a 'tamarind tree of feather' is equally puzzling in English as the equivalent is in Nata.

constraint in (20) is reprinted from (16) above.

(20) PP to ϕ-phrase mapping

Al(PP,ϕ): $\forall$ PP $\exists$ ω **C**(Edge(PP,L), Edge(ϕ,L))

For every PP, assign a violation mark if the left edge of that DP does not coincide with the left edge of some ϕ-phrase.

This constraint accounts for the behaviour of all PPs, including the locative and nominative prepositions.

(21) Alignment of ϕ-phrase edge in complex form

	[$_{\text{PP}}${w, wo}+[$_{\text{DP}}${o, oo, óó}+ [$_{\text{NumP}}${mó, mo}+[$_{\text{NP}}${rem}+{i}]]]	AL(PP,ϕ)	AL(DP,ϕ)
☞	a. [$_{\iota}$[$_{\phi}$w-óó-mo-[$_{\omega}$rem-i		*
	b. [$_{\iota}$w-óó-[$_{\phi}$mo-[$_{\omega}$rem-i	*!	

3.5.2 Locative Prefix

The locative prefixes 'ku-' and 'mu-' add the meaning 'on N', or 'in N', to a noun they precede, respectively. The locative prefixes, unlike the associative and comitative, are restricted to occurring with the overt determiner. Although the cooccurrence of a locative prefix with a non-overt determiner is theoretically coherent, the context for such forms has yet to be discovered. See Gambarage, 2019 for more information on determiners and how they interact with locatives.

Table 3.21: Structure of a locative PP

Form	Gloss
LOC-DET-NUM-N	'on, in N'

The tree representation of a locative prepositional phrase is shown in Figure 3.7.

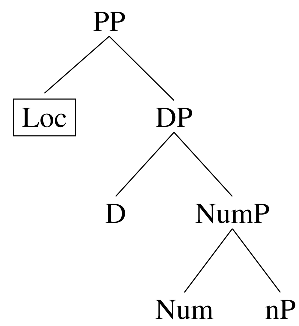


Figure 3.7: Syntactic structure of a Locative Prepositional Phrase

The locative prefixes share the same mapping as the associative and comitative prefixes. As we shall see in Chapter 4, all three of these prepositions behave the same with respect to tone assignment, precisely because they are form a single class for prosodic mapping purposes.

3.5.3 Comitative

Two nouns can be conjoined with the prefix 'na-'. This prefix is slightly different from locatives and assocaitves in that it results in different agreement with the conjoined nouns; for instance, a verb with a conjoined nominal subject may have a subject marker that does not match the class of either of the conjoined subjects. Below are some examples of nominals joined by the comitative prefix with nonovert and overt determiners.

Table 3.22: Comitative PPs

Form	Gloss
mu-kári ná-mɔ-rɔrɔ	'no woman and no fire' (c1, c3)
mó-rem-i na-ki-ɲaatá	'no farmer and no belt' (c1, c7)
o-mu-kári n-oo-mo-súβe	'woman and man' (c1, c1)

The comitative prefix, like the other prepositions, is mapped to a ϕ-phrase. Therefore, the comitative patterns like the other prepositions for tone assignment.

3.6 Mapping Summary

Only maximal ϕ and ω are relevant. The highest phrase of PP, DP, NumP, will map to maximal ϕ. NP maps to ω. These mappings are not violated.

Chapter 4

Tone

In this chapter I will discuss the phonological representation of tone, the tonal configurations of citation form nouns, noun phrases, and two exceptional class prefixes. The analysis of tone is composed of two general phonotactics requiring: i) that there is one and only one high tone per ϕ-phrase; and ii) that high tone is aligned as far to the left of the ϕ-phrase as possible. Some allomorphs impose additional requirements on tone: prepositional prefixes and the class 5 and class 9 prefixes. These aspects of the analysis are encoded in the lexical entries of these morphemes.

I begin in Section 4.1 with a brief overview on tone in phonology, followed by general properties of tone in Nata in Section 4.2. In Section 4.3 I layout the relevant prosodic structures for investigating nominal tone.

In Section 4.4 I focus on Low tone class. In Section 4.5 I focus on Final H tone class and in Section 4.6 I focus on Initial H tone class. For each class I consider basic nominals (with overt and null determiners), nouns in classes 5, 9, and 10, and finally nominals with prepositional prefixes as well as their interaction with determiners, and the aforementioned classes.

I conclude the chapter in Section 4.7, summarizing the properties and analysis of nominal tone in Nata.

4.1 Tone in Phonology

Welmers, 1959 is an early example of tone being considered as both a phonological and morphological object. That is, tone can be a property of a particular syllable, but it may also be the realization of a morpheme. Hyman, 2006, 2011; Hyman and Leben, 2001 provides a modern definition in the spirit of Welmers:

(22) "[A **tone language** is one] in which an indication of pitch enters into the lexical realization of at least some morphemes." (Hyman 2011:207)

"An indication of pitch" is meant to mean "tone features or any other analytical device whose only function is to characterize pitch" (Hyman, 2006). One of the interesting properties of this definition is that in order to be a tone language, tone must be introduced at the lexical level. In Nata, tonal allomorphs are present in the lexical entries of many morphemes, satisfying this description.

Tone has been recognized to have surprising properties in comparison to segmental phonology (Hyman, 2009a). For instance, tone melodies can be identified as stable elements, separate from their segmental hosts (Leben, 1978). The independence of tone from its host segment lead to proposals such as Goldsmith's (1975, 1976) autosegmental model. Yip, 2001 identifies the list of tone properties shown in Table 4.1.

Table 4.1: Tone properties (Yip, 2001 p. 65)

Property	Description
Mobility	Movement away from point of origin
Stability	Survival after loss of original host segment
One-to-many	A single tonal feature shared by two or more segments
Many-to-one	Multiple tonal features surfacing on a single host segment
Toneless segments	Potentially tone-bearing segments that never acquire phonological tone

These properties of tone are used to motivate an autosegmental account in which tone is autonomous from the segment (vowel, mora) that hosts it. Regarding Nata, mobility and stability are of interest as H tones are attracted to a particular edge, but only for some types of forms. At the syllable level, Nata permits only one-to-one association between syllables and high tones. In contrast, some Bantu languages allow a single high tone to link to many syllables (Downing, 1990; Kanerva, 1990). Nata permits many-to-one association at the syllable level: a H and L tone to both be linked to a single syllable, forming a contour (though LH is not permitted in Nata). Nata also permits one-to-many association at the mora level: a tone may be linked to multiple moras within a syllable as in the case of a long level H, or L. We shall examine the distribution and analysis of tone in more detail in the following section.

4.2 Background on tone in Nata

We will now discuss the distribution of tone in Nata. Only vowels host tone, and there is a distinction between the short and long vowels. There are five tone patterns for a syllable in Nata: two melodies for light syllables (V), and three for heavy syllables (VV). Note the absence of a rising contour on heavy syllables in Table 4.2.

Table 4.2: Tone by vowel length

Type	Form	Gloss
Light, High	o**mó**remi	'the/a farmer' (c1)
Light, Low	o**mo**súβe	'the/a man' (c1)
Heavy, Falling	riiβu**rúu**ŋga	'the/a egg' (c5)
Heavy, Level H	**tʃáá**ndoro	'the/a pancreas' (c10)
Heavy, Low	rii**huu**ndúku	'the/a corpse' (c5)
Heavy, Rise	*rii**huú**nduku	—

In Nata non-vowel segments are not hosts for tone, though this is not universally the case (Yip, 2001). Compare Nata to languages where a nasal consonant bears high tone, for instance, Tuki (Hyman & Biloa, 1992). In Tuki, a verbal suffix -ḿ can surface with high tone[1]

Table 4.3: Tuki forms with tone bearing nasal (Hyman & Biloa, 1992)

Form	Gloss
à-n-dìngà-**ḿ**	'he loves me'
à-n-dángá-**ḿ**	'he loses me'

Nata does not have nasal segments which are moraic; however there are restrictions on how tone interacts with different moraic structures. Moras (μ) encode a contrast between heavy and light syllables (Hyman,

[1]This morpheme is the only high tone prelinked to a consonant and surfaces with it. The first person object prefix N- is prelinked to a low tone but does not surface with it.

1985). A relevant diagnostic for how tone associates to moras is the behaviour of heavy (bimoraic) syllables; do such syllables behave as one tone bearing unit (TBU) or two? For our purposes, heavy syllables are just those with long vowels.[2]

I claim that tones are linked to moras in Nata, as supported by a distinction between level H and falling H on long vowels. The assumed relationship between tones and moras for light (monomoraic) and heavy (bimoraic) syllables is given in Figure 4.1.

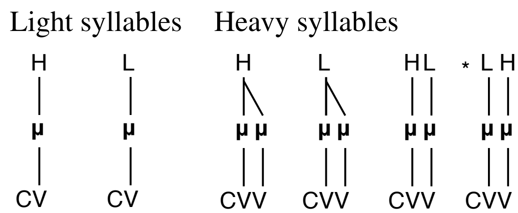


Figure 4.1: Nata surface inventory of tones by syllable weight

Nata lacks a rising contour; however, such structures are permitted in other languages (Yip, 2001). For example, Heath, 2008 identifies the following pattern for Jamsay, a Dogon (Niger-Congo) language of Mali: light syllables may have high tone or low tone; heavy syllables may be high, low, rising (LH) or falling (HL). Given freely combining high and low tones, we predict exactly the pattern described by Heath.

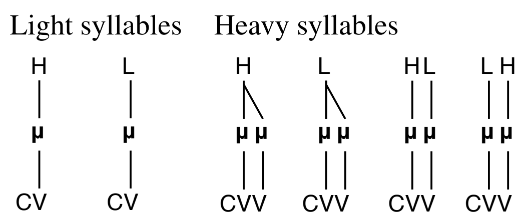


Figure 4.2: Jamsay inventory of tones by syllable weight

In Nata, there is a distributional restriction on long vowels with an H tone. If the long vowel is in the penultimate syllable of a ϕ-phrase, then it will have a falling contour. If the long vowel is not in the penultimate syllable, it will have a level H.

[2] Coda consonants are generally prohibited in Bantu languages of the Mara region (Aunio, 2017), and are not attested in Nata, as shown in Section 2.1.2.

Table 4.4: Realization of H tone on heavy syllables

Type	Form	Gloss
Falling	riiβu**rúu**ŋga	'the/a egg' (c5)
Level H	**tʃáá**ndoro	'the/a pancreas' (c10)

In conjunction with the complementary distribution of level H and falling H on long vowels, recall that there are no long vowels in ϕ-phrase final positions, as shown in Section 2.1.2. This means that the only possible location for falling contours on heavy syllables is in the penultimate syllable of a ϕ-phrase.

Table 4.5: Only falling H on penultimate long vowels

Position	Form	Gloss
Penultimate	[$_\phi$omu**náa**ta]	'the/a Nata person' (c1)
Final	*[$_\phi$riisi**máa**]	—

The distribution of falling high tones (and long vowels) in Nata is reflected in the allomorphs for morphemes that can occur in the penultimate position of a ϕ-phrase. These are generally root morphemes (possibly with a suffix), which are syntactically the nP, as we saw in Section 3.4.[3] For any root that has a falling H contour on its penultimate syllable, there is not a corresponding allomorph with a level H tone (*nááta, *βurúúŋga).

Table 4.6: Root allomorphs with penultimate long vowels

Morpheme	Gloss
{náata}	NATA
{βurúuŋga}	EGG

[3]In the verbal domain, extensions and final vowels sometimes fall within this final two syllable window of a ϕ-phrase.

However, for forms in class 10, which have long vowels and may occur either in a penultimate or prepenultimate position, both level H and falling H tone allomorphs are attested. As predicted by the distribution of HH and HL on long vowels, the HL long allomorphs occur in penultimate positions while the HH allomorphs occurs elsewhere.

Table 4.7: c5 & c10 forms with alternating HL∼HH

Form	Gloss
[$_\phi$rí-i-to]	'the/a leaf' (c5)
[$_\phi$rí-í-βuri]	'the/a feather' (c5)
[$_\phi$tʃáá-n-tʃogu]	'the/a elephants' (c10)
[$_\phi$tʃáa-ka]	'the/a homes' (c10)

This alternation is reflected in a different configuration of allomorphs for these prefix morphemes than for the root morphemes in Table 4.7.

Table 4.8: Prefix allomorphs with long vowels

Morpheme	Gloss
{tʃaa, tʃáa, tʃáá}	DET.C10

To account for the distribution of contour tone on long vowels, I assume that a general dispreference for contours prevents the selection of LH allomorphs, and limits HL to syllables in ϕ-phrase penultimate position.

(23) No contour tones — Yip, 2001

*CONTOUR: Assign a violation mark to any syllable whose moras are associated to more than one tone.

In the context of the penultimate syllable, a phonotactic restriction on level H results in the selection of HL allomorphs.[4]

(24) No level H in penultimate position

*LongH/Penultσ: For every ϕ-phrase, assign a violation mark to the penultimate syllable of the ϕ-phrase if it is bimoraic and both moras are associated to a high tone.

This is illustrated in the tableaux below, where a HL is permitted because it satisfies the higher ranked contextual phonotactic on HL. Note that the default low tone option is not optimal due to a higher ranked constraint which requires that ϕ has an H tone within it, as we shall see later.

(25) Evaluation of H on heavy penultimate syllable

	[$_{\text{DP}}${tʃaa, tʃáá, tʃáa}+ [$_{\text{NumP}}${∅, N}+[$_{\text{nP}}${ka}]]]	*LongH/Penultσ	*Contour
	a. [$_{\phi}$tʃáá-ka]	*!	
☞	b. [$_{\phi}$tʃáa-ka]		*

For the remainder of this chapter, I will condense the constraints on contours tones into a single constraint VV-Tone, defined below.

(26) Tone contour constraint

VV-Tone: Assign a violation mark to bimoraic syllables associated with LH. Assign a violation mark to bimoraic syllables that are not in ϕ-penultimate position and are associated with HL. Assign a violation mark to bimoraic syllables that are in ϕ-penultimate position and which have both moras associated to an H.

As we shall see throughout this chapter, ϕ-phrases in Nata generally have a single high tone syllable (Anghelescu, 2012; Anghelescu et al., 2017). This observation is compatible with an interpretation of high pitch as "accent", where accent is defined by obligatoriness and culminativity (Hyman, 2006). Obligatoriness is the property which requires that every word (or other domain) have a prominent syllable; culminativity is the property requiring that every word (or other domain) have at most one most prominent syllable. This situation is not unique to Nata among Eastern Bantu languages to Nata. Schadeberg, 1973 identifies Kinga (G.65), also spoken in Tanzania, as a language where words bear at most one high tone.

[4]Nata never allows rising contours on long vowels; I assume a high ranking and unviolated constraint penalizing rising contours. Crucially, the constraint penalizing rising contours outranks the constraint penalizing falling contours: *LH≫*HL.

Finally, it is worth noting that many of the properties of nominal tone that are described and analyzed in this chapter are shared by the verbal tone system. Anghelescu et al., 2017 compare tone on nouns and verbs, demonstrating that all of the nominal tone patterns appear in the verbal domain. Relative to that analysis, the current approach relies on prosodic domains that are related to syntactic structure, as described in the preceding chapter. One stark difference is that in the verbal domain, a ϕ may occur with more than one H tone.

4.3 Prosodic and syntactic structure of nominals

4.3.1 Bare nominals

The data in this section are the citation forms of nouns, in other words, the DP, as described in Section 3.4.3.

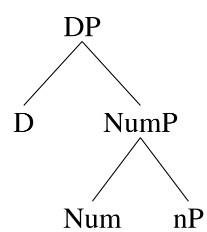


Figure 4.3: Syntactic structure of a simple nominal

Table 4.9: Prosodic structure of a simple nominal

Form	Gloss
$[_\iota[_\phi$e-ɣé-$[_\omega$seku]]]	‘the/a door’ (c7)

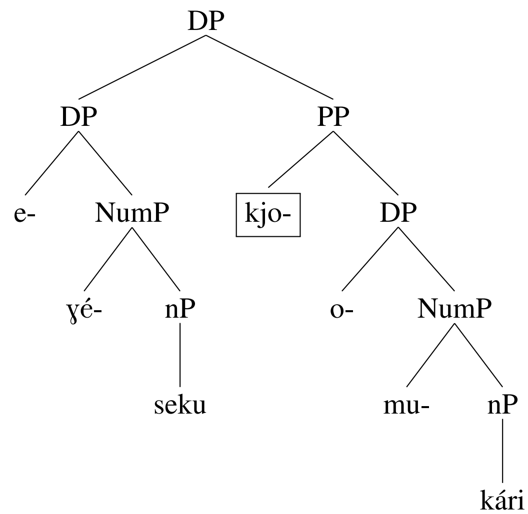
4.3.2 Associative Construction

The associative construction relates two nouns. The first of these is the head, and the second is the modifier, as described in Section 3.5.1. The associative construction will serve as the exemplar for tone in complex forms. Consider the complex forms in Table 4.10, illustrating the associative (a.), comitative (b.), and locative (c.); for the associative and comitative constructions, the noun bearing the relevant prefix is given in bold.

Table 4.10: Complex nominals

	Form	Gloss
a.	e-ɣé-seku **kjo-o-mu-kári**	‘the/a door of the/a woman’ (c7, c1)
b.	o-mu-kári **né-é-ɣe-seku**	‘the/a woman and the/a door’ (c1, c7)
c.	**mwé-é-ɣe-seku**	‘on the/a door’ (c7)

The syntactic structure of the associative construction is given in Figure 4.4.



e-ɣé-seku kjo-o-mu-kári ‘the/a door of the/a woman’ (c7, c1)

Figure 4.4: Syntactic structure of Associative Construction

The associative morpheme is displayed in a box for ease of parsing. The structure also represents comitative and locative forms; however locatives do not occur with a second DP.

Like the simple nominals from the previous section, the complex nominals are utterances (ι); however, because the associative construction contains two DPs, the corresponding prosodic structure also contains two ϕ-phrases. Each ϕ-phrase contains an ω-word, mapped from the nP.

Table 4.11: Prosodic structure of a complex nominal

Form	Gloss
$[_\iota[_\phi$e-ɣé-$[_\omega$seku]]$[_\phi$kjo-o-mu-$[_\omega$kári]]]	'the/a door of woman' (c7, c1)

Although both DP and PPs are mapped to ϕ via the constraints Al(PP; ϕ) and Al(DP; ϕ), respectively, the presence of *RECUR(ϕ) prohibits ϕ from containing other ϕ's. Therefore, only the highest ranked of the XP to ϕ constraints can be satisfied. As we saw in the previous chapter, Al(PP; ϕ) outranks Al(DP; ϕ).

The mapping developed in Section 3.3 predicts heads and modifiers should be tonally independent given that they are in distinct ϕ-phrases and our observations of simplex cases. As we shall see, this prediction is borne out.

4.4 Low tone class

4.4.1 General

Low tone roots are characterized by their general lack of a high tone allomorph. Words in Nata generally require exactly one syllable with high tone. In order to satisfy this restriction, words with low tone roots surface with high tone prefix allomorphs. Consider the forms in Table 4.12; these forms represent the general cases involving underived low tone roots.

Table 4.12: Underived L-tone root with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	e-	ké-	ɣi	'the/a wasp' (c7)
b.	e-	ké-	ribitʃi	'the/a waist' (c7)
c.	e-	ɣé-	seku	'the/a door' (c7)
d.	o-	rú-	βɛrɛ	'the/some millet' (c11)

In Nata, phonologically null determiners encode non-existential entities, as described in Gambarage,

2019. In the context of low tone roots, the alternation between phonologically overt and phonologically null determiner does not influence which syllable will bear high tone.

Table 4.13: Underived L-tone root with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		ké-	ɣi	'no wasp' (c7)
b.		ké-	ribitʃi	'no waist' (c7)
c.		ɣé-	seku	'no door' (c7)
d.		rú-	βɛrɛ	'no millet' (c11)

Consider the set of forms in Table 4.14 and Table 4.15, which include derived roots. These roots are formed by the addition of a nominal suffix vowel to an a-categorical stem. There is no tonal distinction between low tone roots which are derived and those which are underived.

Table 4.14: Derived L-tone root with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	o-	mó-	rem-i	'the/a farmer' (c1)
b.	o-	mó-	ɣor-i	'the/a buyer' (c1)
c.	o-	mó-	tir-ɔ	'the/a ladder' (c3)
d.	o-	mó-	tum-ɔ	'the/a seam' (c3)

Table 4.15: Derived L-tone root with null determiner

		Form		Gloss
	D-	NUM-	*n*	
a.		mó-	rem-i	'no farmer' (c1)
b.		mó-	ɣor-i	'no buyer' (c1)
c.		mó-	tir-ɔ	'no ladder' (c3)
d.		mó-	tum-ɔ	'no seam' (c3)

The tableaux in (29) and (30) illustrate two general properties of ϕ-phrases: they must have a high tone syllable, and they must not have more than one high tone syllable. This property of Nata words has been reported by Anghelescu, 2012, Lam, 2013 (for verbal tone), and Anghelescu et al., 2017. These properties are encoded in the constraints below. Unlike previous formulations of these constraints, the variants presented below are relative to the ϕ-phrase.

(27) MONOH and HIGHϕ constraints

MONOH: Assign a violation mark to a ϕ that contains more than one H tone.

HIGHϕ: Assign a violation mark to a ϕ that does not contain at least one H tone.

As we shall see later, determiners have low and high tone allomorphs, like class prefixes. However, the high tone allomorph of the determiner does not appear in the general cases. This represents a conflict between aligning tone to the left edge of a word, and restricting high tones on onsetless short vowels, as encoded by the constraints below.

(28) *($_\sigma$V́ and Alignment constraints

*($_\sigma$V́: Assign a violation mark to any syllable without an onset and that is also associated with H tone.

ALIGN(H,ϕ): Assign a violation mark to the left edge of any ϕ that is not aligned with an H tone.

We shall see evidence for the crucial ranking of *($_\sigma$V́ below HIGHϕ when we consider class 5 cases in Section 4.4.2. More generally regarding rankings, tableaux display crucial constraint rankings for the analysis throughout the document; however, justification for the rankings may not be provided for a particular set of constraints until after the constraints have been introduced.

As illustrated in the tableaux below, the positional restriction on high tones out ranks alignment; therefore, the forms with high tone class prefixes are optimal, despite violating alignment. The candidate in (29d.) loses to (29b.) because the former violates *($_{\sigma}$V́.

The candidate in (29 a.) loses to (29 b.) because the former violates HIGHϕ. The candidate in (29 c.) loses to (29 b.) because the former violates MONOH.

(29) Evaluation of L-tone roots with overt determiner

[$_{DP}${e, é}+[$_{NumP}${ɣe, ɣé}+[$_{n}${seku}]]]

		MONOH	HIGHΦ	*($_{\sigma}$V́	AL(H,ϕ)
	a. [$_{\phi}$e-ɣe-[$_{\omega}$seku]]		*!		
☞	b. [$_{\phi}$e-ɣé-[$_{\omega}$seku]]				*
	c. [$_{\phi}$é-ɣé-[$_{\omega}$seku]]	*!		*	
	d. [$_{\phi}$é-ɣe-[$_{\omega}$seku]]			*!	

(30) Evaluation of L-tone roots with null determiner

[$_{DP}$[$_{NumP}${ɣe, ɣé}+[$_{n}${seku}]]]

		MONOH	HIGHΦ	*($_{\sigma}$V́	AL(H,ϕ)
	a. [$_{\phi}$ɣe-[$_{\omega}$seku]]		*!		
☞	b. [$_{\phi}$ɣé-[$_{\omega}$seku]]				

Low tone roots with associative prefixes do not surface with high tone on the class prefix. Instead, a high tone allomorph of the associative prefix is used for such cases. Note that there is an interaction between the associative prefix and determiner, which results in the associative prefix occurring with a glide and vowel identical to the determiner vowel; this is explored in Appendix A, but crucially is independent of tone.

Table 4.16: Associative L-tone root with overt determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	e-ɣe-sı́ma	kjó-	ó-	mo-	rem-i	'the/a well of the/a farmer' (c7, c1)
b.	e-ki-ɣέrɔ	ké-	é-	ɣe-	seku	'the/a thing of the/a door' (c7, c7)

Associative forms with a null determiner also surface with a high tone allomorph of the associative prefix; however, there is no vowel coalescence interaction between the associative prefix and the determiner.

Table 4.17: Associative L-tone root with null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	ɣe-sı́ma	ké-		mo-	rem-i	'no well of no farmer' (c7, c1)
b.	ki-ɣέrɔ	ké-		ɣe-	seku	'no thing of no door' (c7, c7)

Forms with an associative prefix and determiner are subject to restrictions on high tone on long vowels, because these forms have a long vowel.

(31) VV-TONE constraint

VV-TONE: Assign a violation mark to bimoraic syllables associated with LH. Assign a violation mark to bimoraic syllables that are not in ϕ-penultimate position and are associated with HL. Assign a violation mark to bimoraic syllables that are in ϕ-penultimate position and which have both moras associated to an H.

Candidates like those in (32c.), (32d.), (32f.), and (32g.) violate VV-TONE (f. and g. fatally so). VV-TONE penalizes rising contours in any position, and falling contours outside of the penultimate syllable.

The winning candidate in (32h.) satisfies both alignment and *($_\sigma$V́, because the left edge of the ϕ is not vowel initial. This stands in contrast with the comparable forms with the same root, but without an associative prefix; recall that in those cases the optimal forms do violate alignment in order to satisfy the more highly ranked $*(_\sigma\acute{V}$.

(32) Evaluation of associative L-tone root with overt determiner

$[_{PP}\{kjo, kjó\}+[_{DP}\{o, ó\}+[_{NumP}\{mo, mó\}+[_{nP}\{rem\}+\{i\}\}]]]]$

	MONOH	HIGHΦ	$*(_\sigma\acute{V}$	VV-TONE	AL(H,ϕ)
a. $[_\iota[_\phi$kjo-o-mo-$[_\omega$remi]]		*!			
b. $[_\iota[_\phi$kjo-o-mó-$[_\omega$remi]]					*
c. $[_\iota[_\phi$kjo-ó-mó-$[_\omega$remi]]	*!			*	*
d. $[_\iota[_\phi$kjó-o-mó-$[_\omega$remi]]	*!			*	
e. $[_\iota[_\phi$kjó-ó-mó-$[_\omega$remi]]	*!				
f. $[_\iota[_\phi$kjo-ó-mo-$[_\omega$remi]]				*!	*
g. $[_\iota[_\phi$kjó-o-mo-$[_\omega$remi]]				*!	
☞ h. $[_\iota[_\phi$kjó-ó-mo-$[_\omega$remi]]					

Forms with an associative prefix and no determiner do not interact with VV-TONE, as there are no long vowels. As illustrated in the tableau in (33), the winning candidate in (33a.) satisfies alignment, while other possible candidates fail to satisfy alignment (33b.), MONOH (33c.), or HIGHϕ (33d.).

(33) Evaluation of associative L-tone root with null determiner

$[_{PP}\{ke, ké\}+[_{DP}[_{NumP}\{mo, mó\}+[_{nP}\{rem\}+\{i\}\}]]]]$

	MONOH	HIGHΦ	$*(_\sigma\acute{V}$	VV-TONE	AL(H,ϕ)
☞ a. $[_\iota[_\phi$ké-mo-$[_\omega$remi]]					
b. $[_\iota[_\phi$ke-mó-$[_\omega$remi]]					*!
c. $[_\iota[_\phi$ké-mó-$[_\omega$remi]]	*!				
d. $[_\iota[_\phi$ke-mo-$[_\omega$remi]]		*!			

4.4.2 Classes 5, 9, 10

Classes 5, 9, and 10 have different phonological shapes for their prefix and determiner morphemes. This interacts with where high tone is realized. For forms with low tone roots, this is due to the availability of a consonant initial determiner in class 5, and a non-TBU class marker in class 9. These morpheme shapes interact with the positional restriction on H tone penalizing H on onsetless vowels.

Class 5

Class 5 has the same morpho-syntactic structure as other nominals; these structures have a noun stem preceded by a class prefix, which is preceded by a determiner, as described in Section 3.4.3. Class 5 differs from the other classes in the forms of its determiner and class prefix. The class 5 determiner is not a V, but rather a CV. The class 5 prefix is not a CV-, but rather a V-. Lafon, 1994; Maho, 1999, 2003, 2009 identify similar differences between class 5 and other noun classes in a variety of Bantu languages; often these differences include tonal effects.

Table 4.18: Class 5 structures

Syntactic Form	Prosodic Form	Gloss
$[_{DP}$rí-$[_{NumP}$í-$[_{nP}$βuri	$[_{\phi}$rí-í-$[_{\omega}$βuri	'feather' (c5)
$[_{DP}$rí-$[_{NumP}$í-$[_{nP}$konono	$[_{\phi}$rí-í-$[_{\omega}$konono	'a/the elephant's trunk' (c5)
$[_{DP}$rí-$[_{NumP}$í-$[_{nP}$rem-i	$[_{\phi}$rí-í-$[_{\omega}$rem-i	'a/the farmer (eval.)' (c5)

Many class 5 forms have corresponding class 6 plurals. Class 6 has the same morpheme shapes as the classes we have seen in the preceding section; therefore it is useful to compare roots in class 5 with their plural class 6 forms.

Low tone roots in class 5 surface with a level high tone on their initial syllable. This initial syllable is composed of a determiner morpheme and a class prefix morpheme. Corresponding class 6 forms surface with a high tone on the class marker, as we have seen previously for the general low tone root forms.

Table 4.19: L-tone c5/6 roots with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	rí-	í-	βuri	'a/the feather' (c5)
b.	a-	má-	βuri	'some/the feathers' (c6)
c.	rí-	í-	konono	'a/the elephant's trunk' (c5)
d.	a-	má-	konono	'some/the elephant's trunks' (c6)
e.	rí-	í-	rem-i	'a/the farmer (eval.)' (c5)
f.	a-	má-	rem-i	'some/the farmers (eval.)' (c6)

When a low tone root in class 5 occurs with a phonologically null determiner, the class prefix still surfaces with a high tone allomorph. This is unexpected given that generally high tone is prenasalized when it occurs on an onsetless vowel.

Table 4.20: L-tone c5/6 roots with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		í-	βuri	'no feather' (c5)
b.		má-	βuri	'no feathers' (c6)
c.		í-	konono	'no elephant's trunk' (c5)
d.		má-	konono	'no elephant's trunks' (c6)
e.		í-	rem-i	'a/the farmer (eval.)' (c5)
f.		má-	rem-i	'some/the farmers (eval.)' (c6)

The evaluation of low tone roots in class 5 is straightforward given what we have seen so far. Like other nouns, these forms must have exactly one H within the ϕ. Like the associative forms, the H tone must be level (given that it is not in penultimate position unless the root is monosyllabic, which we will not discuss in this work.)

The forms in (34b.) and (d.) lose to (34c.) because they violate VV-TONE. The form in (34a.) violates HIGHϕ. There is no possible form with multiple high tones, given the morphemes and allomorphs involved in structures with a low tone root in class 5.

(34) Evaluation of L-tone c5 root with overt determiner

[$_{DP}$\{ri, rí\}+[$_{NumP}$\{i, í\}+[$_{nP}$\{βuri\}]]]]

	MONOH	HIGHΦ	*($_\sigma$V́	VV-TONE	AL(H,ϕ)
a. [$_\iota$[$_\phi$ri-i-[$_\omega$βuri]]		*!			
b. [$_\iota$[$_\phi$ri-í-[$_\omega$βuri]]				*!	*
☞ c. [$_\iota$[$_\phi$rí-í-[$_\omega$βuri]]					
d. [$_\iota$[$_\phi$rí-i-[$_\omega$βuri]]				*!	

The unexpected form of low tone roots in class 5 with a null determiner is a result of HIGHϕ outranking *($_\sigma$V́, and the available allomorphs with H tone being limited. Because low tone roots generally do not have any allomorphs with high tone, only the class prefix and determiner can supply the H required by HIGHϕ. While the resulting form does violate *($_\sigma$V́, this violation is not fatal.

(35) Evaluation of L-tone c5 root with null determiner

[$_{DP}$[$_{NumP}$\{i, í\}+[$_{nP}$\{βuri\}]]]]

	MONOH	HIGHΦ	*($_\sigma$V́	VV-TONE	AL(H,ϕ)
a. [$_\iota$[$_\phi$i-[$_\omega$βuri]]		*!			
☞ b. [$_\iota$[$_\phi$í-[$_\omega$βuri]]			*		

When low tone roots in class 5 occur with an associative prefix, the associative prefix occurs with a high tone allomorph. This is predicted by alignment. Corresponding class 6 forms are given in the chart below, these differ in that they surface with a long vowel composed of the associative prefix and determiner.

Table 4.21: Associative L-tone c5/6 roots with overt determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	o-mu-kári	wó-	ri-	i-	rem-i	'the/a woman of a/the farmer (eval.)' (c1, c5)
b.	o-mu-kári	wá-	á-	ma-	rem-i	'the/a woman of some/a farmers (eval.)' (c1, c6)

Low tone roots in class 5 with an associative prefix and null determiner are similar to the general low tone roots with associative prefixes. This is because the left edge of the ϕ is a CV-V and therefore VV-TONE plays a role. Unlike the general low tone roots with associative prefixes where the CV-V is the associative-determiner; for low tone roots in class 5 with an associative prefix and null determiner the CV-V is the associative-class prefix.

Table 4.22: Associative L-tone c5/6 roots with null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	mu-kári	wí-		í-	rem-i	'no woman of no farmer (eval.)' (c1, c5)
b.	mu-kári	wɔ́-		ma-	rem-i	'no woman of no farmers (eval.)' (c1, c6)

The optimal form for the low tone roots in class 5 with an associative prefix satisfy alignment. Due to the number of morphemes involved, there are a number of possible forms that fatally violate MONOH (36d., h., i.), or VV-TONE (36b. & e.). The candidate in (36a.) fatally violates HIGHϕ. The candidate in (36g.) loses to (36c.) because the former violates alignment.

(36) Evaluation of associative L-tone c5 root with overt determiner

$[_{\text{PP}}$ {wo, wó}+$[_{\text{DP}}$ {ri, rí}+$[_{\text{NumP}}$ {i, í}+$[_{\text{nP}}$ {rem}+{i}}]]]]

	MONOH	HIGHΦ	*($_\sigma$V́	VV-TONE	AL(H,ϕ)
a. $[_\iota[_\phi$ wo-ri-i-$[_\omega$remi]]		*!			
b. $[_\iota[_\phi$ wo-rí-i-$[_\omega$remi]]				*!	*
☞ c. $[_\iota[_\phi$ wó-ri-i-$[_\omega$remi]]					
d. $[_\iota[_\phi$ wó-rí-i-$[_\omega$remi]]	*!			*	
e. $[_\iota[_\phi$ wo-ri-í-$[_\omega$remi]]				*!	*
g. $[_\iota[_\phi$ wo-rí-í-$[_\omega$remi]]					*!
h. $[_\iota[_\phi$ wó-ri-í-$[_\omega$remi]]	*!			*	
i. $[_\iota[_\phi$ wó-rí-í-$[_\omega$remi]]	*!				

The evaluation of a low tone root in class 5 with an associative and a null determiner is identical to the evaluation of a low tone root in class 5 with a determiner (but no associative prefix). This is because the associative and class prefix form a CV-V sequence, just like the determiner and class prefix do.

(37) Evaluation of associative L-tone c5 root with null determiner

$[_{\text{PP}}$ {wi, wí}+$[_{\text{DP}}[_{\text{NumP}}$ {i, í}+$[_{\text{nP}}$ {rem}+{i}}]]]]

	MONOH	HIGHΦ	*($_\sigma$V́	VV-TONE	AL(H,ϕ)
a. $[_\iota[_\phi$ wi-i-$[_\omega$remi]]		*!			
b. $[_\iota[_\phi$ wí-i-$[_\omega$remi]]				*!	
c. $[_\iota[_\phi$ wi-í-$[_\omega$remi]]				*!	
☞ d. $[_\iota[_\phi$ wí-í-$[_\omega$remi]]					

Class 9/10

Classes 9 and 10 differ from other classes in that they do not have a tone bearing class marker. Class 9 has a V- determiner, like we have seen in the general cases; however, class 10 has a CVV- determiner.

Low tone roots in class 9/10 have an additional allomorph with an initial H tone, as observed from the forms below. This allomorph is morpho-syntactically restricted to occur in the class 9 or class 10 context, as it never surfaces elsewhere, even if it would be phonologically optimal. Crucially, low tone roots do not generally have an H initial allomorph; this is strictly a property of class 9/10 low tone roots.

Low tone roots in class 9 with overt determiners surface with a high tone on the root initial syllable. The same roots in class 10 surface with the more general all low allomorph, and the class 10 determiner occurs with a high tone allomorph.

Table 4.23: L-tone c9/10 roots with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	a-		súkuβi	‘a/the hump’ (c9)
b.	tʃáá-		sukuβi	‘some/the humps’ (c10)
c.	a-		ŋwíina	‘a/the crocodile’ (c9)
d.	tʃáá-		ŋwiina	‘some/the crocodiles’ (c10)
e.	a-		súɡura	‘a/the tradition’ (c9)
f.	tʃáá-		suɡura	‘some/the traditions’ (c10)
g.	a-	m-	βáata	‘a/the duck’ (c9)
h.	tʃáá-	m-	βaata	‘some/the ducks’ (c10)
i.	a-	n-	dóro	‘a/the pancreas’ (c9)
j.	tʃáá-	n-	doro	‘some/the pancreases’ (c10)

Low tone roots in class 9 with a null determiner occur with the initial H allomorph. Low tone roots in class 10 with a null determiner occur with the all low allomorph, which is unexpected because the resulting form lacks a high tone.

Table 4.24: L-tone c9/10 roots with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.			súkuβi	'no hump' (c9)
b.			sukuβi	'no humps' (c10)
c.			ŋwíina	'a/the crocodile' (c9)
d.			ŋwiina	'some/the crocodiles' (c10)
e.			súgura	'no tradition' (c9)
f.			sugura	'no traditions' (c10)
g.		m-	βáata	'no duck' (c9)
h.		m-	βaata	'no ducks' (c10)
i.		n-	dóro	'no pancreas' (c9)
j.		n-	doro	'no pancreases' (c10)

The evaluation of class 9 forms crucially involves a type of constraint we have not considered thus far, SELECTION; specifically, SEL:L.

(38) SELECT:L constraint

SEL:L: Assign a violation mark to any allomorph that has a Sel:L restriction not followed by a syllable with L tone.

SEL:L is relevant because the class 9/10 prefix has a selectional restriction; specifically, the prefix selects for a following syllable with low tone[5], if it is not followed by such a syllable, a violation is assigned to the output form. The selectional restriction is marked on the class 9/10 prefix morpheme: $\{N, \emptyset\}_L$. See Section 2.2.2 for more discussion on selectional restrictions.

In addition, notice that there is an allomorph which is indexed to class 9. We will return to the relevance of this indexation when we consider class 10 forms with a null determiner.

[5]Keep in mind that the form of the c9/10 prefix being represented is not a nasal consonant, but the c9/10 morpheme itself conditions prenasalization. For this reason, it is not itself a syllable, like a CV- prefix is. The syllable following the prenasalization is interpreted as being the same as the syllable which has the prenasalized onset.

The candidate in (39b.) violates *($_\sigma$V́, whereas the winning candidate in (39c.) does not. This is essentially because low roots in class 9 and 10 have a H initial allomorph which can satisfy HIGHϕ while not violating *($_\sigma$V́. The candidates in (39a. & d.) violate HIGHϕ and MONOH, respectively.

(39) Evaluation of L-tone c9 root with overt determiner

$[_{DP}\{\text{a, á}\}+[_{NumP}\{\text{N}, \emptyset\}_L+[_{nP}\{\text{βaata, βáata}_{c9}\}]]]]$

	MONOH	HIGHΦ	*($_\sigma$V́	VV-TONE	SEL:L	AL(H,ϕ)
a. $[_\iota[_\phi$a-m$_L$-$[_\omega$βaata]]		*!				
b. $[_\iota[_\phi$á-m$_L$-$[_\omega$βaata]]			*!			
☞ c. $[_\iota[_\phi$a-m$_L$-$[_\omega$βáata$_{c9}$]]					*	*
d. $[_\iota[_\phi$á-m$_L$-$[_\omega$βáata$_{c9}$]]	*!		*		*	

The evaluation of low tone roots in class 9 with a null determiner is dependant on HIGHϕ, as there are only two possible surface forms: one with a H and one without.

(40) Evaluation of L-tone c9 root with null determiner

$[_{DP}+[_{NumP}\{\text{N}, \emptyset\}_L+[_{nP}\{\text{βaata, βáata}_{c9}\}]]]]$

	MONOH	HIGHΦ	*($_\sigma$V́	VV-TONE	SEL:L	AL(H,ϕ)
a. $[_\iota[_\phi$m$_L$-$[_\omega$βaata]]		*!				
☞ b. $[_\iota[_\phi$m$_L$-$[_\omega$βáata$_{c9}$]]					*	*

Low tone roots in class 10 surface with a high level tone allomorph of the determiner. Note that the class 10 determiner does have a falling high contour ({tʃáa}), which surfaces with monosyllabic roots (not discussed in this work). The primary candidates of interest are the optimal form in (41b.), and the form with the root initial H tone in (41d.) The loser in (41d.) violates the selectional restriction on the class 9/10 prefix which requires a following low tone.

(41) Evaluation of L-tone c10 root with overt determiner

[$_{DP}${tʃaa, tʃáá, tʃáa}+[$_{NumP}${N, ∅}$_L$+[$_{nP}${βaata, βáata$_{c9}$}]]]]

	MONOH	HIGHΦ	$*(_\sigma \acute{V}$	VV-TONE	SEL:L	AL(H,ϕ)
a. [$_\iota$[$_\phi$tʃaa-m$_L$-[$_\omega$βaata]]		*!				
☞ b. [$_\iota$[$_\phi$tʃáá-m$_L$-[$_\omega$βaata]]						
c. [$_\iota$[$_\phi$tʃáa-m$_L$-[$_\omega$βaata]]				*!		
d. [$_\iota$[$_\phi$tʃaa-m$_L$-[$_\omega$βáata$_{c9}$]]					*!	*
e. [$_\iota$[$_\phi$tʃáá-m$_L$-[$_\omega$βáata$_{c9}$]]	*!				*	
f. [$_\iota$[$_\phi$tʃáa-m$_L$-[$_\omega$βáata$_{c9}$]]	*!		*		*	

The surprising case of the low tone roots in class 10 with a null determiner is not correctly predicted by our current model of Nata phonology. This is because the observed surface form violates HIGHϕ. One repair to this case is to invoke an undominated MORPHEME PREFERENCE constraint which penalizes an indexed form for occurring outside of the morphological context that it is indexed to; crucially, in this case the constraint must penalize a root for not matching the class features of a class prefix, as by assumption the null determiner lacks class features; consider the definition below in (42).

(42) MORPHPREF:ROOT-CLASS MARKER

MP:RT-CM: Assign a violation mark to any form that has a root marked for a class feature and that class feature is not the same as the class feature of the preceding class prefix within the ϕ.

The constraint must be undominated because it outranks HIGHϕ, which is the only constraint violated by the observed surface form. As we shall see when we consider initial H roots, this constraint is independently necessary to decide between HL and LH allomorphs, as both are equally phonologically well formed. Unfortunately, for the initial H cases, the ranking of MP:RT-CM is below HIGHϕ and therefore, it will not solve the misprediction in (43). We return to this constraint in for initial H roots in (70).

(43) Evaluation of L-tone c10 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_L + [_{nP}\{\beta aata, \beta \acute{a}ata_{c9}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:L	Al(H,ϕ)
☹	a. $[_\iota[_\phi m_L\text{-}[_\omega \beta aata]]$		*!				
☞	b. $[_\iota[_\phi m_L\text{-}[_\omega \beta \acute{a}ata_{c9}]]$					*	*

When low tone roots in class 9 and 10 occur with an associative prefix, the associative and determiner occur with high tone; this case is comparable to the general low tone root cases in so far as the associative prefix and determiner constitute a long vowel, as discussed in Appendix A.

Table 4.25: Associative L-tone c9/10 roots with overt determiner

		Form				Gloss
		Assoc-	D-	Num-	*n*	
a.	e-rı́-ino	rjá-	á-		ŋwiina	‘the/a tooth of a/the crocodile’ (c5, c9)
b.	e-rı́-ino	rí-	tʃaa		ŋwiina	‘the/a tooth of some/a crocodiles’ (c5, c10)
c.	o-mo-rı́ɣo	wá-	á-	m-	βaata	‘the/a load of a/the ducks’ (c3, c9)
d.	o-mo-rı́ɣo	wɔ́-	tʃaa-	m-	βaata	‘the/a load of some/a ducks’ (c3, c10)

When low tone roots in class 9 and 10 occur with an associative prefix and a null determiner the associative prefix occurs with a high tone allomorph.

Table 4.26: Associative L-tone c9/10 roots with null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	rí̀-ino	ré-			ŋwiina	‘no tooth of no crocodile’ (c5, c9)
b.	rí̀-ino	ré-			ŋwiina	‘no tooth of no crocodiles’ (c5, c10)
c.	mo-rí̀ɣo	wɔ́-		m-	βaata	‘no load of no ducks’ (c3, c9)
d.	mo-rí̀ɣo	wɔ́-		m-	βaata	‘no load of no ducks’ (c3, c10)

The optimal form satisfies SEL:L. In contrast, the losing candidate in (44e.) violates SEL:L. Moreover, the form in (44e.) fails to satisfy alignment, which the optimal candidate does satisfy.

As we have seen previously for low tone roots, candidates which fail to satisfy HIGHϕ (44a.) and MONOH (44g.-i.) in general lose to the optimal candidate. Again, as before, candidates which violate VV-TONE (44b. & c.) lose to the optimal candidate.

(44) Evaluation of associative L-tone c9 root with overt determiner

[$_{PP}${wa, wá}+[$_{DP}${a, á}+[$_{NumP}${N, ∅}$_L$+[$_{nP}${βaata, βáata$_{c9}$}]]]]

	MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:L	Al(H,ϕ)
a. [$_\iota$[$_\phi$wa-a-m$_L$-[$_\omega$βaata]]		*!				
b. [$_\iota$[$_\phi$wá-a-m$_L$-[$_\omega$βaata]]				*!		
c. [$_\iota$[$_\phi$wa-á-m$_L$-[$_\omega$βaata]]				*!		*
☞ d. [$_\iota$[$_\phi$wá-á-m$_L$-[$_\omega$βaata]]						
e. [$_\iota$[$_\phi$wa-a-m$_L$-[$_\omega$βáata$_{c9}$]]					*!	*
g. [$_\iota$[$_\phi$wá-a-m$_L$-[$_\omega$βáata$_{c9}$]]	*!			*	*	
h. [$_\iota$[$_\phi$wa-á-m$_L$-[$_\omega$βáata$_{c9}$]]	*!			*	*	*
i. [$_\iota$[$_\phi$wá-á-m$_L$-[$_\omega$βáata$_{c9}$]]	*!				*	

The evaluation of low tone roots in class 9 with a null determiner is essentially the same as with the evaluation for forms with an overt determiner, except VV-Tone plays no role, as there are no long vowels which could have high tone. As in other forms with the class 9/10 prefix, using the H initial allomorph of the root results in violations of Sel:L, as in candidates (45c. & d.).

(45) Evaluation of associative L-tone c9 root with null determiner

[$_{PP}${wɔ, wɔ́}+[$_{DP}$[$_{NumP}${N, ∅}$_L$+[$_{nP}${βaata, βáata$_{c9}$}]]]]

	MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:L	Al(H,ϕ)
a. [$_\iota$[$_\phi$wɔ-m$_L$-[$_\omega$βaata]]		*!				
☞ b. [$_\iota$[$_\phi$wɔ́-m$_L$-[$_\omega$βaata]]						
c. [$_\iota$[$_\phi$wɔ-m$_L$-[$_\omega$βáata$_{c9}$]]					*!	*
d. [$_\iota$[$_\phi$wɔ́-m$_L$-[$_\omega$βáata$_{c9}$]]	*!				*	

The evaluation of low tone roots in class 10 with an associative prefix is similar to cases we have already seen in so far as the optimal candidate satisfies alignment. The candidate with a high tone allomorph of the c10 determiner (46c.) loses to the optimal candidate in (46b.) because the former violates alignment.

(46) Evaluation of associative L-tone c10 root with overt determiner

[$_{\text{PP}}${wɔ, wɔ́}+[$_{\text{DP}}${tʃaa, tʃáá}+[$_{\text{NumP}}${N, ∅}$_{\text{L}}$+[$_{\text{nP}}${βaata, βáata$_{c9}$}]]]]

		MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:L	Al(H,ϕ)
	a. [$_\iota$[$_\phi$ wɔ-tʃaa-m-[$_\omega$βaata]]		*!				
☞	b. [$_\iota$[$_\phi$ wɔ́-tʃaa-m-[$_\omega$βaata]]						
	c. [$_\iota$[$_\phi$ wɔ-tʃáá-m-[$_\omega$βaata]]						*!
	d. [$_\iota$[$_\phi$ wɔ́-tʃáá-m-[$_\omega$βaata]]	*!					
	e. [$_\iota$[$_\phi$ wɔ-tʃaa-m-[$_\omega$βáata$_{c9}$]]					*!	*
	g. [$_\iota$[$_\phi$ wɔ́-tʃaa-m-[$_\omega$βáata$_{c9}$]]	*!				*	
	h. [$_\iota$[$_\phi$ wɔ-tʃáá-m-[$_\omega$βáata$_{c9}$]]	*!				*	*
	i. [$_\iota$[$_\phi$ wɔ́-tʃáá-m-[$_\omega$βáata$_{c9}$]]	*!				*	

The evaluation of low tone roots in class 10 with an associative prefix and a null determiner depends crucially on the ranking of Sel:L over Highω.

(47) Highω constraint

Highω: Assign a violation mark to any ω that does not contain an H tone.

The optimal form in (48b.) violates the lower ranked constraint, while the losing candidate in (48c.) satisfies Highω but violates the more highly ranked Sel:L. Additionally, the optimal candidate satisfies alignment.

(48) Evaluation of associative L-tone c10 root with null determiner

[$_{PP}${wɔ, w´ɔ}+[$_{DP}$[$_{NumP}${N, ∅}$_{L}$+[$_{nP}${βaata, βáata$_{c9}$}]]]]

	MONOH	HIGHΦ	*(σV́	VV-TONE	SEL:L	HIGHϖ	AL(H,ϕ)
a. [$_\iota$[$_\phi$wɔ-m-[$_\omega$βaata]]		*!				*	
☞ b. [$_\iota$[$_\phi$wɔ́-m-[$_\omega$βaata]]						*	
c. [$_\iota$[$_\phi$wɔ-m-[$_\omega$βáata$_{c9}$]]					*!		*
d. [$_\iota$[$_\phi$wɔ́-m-[$_\omega$βáata$_{c9}$]]	*!						

4.4.3 Data summary

In this section we have observed the surface forms involving low tone roots will generally surface with a H as far left as possibly, in alignment with the ϕ, but also subject to the condition that onsetless short vowels not bear high tone.

Table 4.27: Summary: Low tone root class

		D-Num-*n*	Gloss
a)		o-mó-[rem-i]	'the/a farmer' (c1)
b)		∅-mó-[rem-i]	'some farmer' (c1)
c)		rí-í-[rem-i]	'the/a farmer (eval.)' (c5)
d)		∅-í-[rem-i]	'some farmer (eval.)' (c5)
e)		a-m-βáata	'the/a duck' (c9)
f)		∅-m-βáata	'some duck' (c9)
g)		tʃáá-m-βaata	'the/a ducks' (c10)
h)		∅-m-βaata	'some ducks' (c10)
	D-Num-*n*	Assoc-D-Num-*n*	Gloss
i)	e-ɣé-seku	kjó-ó-mo-[rem-i]	'the/a door of farmer' (c7, c1)
j)	∅-ɣé-seku	ké-∅-mo-[rem-i]	'some woman of some farmer' (c7, c1)
k)	e-ɣé-seku	ké-ri-i-[rem-i]	'the/a door of the/a farmer (eval.)' (c7, c5)
l)	∅-ɣé-seku	kí-∅-í-[rem-i]	'some door of some farmer (eval.)' (c7, c5)
m)	o-mo-ríɣo	wá-á-m-βaata	'the/a load of the/a duck' (c7, c9)
n)	∅-mo-ríɣo	wɔ́-∅-m-βaata	'some load of some duck' (c7, c9)
o)	o-mo-ríɣo	wɔ́-tʃaa-m-βaata	'the/a load of the/a ducks' (c7, c10)
p)	∅-mo-ríɣo	wɔ́-∅-m-βaata	'some load of some ducks' (c7, c10)

4.4.4 Analysis summary

The analysis of low tone roots largely depends on the lexicon. Most low tone roots have no allomorphs with high tone; therefore, satisfaction of Highϕ depends on the material to the left of the root. Alignment would prefer that the H tone be on the leftmost TBU in ϕ; however, *$(_\sigma\acute{V}$ prevents forms with high tone V-determiners from being optimal.

Class 5 cases rely on prohibitions on high tone over long syllables, which is encoded by VV-TONE. Class 9/10 cases involve an additional root allomorph with high tone; however this allomorph is restricted by morphological context, and crucially the phonotactic penalizing high tone on the syllable following the determiner.

The puzzling case of class 10 forms with a null determiner remain unexplained by the analysis at hand. This case is puzzling because it violates HIGHϕ, which is otherwise never violated by a surface form. Comparing the c9 and c10 surface forms with null determiners shows that they are only differentiated by the form of the root; in c9 the root occurs with the H initial allomorph, whereas in c10 the root occurs all low. Nevertheless, the mechanism that would differentiate between matched root/prefix class is demonstrably ranked lower than the case of class 10 forms with a null determiner would require, as we shall see when we consider initial H forms.

4.4.5 Morph set relations

Not every possible distribution of tonal allomorphs are attested; for example, there is not a valid lexical entry for a prefix with only a high tone allomorph. Following Archangeli and Pulleyblank, 2021, I will examine the relations between morphs that are minimally different, as these are the types of pairs that a learner would consider when forming lexical entries, and then later when expanding their lexicon.

Prefixes generally occur with H and L tone allomorphs as we have seen for class prefixes, determiners, and prepositional prefixes. This is illustrated by the relation below:

(49) Morph set relation: Tone (prefixes)

MSR_{PfTone}: Pairs of otherwise identical prefix allomorphs differ only with respect to an H tone in one being L in the other.

$\{M_i, M_j\}$ M_i: [H]

M_j: [L]

A learner can form the following condition, to ensure that they can produce novel forms when they encounter a prefix that does not yet have a well established lexical entry. Essentially, this condition would state that a prefix has a H allomorph and has a L allomorph, or else is not a well formed prefix lexical entry.

(50) Morph set condition: Tone (prefixes)

With respect to MSR_{PfTone}, a nominal prefix morph set is ill-formed if M_j is present and there is no corresponding M_i, or if M_i is present and there is no corresponding M_j

MSC_{PfTone}: $*\{M_j, \neg M_i\}$

$*\{M_i, \neg M_j\}$

Roots occur in one of three types, as we will further explore in this chapter. They have different types of lexical entries than prefixes do, and a learner will need to discover this. For instance, if a learner posits that the condition in (50) above is totally general of the lexicon, they will incorrectly predict that roots should have uniform tonal behaviour, and they observably do not.

Low tone roots generally have only one allomorph, their namesake all low form. This is reflected in the lack of a relation, except in the case of class 9 roots, which have an allomorph with an initial high tone.

(51) Morph set relation: Tone (Class 9 root)

MSR_{C9Tone}: Pairs of otherwise identical root allomorphs in class 9 differ only with respect to an initial H tone in one being L in the other.

$\{M_i, M_j\}$ M_i: [HL...]

M_j: [L...]

If a root is in class 9 and has a low allomorph, it must have a initial H allomorph, and vice versa. This is true of low tone roots, but also of initial H roots; although in the case of initial H roots, they have both allomorphs in all classes, as we shall see in Section 4.6.

(52) Morph set condition: Tone (Low tone class 9 root)

With respect to MSR_{C9Tone}, a c9 nominal root morph set is ill-formed if M_j is present and there is no corresponding M_i, or if M_i is present and there is no corresponding M_j

MSC_{C9Tone}: $*\{M_j, \neg M_i\}$

$*\{M_i, \neg M_j\}$

4.5 Final H tone class

4.5.1 General

Forms with final H roots always occur with a high tone at the right edge of the ϕ (and ω). They do not vary across context (with overt/null determiner, with/without prepositional prefix, in class 9, 10, 5).

Final H roots contrast with low roots in that they have a high tone allomorph. The existence of such an allomorph will satisfy HIGHϕ (and HIGHω); however, this morph is at odds with alignment, which favours forms with high tone at the left edge of the ϕ. Because final H roots only have one allomorph, words including these roots will always have a ϕ final H. Morphemes to the left of the root are prevented from occurring with H allomorphs by the highly ranked MONOH.

In essence this class of roots is straightforward: the single root allomorph is invariant, all morphs to the left of the root are low. Because prefix morphemes always have a low tone allomorph, there is no conflict that could force violations of MONOH.

Table 4.28: Underived Final H-tone roots with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	e-	ke-	hurɛɛrɔ́	'the/a cooking pot' (c7)
b.	e-	ɣi-	sɛɛrɔ́	'the/a hide' (c7)
c.	e-	ɣe-	teeté	'the/a husk' (c7)
d.	o-	ro-	tʃuumbé	'the/a cow shed' (c11)
e.	o-	mo-	sirikaré	'the/a policeman' (c1)

Table 4.29: Underived Final H-tone roots with phonologically null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		ke-	hurɛɛrɔ́	‘no cooking pot’ (c7)
b.		ɣi-	sɛɛrɔ́	‘no hide’ (c7)
c.		ɣe-	teeté	‘no husk’ (c7)
d.		ro-	tʃuumbé	‘no cow shed’ (c11)
e.		mo-	sirikaré	‘no policeman’ (c1)

Final H roots are not derived from a-categorical stems and nominal suffixes. This property is not wholly unexpected, given that the nominal suffixes only have an allomorph with low tone.

The evaluation of final H tone roots is essentially the same across contexts. The basic case below illustrates this. The optimal candidate in (53a.) violates alignment, but unlike the other candidates in (53b.-d.), it satisfies MONOH.

For completeness sake, the same set of cases we considered for the low tone root class, and which we will consider for the initial H root class, is shown for the final H roots.

(53) Evaluation of final H tone root with overt determiner

[$_{DP}${e, é}$_{L}$+[$_{NumP}${ ɣi, ɣé}+[$_{n}${teeté}]]]

		MONOH	HIGHΦ	$*(_{\sigma}\acute{V}$	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
☞	a. [$_{\phi}$e-ɣe-[$_{\omega}$teeté]]											*
	b. [$_{\phi}$e$_{L}$-ɣé-[$_{\omega}$teeté]]	*!					*					*
	c. [$_{\phi}$é$_{L}$-ɣé-[$_{\omega}$teeté]]	*!		*			*					
	d. [$_{\phi}$é$_{L}$-ɣe-[$_{\omega}$teeté]]	*!		*								

(54) Evaluation of final H tone root with null determiner

[$_{DP}$[$_{NumP}${ ɣi, ɣí}+[$_{n}${teeté}]]]

	MonoH	HighΦ	*(σ V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_{\phi}$ ɣe-[$_{\omega}$teeté]]											*
b. [$_{\phi}$ ɣé-[$_{\omega}$teeté]]	*!										

Table 4.30: Associative final H-tone root with overt determiner

		Form				Gloss
		Assoc-	D-	Num-	*n*	
a.	e-ki-ɣɛ́rɔ	kjo-	o-	ro-	tʃuumbé	'the/a thing of the/a cow shed' (c7, c1)
b.	e-ɣe-sím̀a	kjo-	o-	mo-	sirikaré	'the/a thing of the/a policeman' (c7, c1)

Table 4.31: Associative final H-tone root with null determiner

		Form				Gloss
		Assoc-	D-	Num-	*n*	
a.	ki-ɣɛ́rɔ	ke-		ro-	tʃuumbé	'the/a thing of the/a cow shed' (c7, c1)
b.	ɣe-sím̀a	ke-		mo-	sirikaré	'the/a thing of the/a policeman' (c7, c1)

(55) Evaluation of associative final H-tone root with overt determiner

$[_{PP}\{$kjo$_{H}$, kjó, $\}+[_{DP}\{$o, ó$\}_{L}+[_{NumP}\{$mo, mó$\}+[_{nP}\{$sirikaré$\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_{\iota}[_{\phi}$kjo$_{H}$-o$_{L}$-mo-$[_{\omega}$sirikaré]]								*			*
b. $[_{\iota}[_{\phi}$kjo$_{H}$-o$_{L}$-mó-$[_{\omega}$sirikaré]]	*!					*					*
c. $[_{\iota}[_{\phi}$kjo$_{H}$-ó$_{L}$-mo-$[_{\omega}$sirikaré]]	*!							*			*
d. $[_{\iota}[_{\phi}$kjó-o$_{L}$-mo-$[_{\omega}$sirikaré]]	*!										
e. $[_{\iota}[_{\phi}$kjó-ó$_{L}$-mo-$[_{\omega}$sirikaré]]	*!										
f. $[_{\iota}[_{\phi}$kjó-ó$_{L}$-mó-$[_{\omega}$sirikaré]]	*!					*					
g. $[_{\iota}[_{\phi}$kjó-o$_{L}$-mó-$[_{\omega}$sirikaré]]	*!					*					
h. $[_{\iota}[_{\phi}$kjo$_{H}$-ó$_{L}$-mó-$[_{\omega}$sirikaré]]	*!					*					*

(56) Evaluation of associative final H-tone root with null determiner

$[_{PP}\{$ke$_{H}$, ké, $\}+[_{DP}[_{NumP}\{$mo, mó$\}+[_{nP}\{$sirikaré$\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_{\iota}[_{\phi}$ke$_{H}$-mo-$[_{\omega}$sirikaré]]								*			*
b. $[_{\iota}[_{\phi}$ke$_{H}$-mó-$[_{\omega}$sirikaré]]	*!										*
c. $[_{\iota}[_{\phi}$ké-mo-$[_{\omega}$sirikaré]]	*!										
d. $[_{\iota}[_{\phi}$ké-mó-$[_{\omega}$sirikaré]]	*!										

4.5.2 Classes 5, 9, 10

Class 5

Table 4.32: Final H-tone c5/6 roots with overt determiner

		Form		Gloss
	D-	NUM-	*n*	
a.	ri-	i-	tooká	'store' (c5)
b.	a-	ma-	tooká	'stores' (c6)
c.	ri-	i-	βiriká	'kettle' (c5)
d.	a-	ma-	βiriká	'kettles' (c6)

Table 4.33: Final H-tone c5/6 roots with null determiner

		Form		Gloss
	D-	NUM-	*n*	
a.		i-	tooká	'store' (c5)
b.		ma-	tooká	'stores' (c6)
c.		i-	βiriká	'kettle' (c5)
d.		ma-	βiriká	'kettles' (c6)

(57) Evaluation of Final H-tone c5 root with overt determiner

$[_{DP}\{ri, rí\}_{L}+[_{NumP}\{i, í\}+[_{nP}\{βiriká\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_ι[_φ$ri-i-$[_ω$βiriká]]											*
b. $[_ι[_φ$ri$_L$-í-$[_ω$βiriká]]	*!			*							
c. $[_ι[_φ$rí$_L$-í-$[_ω$βiriká]]	*!										
d. $[_ι[_φ$rí$_L$-i-$[_ω$βiriká]]	*!			*							

(58) Evaluation of Final H-tone c5 root with null determiner

$[_{DP}[_{NumP}\{i, í\}+[_{nP}\{βiriká\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_ι[_φ$i-$[_ω$βiriká]]											*
b. $[_ι[_φ$í-$[_ω$βiriká]]	*!		*								

Table 4.34: Associative final H-tone c5/6 roots with overt determiner

	Form					Gloss
		Assoc-	D-	Num-	*n*	
a.	o-mu-kári	wo-	ri-	i-	tooká	‘the/a woman of a/the store’ (c1, c5)
b.	o-mu-kári	wa-	a-	ma-	tooká	‘the/a woman of some/a stores’ (c1, c6)

Table 4.35: Associative final H-tone c5/6 roots with null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	mu-kári	wi-		i-	tooká	'no woman of no store' (c1, c5)
b.	mu-kári	wɔ-		ma-	tooká	'no woman of no stores' (c1, c6)

(59) Evaluation of associative final H-tone c5 root with overt determiner

$[_{PP}\{$wo$_H$, wó$\}$+$[_{DP}\{$ri, rí$\}_L$+$[_{NumP}\{$i, í$\}$+$[_{nP}\{$tooká$\}]]]]$

	MONOH	HIGHΦ	*(σ V́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
☞ a. [$_\iota$[$_\phi$wo$_H$-ri$_L$-i-[$_\omega$tooká]]								*			*
b. [$_\iota$[$_\phi$wo$_H$-rí$_L$-i-[$_\omega$tooká]]	*!			*							*
c. [$_\iota$[$_\phi$wo$_H$-rí$_L$-í-[$_\omega$tooká]]	*!										*
d. [$_\iota$[$_\phi$wo$_H$-ri$_L$-í-[$_\omega$tooká]]	*!			*							*
e. [$_\iota$[$_\phi$wó-ri$_L$-i-[$_\omega$tooká]]	*!										
f. [$_\iota$[$_\phi$wó-rí$_L$-i-[$_\omega$tooká]]	*!			*							
g. [$_\iota$[$_\phi$wó-rí$_L$-í-[$_\omega$tooká]]	*!										
h. [$_\iota$[$_\phi$wó-ri$_L$-í-[$_\omega$tooká]]	*!			*							

(60) Evaluation of associative final H-tone c5 root with null determiner

$[_{PP}\{wi_H, wí\}+[_{DP}[_{NumP}\{i, í\}+[_{nP}\{tooká\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞	a. $[_\iota[_\phi wi_H$-i-$[_\omega$tooká]]								*			*
	b. $[_\iota[_\phi wi_H$-í-$[_\omega$tooká]]	*!			*				*			*
	c. $[_\iota[_\phi$ wí-i-$[_\omega$tooká]]	*!			*							
	d. $[_\iota[_\phi$ wí-í-$[_\omega$tooká]]	*!										

Class 9/10

Table 4.36: Final H-tone class 9/10 roots with overt determiner

	Form			Gloss
	D-	Num-	*n*	
a.	a-	ɲ-	akwaahá	'a/the armpit' (c9)
b.	tʃaa-	ɲ-	akwaahá	'some/the armpits' (c10)

Table 4.37: Final H-tone class 9/10 roots with null determiner

	Form			Gloss
	D-	Num-	*n*	
a.		ɲ-	akwaahá	'no armpit' (c9)
b.		ɲ-	akwaahá	'no armpits' (c10)

(61) Evaluation of Final H-tone c9 root with overt determiner

$[_{DP}$\{a, á\}$_{L}$+$[_{NumP}$\{N, ∅\}$_{L}$+$[_{nP}$\{akwaahá\}]]]]

	MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_\iota[_\phi$a$_{L}$-ɲ$_{L}$-$[_\omega$tooká]]											*
b. $[_\iota[_\phi$á$_{L}$-ɲ$_{L}$-$[_\omega$tooká]]	*!		*								

(62) Evaluation of Final H-tone c9 root with null determiner

$[_{DP}[_{NumP}$\{N, ∅\}$_{L}$+$[_{nP}$\{akwaahá\}]]]]

	MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_\iota[_\phi$ɲ$_{L}$-$[_\omega$tooká]]											*

(63) Evaluation of Final H-tone c10 root with overt determiner

$[_{DP}$\{tʃaa, tʃáá, tʃáa\}+$[_{NumP}$\{N, ∅\}$_{L}$+$[_{nP}$\{akwaahá\}]]]]

	MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_\iota[_\phi$tʃaa-ɲ$_{L}$-$[_\omega$tooká]]											*
b. $[_\iota[_\phi$tʃáá-ɲ$_{L}$-$[_\omega$tooká]]	*!										
c. $[_\iota[_\phi$tʃáa-ɲ$_{L}$-$[_\omega$tooká]]	*!			*							

(64) Evaluation of Final H-tone c10 root with null determiner

$[_{DP}[_{NumP}$\{N, ∅\}$_{L}$+$[_{nP}$\{akwaahá\}]]]]

	MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_\iota[_\phi$ɲ$_{L}$-$[_\omega$tooká]]											*

Table 4.38: Associative Final H-tone c9/10 roots with overt determiner

	Form					Gloss
		ASSOC-	D-	NUM-	*n*	
a.	e-ki-ɣέrɔ	kja	a-	ɲ-	akwaahá	‘the/a thing of a/the armpit’ (c7, c9)
b.	e-ki-ɣέrɔ	ɣɛ	tʃaa	ɲ-	akwaahá	‘the/a thing of some/a armpits’ (c7, c10)

Table 4.39: Associative Final H-tone c9/10 roots with null determiner

	Form					Gloss
		ASSOC-	D-	NUM-	*n*	
a.	ki-ɣέrɔ	kɛ		ɲ-	akwaahá	‘no thing of no armpit’ (c7, c9)
b.	ki-ɣέrɔ	kɛ		ɲ-	akwaahá	‘no thing of no armpits’ (c7, c10)

(65) Evaluation of associative Final H-tone c9 root with overt determiner

$[_{PP}$\{kja$_{H}$, kjá\}+$[_{DP}$\{a, á\}$_{L}$+$[_{NumP}$\{N, ∅\}$_{L}$+$[_{nP}$\{akwaahá\}]]]]

	MONOH	HIGHΦ	*(σV́)	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	SEL:H	HIGHω	MP:RT-CM	AL(H,φ)
☞ a. $[_{\iota}[_{\phi}$kja$_{H}$-a$_{L}$-ɲ$_{L}$-$[_{\omega}$akwaahá]]								*			*
b. $[_{\iota}[_{\phi}$kjá-a$_{L}$-ɲ$_{L}$-$[_{\omega}$akwaahá]]	*!			*							
c. $[_{\iota}[_{\phi}$kja$_{H}$-á$_{L}$-ɲ$_{L}$-$[_{\omega}$akwaahá]]	*!			*				*			
d. $[_{\iota}[_{\phi}$kjá-á$_{L}$-ɲ$_{L}$-$[_{\omega}$akwaahá]]	*!										

(66) Evaluation of associative Final H-tone c9 root with null determiner

[$_{\text{PP}}${kɛ$_{\text{H}}$, kɛ́}+[$_{\text{DP}}$[$_{\text{NumP}}${N, ∅}$_{\text{L}}$+[$_{\text{nP}}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_\iota$[$_\phi$kɛ$_{\text{H}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]								*			*
b. [$_\iota$[$_\phi$kɛ́-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]	*!										

(67) Evaluation of associative Final H-tone c10 root with overt determiner

[$_{\text{PP}}${ɣɛ$_{\text{H}}$, ɣɛ́}+[$_{\text{DP}}${tʃaa, tʃáá, tʃáa}$_{\text{L}}$+[$_{\text{NumP}}${N, ∅}$_{\text{L}}$+[$_{\text{nP}}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_\iota$[$_\phi$ɣɛ$_{\text{H}}$-tʃaa$_{\text{L}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]								*			*
b. [$_\iota$[$_\phi$ɣɛ$_{\text{H}}$-tʃáá$_{\text{L}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]	*!										*
c. [$_\iota$[$_\phi$ɣɛ$_{\text{H}}$-tʃáa$_{\text{L}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]	*!			*							*
d. [$_\iota$[$_\phi$ɣɛ́-tʃaa$_{\text{L}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]	*!										
e. [$_\iota$[$_\phi$ɣɛ́-tʃáá$_{\text{L}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]	*!										
f. [$_\iota$[$_\phi$ɣɛ́-tʃáa$_{\text{L}}$-ɲ$_{\text{L}}$-[$_\omega$akwaahá]]	*!			*							

(68) Evaluation of associative Final H-tone c10 root with null determiner

[$_{\text{PP}}${kɛ$_{\text{H}}$, kɛ́}+[$_{\text{DP}}$[$_{\text{NumP}}${N, ∅}$_{\text{L}}$+[$_{\text{nP}}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_\iota$[$_\phi$kɛ$_{\text{H}}$-ɲ-[$_\omega$akwaahá]]								*			*
b. [$_\iota$[$_\phi$kɛ́-ɲ-[$_\omega$akwaahá]]	*!										

4.5.3 Data summary

Table 4.40: Summary: Final H tone class

		D-NUM-*n*	Gloss
a)		o-mo-sirikaré	'the/a policeman' (c1)
b)		∅-mo-sirikaré	'some policeman' (c1)
c)		ri-i-tooká	'the/a store' (c5)
d)		∅-i-tooká	'some store' (c5)
e)		a-ɲ-akwaahá	'the/an armpit' (c9)
f)		∅-ɲ-akwaahá	'some armpit' (c9)
g)		tʃaa-ɲ-akwaahá	'the armpits' (c10)
h)		∅-ɲ-akwaahá	'some armpits' (c10)
	D-NUM-*n*	P-D-NUM-*n*	Gloss
i)	e-ɣé-seku	kjo-o-mo-sirikaré	'the/a door of the/a policeman' (c7, c1)
j)	∅-ɣé-seku	ke-∅-mo-sirikaré	'some door of some policeman' (c7, c1)
k)	e-ɣé-seku	ke-ri-i-tooká	'the/a door of the/a store' (c7, c5)
l)	∅-ɣé-seku	ɣi-∅-i-tooká	'some door of some store' (c7, c5)
m)	e-ki-ɣέrɔ	kja-a-ɲ-akwaahá	'the/a thing of the/an armpit' (c7, c9)
n)	∅-ki-ɣέrɔ	kɛ-∅-ɲ-akwaahá	'some thing of some armpit' (c7, c9)
o)	e-ki-ɣέrɔ	ɣɛ-tʃaa-ɲ-akwaahá	'the/a thing of armpits' (c7, c10)
p)	∅-ki-ɣέrɔ	kɛ-∅-ɲ-akwaahá	'some thing of some armpits' (c7, c10)

4.5.4 Analysis summary

The analysis of the final H tone class is essentially that no constraints particularly dictate the surface form besides MONOH and HIGHϕ. This is precisely because the roots in these cases have only one allomorph, and that allomorph has a high tone. Note that this also relies on nominal structure being minimally composed of a root and class marker.

4.5.5 Morph set relations

Final H roots are simpler than low tone roots in that they never vary. If a root has an allomorph with a final H tone, that set is well formed. The condition above does not apply to such roots, because that condition holds of allomorphs with initial Hs, which final H roots do not have.

4.6 Initial H tone class

4.6.1 General

Initial H tone roots generally occur with a root allomorph that has a high tone on the initial syllable. Forms involving these roots also occur with high tone on the syllable preceding the root, or on the second syllable of the root. The roots involved have three relevant allomorphs: HL, LH, and L. The low allomorph is distinct from the low allomorph of low tone roots in that it also requires the preceding syllable have a high tone.

Consider the forms shown in Table 4.41, which illustrate the basic cases involving initial H roots. In these forms, the root allomorph has a H on the initial syllable and there are no other high tones.

Table 4.41: Underived Initial H-tone roots with overt determiner

		Form		Gloss
	D-	NUM-	*n*	
a.	o-	mu-	kári	'the/a woman' (c1)
b.	o-	mu-	ɣáruka	'the/a old man' (c1)
c.	e-	ɣe-	síma	'the/a well' (c7)
d.	o-	ro-	síri	'the/a rope' (c11)

Forms with an initial H and null determiners also surface with an initial H allomorph of the root.

Table 4.42: Underived Initial H-tone roots with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		mu-	kári	‘the/a woman’ (c1)
b.		mu-	ɣáruka	‘the/a old man’ (c1)
c.		ɣe-	síma	‘the/a well’ (c7)
d.		ro-	síri	‘the/a rope’ (c11)

Derived roots can be of the initial H tone root class, as we saw with the low tone root class. Observe that these surface like their underived counterparts above.

Table 4.43: Derived Initial H-tone roots with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	o-	mu-	sɛ́k-u	‘person who is laughed at’ (c1)
b.	e-	ke-	mér-u	‘thing which is swallowed’ (c7)
c.	o-	ko-	mér-a	‘act of swallowing’ (c15)

Table 4.44: Derived Initial H-tone roots with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		mu-	[sɛ́k-u]	‘person who is laughed at’ (c1)
b.		ke-	[mér-u]	‘thing which is swallowed’ (c7)
c.		ko-	[mér-a]	‘act of swallowing’ (c15)

The evaluation of forms involving initial H roots is more complex than we have seen in the sense that there are more candidates. This is a function of more allomorphs for initial H roots than for low tone roots and final H roots, which both generally have only one allomorph.

Initial H root morphemes have two types of restrictions; the first is phonological selection, which we are already familiar with: the all low allomorph is phonologically restricted by the requirement that it is preceded by a high tone, as governed by SELECTION. The second restriction is morphological; the LH allomorph is morphologically restricted to occur in a class 5 context (preceded by c5 prefix/determiner), as governed by MORPHPREF. Recall that many roots can occur in class 5, as it is used to for an evaluative reading. In terms of analytical mechanisms, the low allomorph of the root has a SEL:H_ restriction, and the LH allomorph is indexed to c5; consider the corresponding constraints below.

(69) SELECT:H and MORPHPREF:ROOT-DETERMINER definitions

SEL:H_:	Assign a violation mark to any allomorph that has a Sel:H_ restriction and is not preceded by a syllable with H tone.
MP:RT-DET:	Assign a violation mark to any form that has a root marked for a class feature and that class feature is not the same as the class feature of the preceding determiner within the ϕ.

Note that because MP:RT-DET is ranked below SEL:L, the violations do not have any impact on the evaluations for low tone roots we saw in Section 4.4.2. Before we continue the analysis, we will pare down some of the cases we consider for the sake of clarity. MONOH is undominated, therefore no candidate with high tone on more than one syllable will ever be optimal; from here on, I will not include this constraint nor the forms that violate it. Consult Appendix B for full tableaux.

The optimal form of the initial H root in the basic context (overt determiner, no prepositional prefixes) violates alignment; comparing the optimal form in (70c.) with the losing form in (70e.) that satisfies alignment, observe that the latter violates $*(_\sigma\acute{V}$ (like similar low tone root forms do), and additionally violates the selectional restriction on the low tone allomorph of the initial H root morph set (the syllable preceding the root is not H). The losing candidate in (70b.) violates the morphological restriction on the LH allomorph of the initial H roots: it is not in a class 5 context; therefore both MP:RT-DET is violated. The losing candidate in (70d.) violates HIGHω, which requires a high tone within the ω; this is the counterpart to the familiar HIGHϕ constraint. In contrast, the winner in (70c.) satisfies HIGHω.

(70) Evaluation of Initial H-tone root with overt determiner

$[_{DP}\{$e, é$\}$+$[_{NumP}\{$ ɣe, ɣé$\}$+$[_{nP}\{$síma, simá$_{c5}$, sima$_{H_}\}]]]$

		HIGHΦ	*($_{\sigma}$V́	VV-TONE	SEL:H_	MP:RT-DET	HIGHω	AL(H,ϕ)
	a. [$_{\phi}$e-ɣe-[$_{\omega}$sima$_{H_}$]]	*!			*		*	*
	b. [$_{\phi}$e-ɣe-[$_{\omega}$simá$_{c5}$]]					*!		*
☞	c. [$_{\phi}$e-ɣe-[$_{\omega}$síma]]							*
	d. [$_{\phi}$e-ɣé-[$_{\omega}$sima$_{H_}$]]						*!	*
	e. [$_{\phi}$é-ɣe-[$_{\omega}$sima$_{H_}$]]		*!		*			

The evaluation of initial H roots with a null determiner is similar to the evaluation with an overt determiner. Crucially this case involves a lower ranked MORPHPREF constraint which related root morphemes with class marker morphemes, as opposed to the constraint related roots and determiners.

(71) MORPHPREF:ROOT-CLASS MARKER

MP:RT-CM: Assign a violation mark to any form that has a root marked for a class feature and that class feature is not the same as the class feature of the preceding class prefix within the ϕ.

This case is unique in illustrating that the features of these morphemes are directly related, as this is the only case in which the determiner has no class features, and there is no phonological reason to prefer the form in (72b.) to the winner in (72c.) aside from the mismatch in features between the root and class marker. The losing candidate in (72d.) fatally violates HIGHω. The optimal candidate in (72c.) violates only alignment.

(72) Evaluation of Initial H-tone root with null determiner

[$_{DP}$[$_{NumP}$\{ ɣe, ɣé\}+[$_{nP}$\{síma, simá$_{c5}$, sima$_{H_}$\}]]]

	HIGHΦ	*(σV́	VV-TONE	SEL:H_	MP:RT-DET	HIGHω	MP:RT-CM	AL(H,ϕ)
a. [$_\phi$ ɣe-[$_\omega$sima$_{H_}$]]	*!			*		*		*
b. [$_\phi$ ɣe-[$_\omega$simá$_{c5}$]]							*!	*
☞ c. [$_\phi$ ɣe-[$_\omega$síma]]								*
d. [$_\phi$ ɣé-[$_\omega$sima$_{H_}$]]						*!		

As was mentioned previously, this case also illustrates that MP:RT-CM is ranked under HIGHϕ. This ranking means that the constraint cannot be used to differentiate between forms in (43), although it is sensitive to exactly the relevant distinction.

Forms with initial H roots and prepositional prefixes occur with the initial H allomorph of the root.

Table 4.45: Associative Initial H-tone root with overt determiner

	Form					Gloss
		ASSOC-	D-	NUM-	*n*	
a.	e-ki-ɣɛ́rɔ	kjo-	o-	mu-	kári	'the/a door of the/a woman' (c7, c1)
b.	e-ɣe-síma	kjo-	o-	mu-	ɣáruka	'the/a door of the/a old man' (c7, c1)

Unlike forms we have seen thus far, forms with a prepositional prefix and null determiner involving initial H roots do not surface with the same relative H tone position. These forms surface with the all low allomorph of the root and a H allomorph of the class prefix. This configuration is unexpected; however, as we shall see, the selectional restriction of the low tone allomorph accounts for this surface form.

Table 4.46: Associative Initial H-tone root with null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	ki-ɣɛ́rɔ	ke-		mú-	kari	'the/a door of the/a woman' (c7, c1)
b.	ɣe-sí́ma	ke-		mú-	ɣaruka	'the/a door of the/a old man' (c7, c1)

Associative forms with initial H-tone roots and overt determiners illustrate a crucial interaction between the selectional restrictions on the low tone preposition allomorph and the determiner. Up to this point, these restrictions have not been relevant, though the morphemes which bear them have been discussed.

The determiner has the same selectional restriction as the class 9/10 prefix: it selects for a following low tone.

(73) Selectional restrictions determiners

$\{V, \acute{V}\}_L$ DET

$\{\ldots\}_L$: This morpheme (set) selects for a following syllable with low tone.

SEL:L: Assign a violation mark to any allomorph that has a Sel:L restriction and is not followed by a syllable with L tone.

The low tone allomorph of the prepositional prefixes (the associative in this case) selects for a following H tone. This is distinct from the selection restriction of the all low allomorph of the initial H tone class of root morphemes.

(74) Selectional restrictions for prepositions

$\{CV_H, C\acute{V}\}$ ASSOC

CV_H: This morpheme selects for a following syllable with high tone.

SEL:H: Assign a violation mark to any allomorph that has a Sel:H restriction and is not followed by a syllable with H tone.

Before turning to how selectional restrictions interact in this case, let us consider the more usual interactions. The form in (75a.) predictably loses out to the optimal form because it lacks an H tone and violates

HIGHϕ. The forms in (75e. & f.) violate VV-TONE because they include either a globally prohibited contour, or contextually prohibited counter. The form in (75g.) satisfies alignment and VV-TONE; however, it fatally violates SEL:H$_{_}$; note that the comparable form involving a low tone root in (32) is not subject to this restriction, because low tone roots do not have an all low allomorph which selects for preceding H.

The forms in (75b.-d.) involve the interaction of selectional restrictions. The form in (75d.) uses the all low allomorph of the root and satisfies the selectional restriction of that root morph, SEL:H$_{_}$, by occurring with a H class prefix preceding the root; however, it violates SEL:L on the determiner, which the optimal form in (75c.) satisfies. The form in (75b.) loses to the optimal form in (75c.) because it violates MP:RT-DET by including the c5 morph of the root in a non-c5 context. The optimal form violates the selectional restriction of the low tone prefix morph, SEL:H.

(75) Evaluation of associative Initial H-tone root with overt determiner

$[_{PP}\{kjo_H, kjó\}+[_{DP}\{o, ó\}_L+[_{NumP}\{mu, mú\}+[_{nP}\{kári, kari_{H\_}, karí_{c5}\}]]]]$

	HIGHΦ	*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	SEL:H	HIGHϖ	MP:RT-CM	AL(H,ϕ)
a. $[_\iota[_\phi kjo_H\text{-}o_L\text{-mu-}[_\omega kari_{H\_}]]$	*!			*			*	*		
b. $[_\iota[_\phi kjo_H\text{-}o_L\text{-mu-}[_\omega karí_{c5}]]$						*!	*		*	*
☞ c. $[_\iota[_\phi kjo_H\text{-}o_L\text{-mu-}[_\omega kári]]$							*			*
d. $[_\iota[_\phi kjo_H\text{-}o_L\text{-mú-}[_\omega kari_{H\_}]]$					*!			*		*
e. $[_\iota[_\phi kjo_H\text{-}ó_L\text{-mu-}[_\omega kari_{H\_}]]$			*!	*				*		
f. $[_\iota[_\phi kjó\text{–}o_L\text{-mu-}[_\omega kari_{H\_}]]$			*!	*			*	*		
g. $[_\iota[_\phi kjó\text{–}ó_L\text{-mu-}[_\omega kari_{H\_}]]$				*!				*		

The evaluation of initial H roots with an associative prefix and null determiner crucially relies on the restriction that low tone prepositional prefixes not be followed by a low tone. This is in contrast to the previous cases with an overt determiner, where SEL:L crucially excluded forms with a H on the class prefix that would satisfy SEL:H. Compare (75d.), a losing candidate in the previous tableaux, with (76d.), the optimal form in the tableaux below. Because forms with a null determiner cannot violate SEL:L, the form in (76d.) wins over (76c.) which satisfies both SEL:H$_{_}$ on the root, and SEL:H on the preposition.

(76) Evaluation of associative Initial H-tone root with null determiner

$[_{PP}\{ke_H, ké\}[_{DP}[_{NumP}\{mu, mú\}+[_{nP}\{kári, kari_{H\_}, karí_{c5}\}]]]]$

	HighΦ	*(σ V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
a. $[_\iota[_\phi ke_H\text{-mu-}[_\omega kari_{H\_}]]$	*!			*			*	*		*
b. $[_\iota[_\phi ke_H\text{-mu-}[_\omega karí_{c5}]]$							*!		*	*
c. $[_\iota[_\phi ke_H\text{-mu-}[_\omega kári]]$							*!			*
☞ d. $[_\iota[_\phi ke_H\text{-mú-}[_\omega kari_{H\_}]]$								*		*
g. $[_\iota[_\phi ké\text{–mu-}[_\omega kari_{H\_}]]$				*!				*		

4.6.2 Classes 5, 9, 10

Initial H roots in classes 5, 9 and 10 occur with a LH allomorph of the root in general. This contrasts with the cases we have just seen where forms with initial H roots occur with the initial H allomorph in general, and in the case with a prepositional prefix and null determiner with the all low allomorph. In terms of analysis, the LH allomorph is indexed to morphological context. Beyond these basic cases, forms with a prepositional prefix and null determiner surface with an initial H allomorph. This is comparable to the cases we have just seen where initial H roots in forms with a prepositional prefix and null determiner surface with an all low root allomorph; notice that in both situations H is one syllable right of the position it is realized in with an overt determiner.

Class 5

Initial H roots in class 5 with an overt determiner surface with high tone on the second root syllable. Considering only two syllable roots, there is an ambiguity between final H and second syllable from the left H; however, trisyllabic cases illustrate that the more broad generalization is second syllable H.

Table 4.47: Initial H-tone Class 5 roots with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	ri-	i-	kará	'charcoal (piece)' (c5)
b.	a-	ma-	kára	'charcoal (mass) (c6)
c.	ri-	i-	huundúku	'corpse' (c5)
d.	a-	ma-	húúnduku	'corpses' (c6)
e.	ri-	i-	βurúuŋga	'egg' (c5)
f.	a-	ma-	βúruuŋga	'eggs' (c6)

Initial H roots in class 5 with a null determiner also surface with a LH root allomorph.

Table 4.48: Initial H-tone Class 5 roots with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		i-	kará	'charcoal (piece)' (c5)
b.		ma-	kára	'charcoal (mass) (c6)
c.		i-	huundúku	'corpse' (c5)
d.		ma-	húúnduku	'corpses' (c6)
e.		i-	βurúuŋga	'egg' (c5)
f.		ma-	βúruuŋga	'eggs' (c6)

The evaluation of initial H roots in the context of class 5, 9, and 10 is straightforward; in all of these contexts, the roots surface with the LH allomorph, which is lexically restricted to class 5. The form in (77a.) violates SEL:L. The forms in (77b.-e.) violate HIGHϕ (among other constraints), which the optimal form in (77i.) satisfies.

(77) Evaluation of Initial H-tone c5 root with overt determiner

$[_{DP}\{$ri, rí$\}_L$+$[_{NumP}\{$i, í$\}$+$[_{nP}\{$βúruuŋga, βuruuŋga$_{H_}$, βurúuŋga$_{c5}\}]]]]$

	HIGHΦ	*($_\sigma$V́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	SEL:H	HIGHϖ	MP:RT-CM	AL(H,ϕ)
a. $[_\iota[_\phi$ri$_L$-i-$[_\omega$βúruuŋga]]					*					*
b. $[_\iota[_\phi$ri$_L$-i-$[_\omega$βuruuŋga$_{H_}$]]	*!			*				*		*
c. $[_\iota[_\phi$ri$_L$-í$[_\omega$βuruuŋga$_{H_}$]]			*!					*		
d. $[_\iota[_\phi$rí$_L$-í-$[_\omega$βuruuŋga$_{H_}$]]								*!		
e. $[_\iota[_\phi$rí$_L$-i-$[_\omega$βuruuŋga$_{H_}$]]			*!					*		
☞ i. $[_\iota[_\phi$ri$_L$-i-$[_\omega$βurúuŋga$_{c5}$]]										*

Forms in c5 with initial H roots and null determiners require a highly ranked constraint which penalizes roots without an index when a root with an index matching the prefix/determiner is available. In other words, a constraint which would favour (78e.) over (78a.). This is similar to the constraint proposed as a solution to the case in (43); however, that constraint assigns violations to indexed roots that do not match prefix morphemes. The constraint at hand assigns violations to unindexed roots, as these do not have identical class features to their prefixes; furthermore, this constraint only needs to outrank SEL:H, as illustrated by the case of associatives with initial H roots in c5 with an overt determiner (80). Note that it also must be ranked under SEL:L, but has no relationship to MP:RT-DET.

(78) *UNMARKEDROOTMORPH (*∅RT)

*∅RT: Assign a violation to mark to forms with roots that are unspecified for a class feature.

(79) Evaluation of Initial H-tone c5 root with null determiner

[$_{DP}$[$_{NumP}${i, í}+[$_{nP}${βúruuŋga, βuruuŋga$_{H_}$, βurúuŋga$_{c5}$}]]]]

	HIGHΦ	*($_\sigma$V́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHϖ	MP:RT-CM	AL(H,ϕ)
a. [$_\iota$[$_\phi$i-[$_\omega$βúruuŋga]]							*!				*
c. [$_\iota$[$_\phi$i-[$_\omega$βuruuŋga$_{H_}$]]	*!			*			*		*		
d. [$_\iota$[$_\phi$í-[$_\omega$βuruuŋga$_{H_}$]]		*!					*		*		
☞ e. [$_\iota$[$_\phi$i-[$_\omega$βurúuŋga$_{c5}$]]											*

Initial H roots in class 5 with a prepositional prefix and overt determiner surface with the LH allomorph of the root. Compare the c6 forms, where the initial H allomorph is used. This demonstrates that the LH allomorph is generally favoured in the class 5 context.

Table 4.49: Initial H-tone roots, c5, associative with overt determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	o-mu-kári	wo-	ri-	i-	βurúuŋga	'the/a woman of a/the egg' (c1, c5)
b.	o-mu-kári	wa-	a-	ma-	βúruuŋga	'the/a woman of some/a eggs' (c1, c6)

Given the forms we have seen above involving initial H roots in class 5 contexts, the forms with a preposition and a null determiner are surprising, because they do not surface with the LH allomorph of the root. Instead, such forms surface with the initial H allomorph of the root. This is also surprising considering the general cases of initial H roots with prepositional prefixes and a null determiner, where the all low allomorph of the root is used. Considering the range of cases with initial H roots, the location of H tone is one syllable to the right in the context with a preposition and null determiner when compared to the context with a preposition and overt determiner.

Table 4.50: Initial H-tone roots, c5, associative with phonologically null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	o-mu-kári	wi-		i-	βúruuŋga	‘no woman of no egg’ (c1, c5)
b.	o-mu-kári	wɔ-		ma-	βúruuŋga	‘no woman of no eggs’ (c1, c6)

Because of the number of morphemes and selectional restrictions in the following tableaux, forms which violate the undominated constraint HIGHϕ are omitted; similarly there are no candidates with vowel initial allomorphs, therefore *($_\sigma$V́ has been omitted.

For the candidates in (80c.), the violation of *∅RT illustrates the crucial ranking of *∅RT over SEL:H; the latter constraint is violated by the winning candidate in (80e.), whereas the former constraint is violated by the candidate in (80c.). The candidate in (80e.), which satisfies alignment, violates the selectional restriction on the all low allomorph of the initial H root; were this an all low root, this would be the optimal candidate, precisely because the all low allomorph of all low roots does not have a selectional restriction requiring a high tone on the preceding syllable. The losing candidates in (80b. & d.) violate VV-TONE because of their illicit contours on a long vowel: the candidate in (80b.) because rising contours are always penalized, and the candidate in (80d.) because falling tone is penalized outside the penultimate syllable of a ϕ.

(80) Evaluation of associative initial H-tone c5 root with overt determiner

$[_{PP}\{wo_H, wó\}+[_{DP}\{ri, rí\}_L+[_{NumP}\{i, í\}+[_{nP}\{$βúruuŋga, βuruuŋga$_{H_}$, βurúuŋga$_{c5}\}]]]]$

	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
a. $[_\iota[_\phi$ wo$_H$-ri$_L$-i-$[_\omega$βúruuŋga]]			*!		*	*			*
b. $[_\iota[_\phi$ wo$_H$-ri$_L$-í-$[_\omega$βuruuŋga$_{H_}$]]	*!				*		*		*
c. $[_\iota[_\phi$ wo$_H$-rí$_L$-í-$[_\omega$βuruuŋga$_{H_}$]]					*!		*		*
d. $[_\iota[_\phi$ wo$_H$-rí$_L$-i-$[_\omega$βuruuŋga$_{H_}$]]	*!				*		*		*
☞ e. $[_\iota[_\phi$ wo$_H$-ri$_L$-i-$[_\omega$βurúuŋga$_{c5}$]]						*			*
f. $[_\iota[_\phi$ wó-ri$_L$-i-$[_\omega$βuruuŋga$_{H_}$]]		*!					*		

The evaluation of initial H roots in class 5 with a prepositional prefix and a null determiner are of interest because these are cases where the surface form does not include the morphologically specified LH allomorph of the root. Unfortunately, our analysis will incorrectly predict that the optimal form surfaces with the c5 indexed form, precisely because of the ranking for *∅Rt established by (80). The observed surface form is indicated with a "☹".

If we ignore violations of *∅Rt the candidate in (81e.) that uses the LH allomorph, loses to the observed form (81a.) because the former violates Sel:H. However, because the candidates in (80a. & c.) violate *∅Rt, the predicted output is (81e.)

(81) Evaluation of associative initial H-tone c5 root with null determiner

$[_{PP}\{\text{wi}_H, \text{wí}\}+[_{DP}[_{NumP}\{\text{i, í}\}+[_{nP}\{\text{βúruuŋga, βuruuŋga}_{H\_}, \text{βurúuŋga}_{c5}\}]]]]$

		VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☹	a. $[_\iota[_\phi \text{wi}_H\text{-i-}[_\omega \text{βúruuŋga}]]$					*!				*
	b. $[_\iota[_\phi \text{wi}_H\text{-í-}[_\omega \text{βuruuŋga}_{H\_}]]$	*!				*	*	*		
	c. $[_\iota[_\phi \text{wí-í-}[_\omega \text{βuruuŋga}_{H\_}]]$					*!		*		
	d. $[_\iota[_\phi \text{wí-i-}[_\omega \text{βuruuŋga}_{H\_}]]$	*!				*		*		
☞	e. $[_\iota[_\phi \text{wi}_H\text{-i-}[_\omega \text{βurúuŋga}_{c5}]]$						*!			*

Class 9/10

Initial H roots in class 9 and in class 10 with an overt determiner occur with the LH allomorph, as they do in class 5. The observation that the LH allomorph occurs in all three of these contexts is crucial evidence that the form is morphologically conditioned, not phonologically conditioned: the class 5 pre-root phonological material is a CVV, the class 9 pre-root material is a V, and the class 10 pre-root material is a CVV. The outlier of class 9 essentially supports the claim that phonological material is not conditioning the LH allomorph.

Table 4.51 illustrates class 9/10 plurals in contrast with class 12 evaluative forms. Nouns with initial H roots occur with the LH allomorph in classes 9 and 10, but those same roots occur with the initial H allomorph in class 12 (which follows the general pattern shown in the preceding section).

Table 4.51: Initial H-tone Class 9/10 roots with overt determiner

	Form			Gloss
	D-	NUM-	*n*	
a.	a-	m-	baráhe	'a/the Thomson's Gazelle' (c9)
b.	tʃaa-	m-	baráhe	'some/the Thomson's Gazelles' (c10)
c.	a-	ka-	bárahe	'a/the Thomson's Gazelle (eval.)' (c12)
d.	a-	ŋ-	gokó	'a/the chicken' (c9)
e.	tʃaa-	ŋ-	gokó	'some/the chickens' (c10)
f.	a-	ka	góko	'a/the chicken (eval.)' (c12)

Initial H roots in classes 9 and 10 with null determiners also surface with the LH allomorph of the root. This is consistent with the general pattern that forms without prepositional prefixes demonstrate with over and null determiner (i.e. same H tone position, same root allomorph in the case of initial H roots).

Table 4.52: Initial H-tone Class 9/10 roots with null determiner

	Form			Gloss
	D-	NUM-	*n*	
a.		m-	baráhe	'no Thomson's Gazelle' (c9)
b.		m-	baráhe	'no Thomson's Gazelles' (c10)
c.		ka-	bárahe	'no Thomson's Gazelle (eval.)' (c12)
d.		ŋ-	gokó	'no chicken' (c9)
e.		ŋ-	gokó	'no chickens' (c10)
f.		ka	góko	'no chicken (eval.)' (c12)

The winning candidate in (82b.) satisfies the selectional restrictions on the determiner and c9/10 prefix; however, it violates alignment. The next best candidate in (82a.) fails to satisfy the selectional restriction of both the determiner and class 9/10 prefix, because the syllable following those morphs is not low. The candidate in (82c.) violates $*(_\sigma\acute{V}$; note that this type of form would win if it included a low tone root; however, because initial H roots have allomorphs that can provide an H tone in a position which does not violate $*(_\sigma\acute{V}$, the candidate at hand loses to them (82a.&b.).

(82) Evaluation of Initial H-tone c9 root with overt determiner

$[_{DP}\{\text{a, á}\}_L + [_{NumP}\{\text{N}, \emptyset\}_L + [_{nP}\{\text{barahe}_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	$*(_\sigma\acute{V}$	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. $[_\iota[_\phi \text{a}_L\text{-m}_L\text{-}[_\omega\text{bárahe}]]$				*!		*				*
☞ b. $[_\iota[_\phi \text{a}_L\text{-m}_L\text{-}[_\omega\text{baráhe}_{c9/10}]]$										*
c. $[_\iota[_\phi \text{á}_L\text{-m}_L\text{-}[_\omega\text{barahe}_{H\_}]]$	*!					*		*		

The evaluation of initial H roots in class 10 with an overt determiner is similar to the evaluation we have considered from comparable forms in class 9. The candidate in (83d.) loses to the winner (83b.) because it violates *∅Rt and Highω. A similar candidate in (83c.) violates VV-Tone because it has a falling contour in a non-penultimate syllable. The candidate in (83a.) violates Sel:L, which is not violated by the winner in (83b.). Note that the LH allomorph of the initial H root class is indexed to class 9 and 10, unlike the HL allomorph of the low root, which is only indexed to class 9.

(83) Evaluation of Initial H-tone c10 root with overt determiner

$[_{DP}\{\text{tʃaa, tʃáá, tʃáa}\} + [_{NumP}\{\text{N}, \emptyset\}_L + [_{nP}\{\text{barahe}_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	$*(_\sigma\acute{V}$	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. $[_\iota[_\phi \text{tʃaa-m}_L\text{-}[_\omega\text{bárahe}]]$				*!		*				*
☞ b. $[_\iota[_\phi \text{tʃaa-m}_L\text{-}[_\omega\text{baráhe}_{c9/10}]]$										*
c. $[_\iota[_\phi \text{tʃáa-m}_L\text{-}[_\omega\text{barahe}_{H\_}]]$		*!				*		*		
d. $[_\iota[_\phi \text{tʃáá-m}_L\text{-}[_\omega\text{barahe}_{H\_}]]$						*!		*		

The evaluation of initial H tone roots in class 9 with a null determiner is very straightforward as the only source of high tone is the root, which only has two high tone allomorphs: HL and LH. Of these two allomorphs, the LH allomorph is also marked for c9, as we have already observed. The losing candidate in (84a.) violates SEL:L. The winning candidate in (84b.) only violates alignment.

(84) Evaluation of Initial H-tone c9 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_{L}+[_{nP}\{\text{barahe}_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
a. $[_{\iota}[_{\phi}m_{L}\text{-}[_{\omega}\text{bárahe}]]$				*!		*				
☞ b. $[_{\iota}[_{\phi}m_{L}\text{-}[_{\omega}\text{baráhe}_{c9/10}]]$										*

The evaluation of initial H roots in class 10 with a null determiner is identical to their class 9 counterparts. This is because the only phonological difference between c9 and c10 forms is the determiner.

(85) Evaluation of Initial H-tone c10 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_{L}+[_{nP}\{\text{barahe}_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
a. $[_{\iota}[_{\phi}m_{L}\text{-}[_{\omega}\text{bárahe}]]$				*!		*				
☞ b. $[_{\iota}[_{\phi}m_{L}\text{-}[_{\omega}\text{baráhe}_{c9/10}]]$										*

Words with initial H tone roots in class 9 and 10 with overt determiners and prepositional prefixes occur with the LH allomorph of the root.

Table 4.53: Initial H-tone roots, c9/10, associative with overt determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	e-rí-ino	rja	a-	m-	baráhe	'the/a tooth of a/the Thomson's Gazelle' (c5, c9)
b.	e-rí-ino	rɛ	tʃaa	m-	baráhe	'the/a tooth of some/a Thomson's Gazelles' (c5, c10)

Like the class 5 counterparts, initial H roots in class 9 and 10 with a null determiner and prepositional prefix differ from their counterparts with an overt determiner in that they occur with the HL allomorph of the root.

Table 4.54: Initial H-tone roots, c9/10, associative with null determiner

		Form				Gloss
		ASSOC-	D-	NUM-	*n*	
a.	e-rí-ino	rɛ		m-	bárahe	'no tooth of no Thomson's Gazelle' (c5, c9)
b.	e-rí-ino	rɛ		m-	bárahe	'no tooth of no Thomson's Gazelles' (c5, c10)

The evaluation of initial H roots in class 9 with an overt determiner and prepositional prefix is essentially the same as for comparable class 5 cases in (80). The winning candidate in (86e.) violates SEL:H, but satisfies all higher ranked constraints. The forms in (86c.) and (86d.) violate *∅RT because they include unmarked allomorphs of the root. Additionally, the candidate in (86d.) violates SEL:L. The candidates in (86a. & b.) fatally violate VV-TONE; the former because it has a rising contour which is penalized in all positions, and the latter because it has a falling contour on a non-penultimate syllable.

(86) Evaluation of associative Initial H-tone c9 root with overt determiner

$[_{PP}\{\text{rja}_{H}, \text{rjá}\}+[_{DP}\{\text{a, á}\}+[_{NumP}\{\text{N}, \emptyset\}_{L}+[_{nP}\{\text{barahe}_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
a. $[_{\iota}[_{\phi}\text{rjá-a-m}_{L}\text{-}[_{\omega}\text{barahe}_{H\_}]]$		*!				*		*		
b. $[_{\iota}[_{\phi}\text{rja}_{H}\text{-á-m}_{L}\text{-}[_{\omega}\text{barahe}_{H\_}]]$		*!				*		*		
c. $[_{\iota}[_{\phi}\text{rjá-á-m}_{L}\text{-}[_{\omega}\text{barahe}_{H\_}]]$						*!		*		*
d. $[_{\iota}[_{\phi}\text{rja}_{H}\text{-a-m}_{L}\text{-}[_{\omega}\text{bárahe}]]$				*!		*	*			
☞ e. $[_{\iota}[_{\phi}\text{rja}_{H}\text{-a-m}_{L}\text{-}[_{\omega}\text{baráhe}_{c9/10}]]$							*			*

As in the class 9 evaluation above, the optimal candidate in (87e.) violates SEL:H and alignment. The losing candidate in (87a.) satisfies SEL:H by virtue of not having a low tone prepositional prefix; however, it fails to satisfy the selectional restriction of the low tone allomorph of the root. The candidate in (87c.) satisfies both SEL:H and SEL:H_, but fatally violates *∅RT; the comparison between (87c.) and the winning candidate in (87e.) illustrates that *∅RT outranks SEL:H because if their ranking were reversed the former would be the winning candidate in this evaluation. The candidate in (87d.) violates SEL:L, as well as *∅RT and SEL:H, in other words it is harmonically bounded by the winner since they both violate SEL:H and the latter also violates a set of other constraints which the winner does not. The candidate in (87b.) violates VV-TONE because it has a falling contour in non-penultimate position.

(87) Evaluation of associative Initial H-tone c10 root with overt determiner

$[_{PP}\{$rɛ$_{H}$, rɛ́$\}$+$[_{DP}\{$tʃaa, tʃáá, tʃáa$\}$+$[_{NumP}\{N, \emptyset\}_{L}$+$[_{nP}\{$barahe$_{H_}$, bárahe, baráhe$_{c9/10}\}]]]]$

		*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
	a. $[_{\iota}[_{\phi}$rɛ́-tʃaa-m$_{L}$-$[_{\omega}$barahe$_{H_}$]]			*!			*		*		
	b. $[_{\iota}[_{\phi}$rɛ$_{H}$-tʃáa-m$_{L}$-$[_{\omega}$barahe$_{H_}$]]		*!				*		*		*
	c. $[_{\iota}[_{\phi}$rɛ$_{H}$-tʃáá-m$_{L}$-$[_{\omega}$barahe$_{H_}$]]						*!		*		*
	d. $[_{\iota}[_{\phi}$rɛ$_{H}$-tʃaa-m$_{L}$-$[_{\omega}$bárahe]]				*!		*	*			*
☞	e. $[_{\iota}[_{\phi}$rɛ$_{H}$-tʃaa-m$_{L}$-$[_{\omega}$baráhe$_{c9/10}$]]							*			*

The evaluations of initial H roots in class 9 and 10 with null determiners and prepositional prefixes fail to produce the observed optimal candidate; as for the cases without a prepositional prefix, the c9 and c10 evaluations are identical. The observed but non-optimal candidate is marked with a "☹". We will return to the mechanical problem with the analysis later in this chapter.

Initial H roots in class 9/10 with a null determiner and prepositional prefix actually occur with the initial H allomorph of the root. Our analysis predicts that such forms will surface with the all low allomorph of the root and a H allomorph of the prepositional prefix. The optimal candidate in (88a.) only violates HIGHω and *∅RT. The observed candidate in (88b.) violates SEL:L fatally, as well as alignment and *∅RT. Note that the candidate in (88c.) also fares better than the observed form in (88b.); the former violates SEL:H, which is crucially ranked lower than SEL:L, as we saw for previous cases.

(88) Evaluation of associative Initial H-tone c9 root with null determiner

$[_{PP}\{$rɛ$_{H}$, rɛ́$\}$+$[_{DP}$+$[_{NumP}\{N, \emptyset\}_{L}$+$[_{nP}\{$barahe$_{H_}$, bárahe, baráhe$_{c9/10}\}]]]]$

		*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,ϕ)
	a. $[_{\iota}[_{\phi}$rɛ́-m$_{L}$-$[_{\omega}$barahe$_{H_}$]]						*!		*		
☹	b. $[_{\iota}[_{\phi}$rɛ$_{H}$-m$_{L}$-$[_{\omega}$bárahe]]				*!		*				*
☞	c. $[_{\iota}[_{\phi}$rɛ$_{H}$-m$_{L}$-$[_{\omega}$baráhe$_{c9/10}$]]							*!			*

The class 10 evaluation is provided below for completeness sake, but as mentioned, it is identical to the c9 case (because the form of the determiner is the only phonological distinction between c9 and c10).

(89) Evaluation of associative Initial H-tone c10 root with null determiner

$[_{PP}\{r\varepsilon_{H}, r\acute{\varepsilon}\}+[_{DP}+[_{NumP}\{N, \emptyset\}_{L}+[_{nP}\{barahe_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

		*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,φ)
	a. $[_{\iota}[_{\phi}$rέ-m_{L}-$[_{\omega}$barahe$_{H_}$]]						*!		*		
☹	b. $[_{\iota}[_{\phi}$rε_{H}-m_{L}-$[_{\omega}$bárahe]]				*!		*				*
☞	c. $[_{\iota}[_{\phi}$rε_{H}-m_{L}-$[_{\omega}$baráhe$_{c9/10}$]]							*!			*

4.6.3 Data Summary

Forms with initial H roots generally surface with an initial H root allomorph. In class 5, 9, and 10, the LH root allomorph occurs. In contexts with a prepositional prefix, the initial H allomorph is used, except for classes 5, 9, and 10, where the LH allomorph is used. In contexts with a prepositional prefix and a null determiner, the H tone occurs one syllable to the right of the position it occurs in comparable contexts with an overt determiner.

Table 4.55: Summary: Initial H tone class

		D-NUM-*n*	Gloss
a)		o-mu-kári	'the/a woman' (c1)
b)		∅-mu-kári	'some woman' (c1)
c)		ri-i-βurúuŋga	'the/an egg' (c5)
d)		∅-i-βurúuŋga	'some egg' (c5)
e)		a-m-baŕahe	'the/a Thomson's Gazelle' (c9)
f)		∅-m-baráhe	'some Thomson's Gazelle' (c9)
g)		tʃaa-m-baráhe	'the Thomson's Gazelles' (c10)
h)		∅-m-baráhe	'some Thomson's Gazelle' (c10)
	D-NUM-*n*	P-D-NUM-*n*	Gloss
i)	e-ɣé-seku	kjo-o-mu-kári	'the/a door of the/a woman' (c7, c1)
j)	∅-ɣé-seku	ke-∅-mú-kari	'some door of some woman' (c7, c1)
k)	o-mu-kári	wo-ri-i-βurúuŋga	'the/a woman of the/an egg' (c7, c5)
l)	∅-mu-kári	wi-∅-i-βúruuŋga	'some woman of some egg' (c7, c5)
m)	e-rí́-ino	rja-a-m-baráhe	'the/a tooth of the/an Thomson's Gazelle' (c7, c9)
n)	∅-rí́-ino	rɛ-∅-m-bárahe	'some tooth of some Thomson's Gazelle' (c7, c9)
o)	e-rí́-ino	rɛ-tʃaa-m-baráhe	'the/a tooth of Thomson's Gazelle' (c7, c10)
p)	∅-rí́-ino	rɛ-∅-m-bárahe	'some tooth of some Thomson's Gazelle' (c7, c10)

4.6.4 Analysis summary

The analysis of initial H roots involves a number of morpheme specific phonotactics which are crucial. Roots have two allomorphs with special conditions. Class 9/10 class markers, determiners, and prepositional prefixes all have tonal phonotactics. MORPH PREFERENCE and *∅RT are crucial for classes 5, 9, and 10; recall that MORPHPREF is also a potential solution to the case of class 10 forms with a null determiner, except for the ranking required by the initial H forms we have considered.

The analysis fails to predict the observed surface forms for initial H roots in class 9/10 with a null determiner and prepositional prefix. The source of the failure is both that the observed surface forms violate SEL:L and do not use the class 9/10 indexed root allomorph.

One relevant observation is that class 9 initial H roots do not regularly surface with an all L allomorph, the way other initial H roots do. Nevertheless, class 9 roots can be used in an evaluative class, which can be used in an associative with a null determiner. In such cases, we would predict an all low allomorph. If this is not the case then the lack of such an allomorph would change our analysis and we would predict the correct surface form.

4.6.5 Morph set relations

Initial H roots have three allomorphs: HL..., LH(L)..., and LL.... If a root morph set has a high tone allomorph, it has a corresponding low tone allomorph. This is true of all disyllabic and larger roots aside from the final H roots. The relation states that allomorphs with a non-final H tone have a corresponding L tone allomorph.

(90) Morph set relation: Tone (Roots)

MSR_{RtTone}: Pairs of otherwise identical root allomorphs differ only with respect to a non-final H tone in one being L in the other.

$\{M_i, M_j\}$ M_i: [...H...]

M_j: [...L...]

Notice that this condition is not bidirectional; a H allomorph implies the existence of an L allomorph; however, a L allomorph does not imply the existence of a H allomorph. This is why low tone roots do not generally have any H tone allomorphs, but initial H roots have HL allomorphs and LL allomorphs. The class 9 low tone roots differ in that they are governed by bidirectional variants of this condition. Prefixes are governed by a version of this condition that globally applies to H tones (*i.e.* can relate final H tones to L), because every prefix we have considered is monosyllabic, the initial and final TBUs are identical.

(91) Morph set condition: Tone (Roots)

With respect to MSR_{RtTone}, a root morph set is ill-formed if M_i is present and there is no corresponding M_j.

MSC_{RtTone}: $*\{M_i, \neg M_j\}$

The relation between HL...and LH(L)...is unique to the initial H roots. This essentially means it does not relate the low tone c9 root HL allomorphs with any other allomorph, but it does relate the initial H tone root HL allomorph to an LH allomorph.

(92) Morph set relation: Tone (Initial H roots)

$MSR_{InitHRtTone}$: Pairs of otherwise identical initial H root allomorphs differ only with respect to a [HL...sequence in one being [LH...in the other.

$\{M_i, M_j\}$ M_i: [HL...]

M_j: [LH...]

The condition governing this relation is bidirectional. An initial H root morph set is ill formed if it has a LH allomorph but not HL, and vice versa. If the relationship were applied to all roots, or to morphemes in general, it would need to be unidirectional with {HL} being permissible, but {LH} being ill-formed; this is because cases like the low tone c9 roots exist, which have HL allomorphs, but no LH allomorphs.

(93) Morph set condition: Tone (Initial H roots)

With respect to $\text{MSR}_{\text{InitHRtTone}}$, an initial H root morph set is ill-formed if M_j is present and there is no corresponding M_i, or if M_i is present and there is no corresponding M_j

$\text{MSC}_{\text{InitHRtTone}}$: $*\{M_j, \neg M_i\}$

$*\{M_i, \neg M_j\}$

4.7 Summary and Conclusion

In this chapter we have seen that nominal forms in Nata have several basic properties; additional morphological complexity exists for classes 5, 9, and 10. There remain two unsolved issues, both involving the forms with a null determiner.

Nominal forms in Nata have exactly one high tone. That high tone can be a contour if it is falling, and on the penultimate syllable; otherwise it must be a level high tone. The high tone cannot be realized on an onsetless vowel, in general. Regarding the placement of the high tone, we observed that this is largely a factor dependant on the type of root involved in the form. Final H roots do not vary and always occur with H on the final syllable of the form. Forms with low tone roots generally have H tone aligned as far to the left as possible, given the restrictions on tone placement; a special case exists for low stems in c9, which have a morphologically marked allomorph with a H on the initial syllable. Forms with initial H roots generally occur with the initial H root allomorph; however, special morphological conditions for c5, 9, and 10 select for a LH allomorph of such roots. Finally, there is an interaction between initial H roots and conditions on prepositional prefixes which require those morphemes be followed by a L tone.

The remaining issues are accounting for low tone roots in c10 with a null determiner, and initial H roots in c9/10 with a prepositional prefix and a null determiner. The first case is puzzling because the observed surface form has no H tone. The problem for the analysis is that the requirement to have an H tone is very highly ranked, and otherwise unviolated by surface forms. The case involving initial H roots is complicated because the observed forms violate a morpheme selection for c9/10 which is otherwise active with both overt and null determiners. In other words, the selectional restriction is crucial for some cases, but appears to be ignored for the problematic cases. In order to better understand the analysis of these cases, we would need more examples of cases where the SEL:L phonotactic could be violated, such as monosyllabic roots with only H allomorphs.

Chapter 5

Vowel Harmony

The analysis of tone proposed in the previous chapter is predicated on the assumption of phonological domains with particular structure. In this chapter we shall see that these domains are also functional in understanding vowel harmony.

I will begin in Section 5.1 by considering the basic restriction on non-identical tongue root positions for vowels within the ω, following work by Gambarage and Pulleyblank, 2017. In Section 5.2 I examine how vowels in class prefixes and other material outside of the ω alternate; this work expands on previous research and illustrates a generalized behavior of material within the ϕ, but outside ω. In Section 5.3, I consider a particular nominal suffix which conditions an alternation within the ϕ.

Finally, I summarize the patterns of harmony across prosodic domains and generalizes over the types of allomorphs relevant to vowel harmony in Section 5.4.

Following many previous studies on tongue root harmony (Archangeli and Pulleyblank, 1994; Baković, 2000; Casali, 2003 among others) I adopt a binary phonological feature for tongue root: [±ATR]. Vowels with advanced tongue root are [+ATR]; vowels with retracted tongue root are [-ATR].

Ladefoged's (1964) X-ray analysis of Igbo vowels argues that tongue root position is the primary articulatory distinction between two sets of vowels; vowels produced with an advanced tongue root have larger pharyngeal cavities than those with retracted tongue root. Later research demonstrated that the size of the pharyngeal cavity can be manipulated through other means in addition to tongue root manipulation (Hess, 1992; Lindau, 1974, 1978; Tiede, 1996 on Akan). Further work has claimed that the advanced tongue position can be articulatorily distinguished from a neutral tongue position (Fusheini, 2014 on Dagbani).

The primary acoustic distinction between advanced and retracted vowels is that the latter have a lower

F1 in comparison to their advanced counterparts (Halle & Stevens, 1969). The retracted high vowels [ɪ, ʊ] share this raised F1, but also can have a slightly lowered F2 (compared to the advanced [i, u]) (Jacobson, 1980). Further work is needed to place the tongue root system of Nata into this phonetic landscape.

5.1 ω vowel harmony

Tongue root harmony is a pattern in which vowels within a particular domain have the same value for tongue root feature, [±ATR]. In Nata harmony operates slightly differently within the ω and outside ω but within ϕ. In this section I will present forms and analysis for patterns within ω.

Within ω, mid vowels always agree for [±ATR] (Gambarage, 2013; Gambarage & Pulleyblank, 2017). This is illustrated by the examples in Table 5.1 a. & b., for retracted and advanced mid vowels, respectively. High and low vowels are unrestricted and may occur freely with retracted or advanced mid vowels, as well as with other high and low vowels (c.-h.).

Table 5.1: Monomorphemic ω

	Form	Gloss
a.	e-ki-[$_\omega$**ɣɛ́rɔ**	'thing' (c7)
b.	e-βé-[$_\omega$**tore**	'cucumbers' (c8)
c.	a-má-[$_\omega$**saahɛ**	'blood' (c6)
d.	o-βú-[$_\omega$**saro**	'beads' (c14)
e.	o-βo-[$_\omega$**rɪ́βo**	'wax' (c14)
f.	o-mó-[$_\omega$**sukɔ**	'pocket' (c3)
g.	o-mu-[$_\omega$**kári**	'woman' (c1)
h.	e-ke-[$_\omega$**rɪ́sa**	'hammer' (c7)

For forms with the nominalizer [-ɔ] in ω, stems surface with retracted mid vowels, consistent with the observations regarding the data in Table 5.1.

Table 5.2: ω including [-ɔ] nominalizer

Form	Gloss
ɔ-mɔ́-[$_{\omega}$**tɔɔŋg-ɔ**	'string' (c3)
ɛ-kɛ́-[$_{\omega}$**mɛr-ɔ**	'throat' (c7)
ɔ-rɔ-[$_{\omega}$**hɔ́ɔŋg-ɔ**	'sieve' (c11)

Compare these same roots with a retracted low final vowel, where roots occur with advanced vowels.

Table 5.3: ω including [-a] nominalizer

Form	Gloss
ɣo-[$_{\omega}$**tóoŋg-a**	'to pierce'
ko-[$_{\omega}$**mér-a**	'to swallow'
ɣo-[$_{\omega}$**hóoŋg-a**	'to sieve'

This illustrates that within the ω retracted mid vowels are prohibited from occurring with advanced mid vowels, and not a more general prohibition on advanced mid vowels followed by retracted vowels. We will return to forms with alternating roots in Section 5.3

Analysis: ω vowel harmony

We can account for the distribution of vowels in prosodic words via a phonotactic prohibiting mid vowels from disagreeing in tongue root within that domain. Gambarage and Pulleyblank, 2017 formalize this via two co-occurrence restrictions relative to the stem domain. The analysis at hand is a modification of this proposal that is relativized to the prosodic word (ω).[1]

[1]Like Gambarage and Pulleyblank, 2017, I do not argue for any particular feature system with respect to vowels, specifically their height or tongue root configuration. Unlike Gambarage and Pulleyblank, 2017, I will use a binary tongue root and height features; although specific phrasing would need to be modified, this could be replaced with monovalent tongue root and height features.

(94) ω-word Harmony Constraints adapted from Gambarage and Pulleyblank, 2017, p. 8

*[... +ATR/-HI,-LO C0 -ATR/-HI,-LO ...]

*[A R]$_{\omega}$: For every advanced mid vowel within the ω-word, assign a violation mark if that mid vowel is followed by a retracted mid vowel.

*[... -ATR/-HI,-LO C0 +ATR/-HI,-LO ...]$_{\omega}$

*[R A]$_{\omega}$: For every retracted mid vowel within the ω-word, assign a violation mark if that mid vowel is followed by an advanced mid vowel.

In (94) are two distinct constraints handling each of the possible orderings: i) advanced mid followed by retracted mid, and ii) retracted mid followed by advanced mid. In the remainder of this work I will represent these two constraints with a single constraint. To my knowledge there are no cases where the ranking of the two component constraints is relevant. The constraint is referred to as ω-HARMONY.

(95) ω-Harmony constraint

ω-HARMONY: For every mid vowel within the ω-word, assign a violation mark if the vowel in the following syllable is a mid vowel that differs in the value for the feature [±ATR].

Table 5.4 illustrates various types of ω-words, both attested (a.-f.) and unattested (g. & h.), with their evaluation for the harmony constraint given above.

Table 5.4: Evaluation of ω-HARMONY

	Form	ω-HARMONY
a.	a-ma-[$_{\omega}$**bɔ́kɔ**	✓
b.	e-ɣi-[$_{\omega}$**sɛɛrɔ́**	✓
c.	ɔ-mɔ-[$_{\omega}$**tɔɔŋg-ɔ**	✓
d.	ɣo-[$_{\omega}$**tóoŋg-a**	✓
e.	ɛ-kɛ́-[$_{\omega}$**mɛr-ɔ**	✓
f.	o-mu[$_{\omega}$**kári**	✓
g.	*...[$_{\omega}$**tɔɔŋgo**	*
h.	*...[$_{\omega}$**merɔ**	*

Cases with inherently nominal stems (such as in Table 5.4 a. & b.) as well as those cases with a nominalizer suffix (c.-e.) satisfy ω-HARMONY. Forms without mid vowels do not violate this constraint (f.) Furthermore, no attested ω-words fail to satisfy this phonotactic; this is indicated by the negative data in (g. & h.)

5.2 ϕ vowel harmony

We will now consider material outside the ω, beginning with the class marker prefix and determiner. Generally, prefix vowels are mid advanced when they occur before a stem beginning with an advanced vowel as in Table 5.5 a.; otherwise, the prefixes surface with a high vowel (b.).

Table 5.5: Class prefix vowel quality

	Form	Gloss
a.	[$_\phi$o-**mó**-[$_\omega$sikera	'someone who enters' (c1)
	[$_\phi$o-**mo**-[$_\omega$súkɔ	'pocket' (c3)
	[$_\phi$e-**me**-[$_\omega$kéra	'tails' (c4)
	[$_\phi$e-**βé**-[$_\omega$tore	'cucumbers' (c8)
b.	[$_\phi$o-**mu**-[$_\omega$kári	'woman' (c1)
	[$_\phi$o-**rú**-[$_\omega$saro	'bead' (c11)
	[$_\phi$o-**mu**-[$_\omega$tɛ́rɛbi	'wooden ladle' (c3)
	[$_\phi$o-**βu**-[$_\omega$sɔ́ɔh-u	'greediness' (c14)

I follow Gambarage and Pulleyblank, 2017 in referring to stems with advanced initial vowels as *advanced stems* (such as Table 5.5 a) and stems with retracted initial vowels as *retracted stems* (b).

The examples in Table 5.5 illustrate the alternation in prefix height based on the initial vowel of the stem. When preceding an advanced stem, class prefixes surface with a mid advanced vowel; when preceding a retracted stem, class prefixes surface with a high vowel.

In some forms, the determiner is a mid advanced vowel; however if the determiner is followed by a retracted vowel, it will surface with a high vowel instead of a mid vowel as in Table 5.6 b.

Table 5.6: Determiner vowel quality

	Form	Gloss
a.	[$_\phi$ **o**-mó-[$_\omega$rem-i	'farmer' (c1)
	[$_\phi$ **o**-βu-[$_\omega$sɔ́oh-u	'greediness' (c14)
	[$_\phi$ **o**-[$_\omega$mw-iiká	'pressure/gas' (c3)
	[$_\phi$ **o**-[$_\omega$mw-íit-i	'killer' (c1)
b.	[$_\phi$ **u**-[$_\omega$mw-áana	'child' (c1)
	[$_\phi$ **u**-[$_\omega$mw-ɛɛrí	'moon' (c3)
	[$_\phi$ **i**-[$_\omega$kj-ɔ́ɔndɛ	'honey badger' (c7)

This indicates that the raising observed for class marker prefix vowels in Table 5.5 b. is a general strategy to avoid sequences of mid vowels that disagree in ±[ATR] across the edge of ω, as opposed to an alternation specific to that morpheme.

5.2.1 Analysis: ϕ vowel harmony

Extending the ω-HARMONY constraint to ϕ is not sufficient to account for the alternation of class marker and determiner prefixes. Tongue root harmony in these domains is distinct in several ways.

Inside the ω, only mid vowels are prohibited from disagreeing in [±ATR]; however, mixed values of [±ATR] are possible due to the low and [-ATR] vowel [a]. This can be observed in forms like [$_\phi$ko-[$_\omega$**mér-a**]$_\omega$]$_\phi$ 'to swallow' and [$_\phi$ɣo-[$_\omega$t**óo**ŋg-**a**]$_\omega$]$_\phi$ 'to pierce'

In contrast, within the ϕ-phrase, both mid and low [-ATR] vowels trigger an alternation in [+ATR] vowels to their left. The alternation of the class prefix illustrates this: [$_\phi$o-mó-[$_\omega$rem-i]$_\omega$]$_\phi$ 'farmer (c1)', [$_\phi$o-**mu**-[$_\omega$k**á**ri]$_\omega$]$_\phi$ 'woman (c1)', [$_\phi$o-m**u**-[$_\omega$t**ɛ́**rɛβi]$_\omega$]$_\phi$ 'ladle (c3)'; see (5.5) for more.

We will begin by focusing on cases where a nominal prefix has a high (advanced) vowel. In order to account for these, we require a phonotactic prohibiting advanced mid vowels followed by retracted vowels (i.e. a harmony phonotactic). The present analysis is based on the proposal by Gambarage and Pulleyblank, 2017 but recast in terms of the prosodic system developed in this work.

(96) ϕ-Harmony constraint

ϕ-HARMONY: For a mid vowel within the ϕ-phrase but outside the ω-word, assign a violation mark if the vowel in the following syllable differs in value for the feature [±ATR].

The restrictor clause "but outside the ω-word" is required to account for the distinct properties of ω and ϕ. As we shall see in Section 5.3, if the ϕ constraint applied to ω we would incorrectly predict roots would occur with retracted mid vowels before both [-ɔ] and [-a] nominal suffix vowels. This constraint varies in scope from the variant presented in Gambarage and Pulleyblank, 2017 because only prefixes immediately left of the stem were considered, and as we shall see from the data presented below, all prefixes within the ϕ show harmonic behaviour.

Table 5.7 illustrates several forms and how they are evaluated by ϕ-HARMONY. While ϕ-HARMONY is necessary to account for the observed alternations, it is not sufficient.

Table 5.7: Evaluation of ϕ-HARMONY

		Form	ϕ-HARMONY
a.	*	[$_{\phi}$ɔ-mɔ-[$_{\omega}$kári	✓
b.		[$_{\phi}$o-mu-[$_{\omega}$kári	✓
c.	*	[$_{\phi}$o-m**o**-[$_{\omega}$kári	* (o. . . a)
d.	*	[$_{\phi}$ɔ-m**ɔ́**-[$_{\omega}$**r**emi	* (ɔ. . . e)
e.	*	[$_{\phi}$o-mú-[$_{\omega}$remi	✓
f.		[$_{\phi}$o-mó-[$_{\omega}$remi	✓

For the form in Table 5.7 a., the retracted mid vowels within the ϕ-phrase but outside the ω-word are followed by retracted vowels (one mid, one low). For the form in (b.), the advanced mid vowel within the ϕ-phrase but outside the ω-word is followed an advanced high vowel, therefore not violating harmony; the case is similar for the form in (e). The form in (f.), like the one in (e.) contains only advanced vowels.

To complete our analysis, we consider the lexical entries of the class prefixes, specifically those with mid vowel allomorphs. For a class marker with mid vowel allomorphs both the [+ATR] and [-ATR] mid variants will be present, as well as a high vowel allomorph.

(97) Lexical entry for class prefixes

{mo, mu, mɔ}	C1
{βa}	C2
{ɣe, ɣi, ɣɛ}	C7
⋮	

Gambarage and Pulleyblank, 2017, following work such as Mascaró, 2007, propose ranking allomorphs such that the advanced mid vowel allomorphs are less marked than the retracted allomorphs. They observe that the vowel quality of prefix allomorphs varies in two dimensions: advanced vs. retracted and mid vs. high. Advanced is preferred to retracted, and mid is preferred to high. Because of the wider scope of the harmony phonotactic employed here, ranking ϕ-HARMONY over phonotactics will result in the observed optimal forms.

In cases with only high and mid vowel allomorphs, the harmony constraint rules out mismatches, as in the candidate in (98c.); a phonotactic preferring non-high vowels prevents forms with the high vowel allomorph from surfacing. The winning candidate in (98a.) uses the mid advanced prefix allomorphs

(98) Mid vowel forms satisfy Harmony

	[{o, ɔ, u…}+{ mo, mɔ, mu…} +{rem …}+{i}]	ϕ-HARM	[*-ATR]	*[+HI]
☞	a. [$_\phi$o-mó-[$_\omega$rem-i			
	b. [$_\phi$o-mú-[$_\omega$rem-i			*!
	c. [$_\phi$ɔ-mɔ́-[$_\omega$rem-i	*!(ɔ́…e)		

In cases with retracted root initial vowels, the phonotactic preferring advanced vowels rules out retracted harmonic candidates, like the losing candidate in (99c.) Violations of *[+HI] and *[-ATR] are shown only for prefix and determiner allomorphs.

(99) Evaluation of simple vowel harmony

[{o, ɔ, u. . . }+{ mo, mɔ, mu. . . } +{kári . . . }]	ϕ-HARM	*[-ATR]	*[+HI]
☞ a. [$_\phi$o-mu-[$_\omega$kári			*
b. [$_\phi$o-mɔ-[$_\omega$kári	*!(o. . . ɔ)	*	
c. [$_\phi$ɔ-mɔ-[$_\omega$kári		*! *	
d. [$_\phi$o-mo-[$_\omega$kári	*!(o. . . a)		

Before considering vowel harmony involving other morphemes, we will consider the relationship between allomorphs of the class prefixes. The morphs of the class prefixes are shown below, repeated from (97).

(100) Lexical entry for class prefixes

{mo, mu, mɔ} C1

{βa} C2

{ɣe, ɣi, ɣɛ} C7

⋮

Not every possible distribution of vowel harmony allomorphs are attested; for example, there is not a valid lexical entry with only a high vowel allomorph. Following Archangeli and Pulleyblank, 2021, I will examine the relations between morphs that are minimally different, as these are the types of pairs that a learner would consider when forming lexical entries, and then later when expanding their lexicon.

There are two relations between allomorphs of prefixes: one relating mid advanced and mid retracted vowels (mid vowels differing minimally in their tongue root configuration), as shown in (101); and another relating mid advanced and high advanced vowels (advanced vowels differing minimally in their height), as shown in (102). Note that these relations apply to the class prefixes we have been looking at, but they also more generally apply to other nominal prefixes; we will consider other nominal prefixes in the following section.

(101) Morph set relation: tongue root

MSR$_{\text{TR}}$: Pairs of otherwise identical nominal prefix allomorphs differ only with respect to a mid advanced vowel in one being mid retracted in the other.

$\{M_i, M_j\}$ M_i: [+ATR, -HI, -LO]

M_j: [-ATR, -HI, -LO]

(102) Morph set relation: height

MSR$_{\text{Hi}}$: Pairs of otherwise identical nominal class prefix allomorphs differ only with respect to a mid advanced vowel in one being mid high in the other.

$\{M_i, M_j\}$ M_i: [+ATR, -HI, -LO]

M_j: [+ATR, +HI, -LO]

These relations function to limit the forms of allomorphs that can be grouped within a class prefix lexical entry. We will begin by considering tongue root.

(103) Morph set condition: TR (nominal prefixes)

With respect to MSR$_{\text{TR}}$, a nominal prefix morph set is ill-formed if M_j is present and there is no corresponding M_i, or if M_i is present and there is no corresponding M_j

MSC$_{\text{TR}}$: $*\{M_j, \neg M_i\}$

$*\{M_i, \neg M_j\}$

A learner might acquire this sort of condition by observing data like which lead to the lexical entries in (100), where there are no lexical entries that have only advanced mid, or only retracted mid vowels (although there are lexical entries that have only retracted low vowels). A learner might postulate that the condition above applies broadly to nominal prefixes (class prefixes, locative prefixes, locative prefixes, determiners); such a learner would find this condition would turn out to be correct given the data we shall see in the remainder of this chapter. However, a learner might also conservatively postulate that MSC$_{\text{TR}}$ applies only to nominal class prefixes. Such a learner would need to modify their grammar when encountering forms with prepositional prefixes, which also exhibit the same distribution of vowel harmony allomorphs with respect to tongue root. A learner may also incorrectly generalize that all Nata morph sets are subject to MSC$_{\text{TR}}$; as we shall see when we return to noun stems, this is not the case.

Now we will consider conditions between morphs based on vowel height. Unlike the tongue root MSC, this condition applies only to class prefixes, locative prefixes, and determiners. Associative prefixes are not subject to this condition; we will consider locative and associative prefixes in the following section.

(104) Morph set condition: Hi

With respect to MSR_{Hi}, a class prefix or locative prefix morph set is ill-formed if M_j is present and there is no corresponding M_i, or if M_i is present and there is no corresponding M_j

$$\text{MSC}_{\text{Hi}}: \quad *\{M_j, \neg M_i\}$$
$$*\{M_i, \neg M_j\}$$

As with MSC_{TR}, MSC_{Hi} can be acquired by considering class prefixes; a learner could then extend this condition to apply to locative prefixes. Alternatively, a learner might over generalize that MSC_{Hi} applies to all nominal prefixes, like MSC_{TR}; in such a case, the learner would encounter data suggesting that hypothesis is incorrect, specifically from the associative prefix; we investigate this in the following section.

Taken together, the conditions on tongue root and vowel height allomorph pairings will result in lexical entries for class markers, such as those in (100). There will never be lexical entries for a class prefix which have an advanced mid vowel, but no retracted mid vowel, and vice versa; moreover, the allomorphs will vary just in tongue root (but not in height, or frontness/backness). There will never be lexical entries for a class prefix which have a mid vowel, but no high vowel, and vice versa. Note that morph sets with just low vowels are permitted by virtue of not being restricted by a condition.

In the following section, we will observe that the locative prefix has the same alternations and allomorphs as the class marker while the associative prefix has a different type of morph set and alternation (with respect to vowel harmony).

5.2.2 Prepositional prefixes

In this section we will examine prefixes which occur to the left of the determiner. These morphemes are the associative, locative, and comitative prefixes. Recall from Chapter 3 that these prefixes occur inside the same ϕ as the determiner and class marking prefix, as indicated by the bracketing in the examples below. This dataset has numerous examples of vowel coalescence; however this is not the primary focus on this chapter; consult Appendix A for details about coalescence and how it can be analyzed.

The comitative prefix is not of particular interest with respect to vowel harmony as it occurs with an invariant low vowel. Because of coalescence, this morpheme only surfaces with an allomorph that has a vowel when it is followed by a consonant initial morpheme. One such context is before the non-existential determiner because this morpheme has a phonologically null allomorph, as we saw in Chapter 4. Consider the examples in Table 5.8 illustrating the form of the comitative.

Table 5.8: Comitative prefix vowel quality

βatarɔɔtʃɛ́ mukári	[$_\phi$**ná-∅**-mɔ-[$_\omega$tɔɔŋg-ɔ	'they weren't seeing any woman.c1 and string.c3'
βatarɔɔtʃɛ́ mukári	[$_\phi$**na-∅**-ki-[$_\omega$ɣɛ́rɔ	'they weren't seeing any woman.c1 and thing.c7'
βatarɔɔtʃɛ́ mukári	[$_\phi$**ná-∅-∅**-[$_\omega$ntʃogu	'they weren't seeing any woman.c1 and elephant.c9'

The locative prefixes have a high vowel allomorph as well as both advanced and retracted mid vowel allomorphs, the latter of which we will see in the following section. These surface in the same contexts as the analogous determiner and class prefix allomorphs, as illustrated by Table 5.9.

Table 5.9: Locative vowel quality

[$_\phi$**koo**-mo-[$_\omega$sísi (c3)	'on tamarind tree.c3'
[$_\phi$**moo**-ɣe-[$_\omega$kúβa (c7)	'in chest.c7'
[$_\phi$**kúú**-ma-[$_\omega$βuri (c6)	'on feathers.c6'
[$_\phi$**muu**-[$_\omega$kj-áarɔ (c7)	'in village.c7'

The associative prefix has a different set of allomorphs (with respect to vowel quality) than the class marker prefixes we have focused on thus far; associative prefixes do not have allomorphs with high vowels. As with the comitative, we will consider a subset of cases where the morpheme following the associative is consonant initial, prohibiting coalescence between the two morphemes (see Appendix A for information regarding coalescence).

Table 5.10: Associative vowel quality (i)

o-mo-sísi	[$_{\phi}$ **wɔ́**-tʃaa-∅-[$_{\omega}$ntʃogu	‘tamarind tree.c3 of elephants.c10
e-me-sísi	[$_{\phi}$ **ɣɛ́**-tʃaa-∅-[$_{\omega}$ntʃogu	‘tamarind trees.c4 of elephants.c10’
e-ɣe-kúβa	[$_{\phi}$ **ɣɛ́**-tʃaa-∅-[$_{\omega}$ntʃogu	‘chest.c7 of elephants.c10’
e-βe-kúβa	[$_{\phi}$ **βɛ́**-tʃaa-∅-[$_{\omega}$ntʃogu	‘chests.c8 of elephants.c10’
o-ro-síri	[$_{\phi}$ **rɔ́**-tʃaa-∅-[$_{\omega}$ntʃogu	‘rope.c11 of elephants.c10’

When preceding a consonant initial DP, associative markers with non-low vowels alternate between advanced and retracted vowel quality. The quality of the associative prefix vowel depends on the quality of the vowel in the syllable to its right. If the vowel in the syllable to the right of the associative prefix is retracted, then the vowel of the associative prefix will be a retracted mid vowel.

Table 5.11: Associative vowel quality (ii)

o-mo-sísi	[$_{\phi}$ **wó**-r-ii-[$_{\omega}$βuri	‘tamarind tree.c3 of feather.c5’
e-me-sísi	[$_{\phi}$ **ɣé**-r-ii-[$_{\omega}$βuri	‘tamarind trees.c4 of feather.c5’
e-ɣe-kúβa	[$_{\phi}$ **ɣé**-r-ii-[$_{\omega}$βuri	‘chest.c7 of feather.c5’
e-βe-kúβa	[$_{\phi}$ **βé**-r-ii-[$_{\omega}$βuri	‘chests.c8 of feather.c5’
o-ro-síri	[$_{\phi}$ **ró**-r-ii-[$_{\omega}$βuri	‘rope.c11 of feather.c5’

If the vowel in the syllable to the right of the associative prefix is advanced, then the vowel of the associative prefix will be an advanced mid vowel (see Table 3.20 in Section 3.3). Note that if the associative prefix for a particular class has a low vowel, it will surface with a low vowel when it is followed by advanced vowels and retracted vowels (cf. c2 associative: **wá**-tʃaa-ntʃogu, **wa**-mw-ɛɛrí, **wá**-rii-βuri).

5.2.3 Analysis

The prefixes we have seen in this section come in three flavours: i) the comitative has a low vowel, and therefore does not participate in vowel harmony alternations; ii) the locative, which functions like the class prefixes we have seen previously; and iii) the associative prefixes, which have different morphs than the locatives and class prefixes. The comitative prefixes require no comment. Consider the lexical entries given for the locative prefixes; class prefixes are included for comparison. The retracted allomorph of the locative will be discussed in the following section; for the time being recall that it is not preferred even when the locative is followed by a retracted (low or mid) vowel, as shown in (5.9)

(105) Lexical entry for locative prefixes

{koo, kuu, kɔɔ} LOC (ON)

{moo, muu, mɔɔ} LOC (IN)

Lexical entry for class prefixes

{mo, mu, mɔ} C1

{ɣe, ɣi, ɣɛ} C7

⋮

The ranking of *[-ATR] over *[+HI] is shown to be crucial by (106b. & c.); the surface form (106c.) satisfies *[-ATR], but not *[+HI], in contrast to (106c.)

(106) Evaluation of locative vowel harmony

[$_\phi${kóó, kɔ́ɔ́, kuu…}+{ a, ∅…} +{ ma…}+[$_\omega${Buri …}]	ϕ-HARM	*[-ATR]	*[+HI]
a. [$_\phi$kóó-ma[$_\omega$βuri	*!(o…a)		
b. [$_\phi$kɔ́ɔ́-ma[$_\omega$βuri		*(kɔ́ɔ́)	
☞ c. [$_\phi$kúú-ma[$_\omega$βuri			*(kúú)

The analysis of the associative prefixes depends on the observation that this set of prefixes lacks high vowel allomorphs. The lexical entries for associative prefixes are given below; for comparison, the lexical entries for class prefixes are shown in (105) above.

(107) Lexical entry for associative prefixes

{wo, wɔ} ASSOC.C1

{ɣe, ɣɛ} ASSOC.C7

⋮

When there are no harmony violations, the vowel phonotactics select the surface form, as illustrated below.

(108) Evaluation of associative vowel harmony (i)

	[$_\phi${wó, wɔ́, . . . }+{ r, . . . } +{ ii. . . }+[$_\omega${Buri . . . }]	ϕ-HARM	*[-ATR]	*[+HI]
☞	a. [$_\phi$wó-r-ii-[$_\omega$βuri			
	b. [$_\phi$wɔ́-r-ii[$_\omega$βuri	*!(ɔ. . . i)	*(wɔ́)	

When there is a harmony violation, the limited set of vowel allomorphs for the associative prefix means that violations of *[-ATR] must be tolerated as there are no other allomorphs which satisfy this global constraint which do not result in a harmony violation; this is illustrated by the case below.

(109) Evaluation of associative vowel harmony (ii)

	[$_\phi${wó, wɔ́, . . . }+{ tʃaa, . . . } +{ ∅. . . }+[$_\omega${ntʃogu . . . }]	ϕ-HARM	*[-ATR]	*[+HI]
	a. [$_\phi$wó-tʃaa-∅-[$_\omega$ntʃogu	*!(o. . . a)		
☞	b. [$_\phi$wɔ́-tʃaa-∅-[$_\omega$ntʃogu		*(wɔ́)	

In terms of morph set conditions, the locative is subject to all the same conditions as class prefixes: MSC_{TR} (103) and MSC_{Hi}(104). On the other hand, the associative is not subject to MSC_{Hi} (thought it is subject to MSC_{TR}). The result of this is that associative prefix morph sets will never have a high vowel allomorph; therefore, they behave differently in the same harmonic contexts when compared to the locative and class prefixes.

5.3 Retracting suffix

We will now return to the stem and a special case of harmony involving a particular suffix. For some forms including the nominalizer suffix [-ɔ], all mid vowels within ϕ have the same advanced/retracted value.

Table 5.12: Retracting suffixes

	Form	Gloss
	[$_{\phi}$ɔ-mɔ́-[$_{\omega}$tɔɔŋg-ɔ	'string' (c3)
*	[$_{\phi}$o-mú-[$_{\omega}$tɔɔŋg-ɔ	
*	[$_{\phi}$u-mú-[$_{\omega}$tɔɔŋg-ɔ	
	[$_{\phi}$ɛ-kɛ́-[$_{\omega}$mɛr-ɔ	'throat' (c7)
*	[$_{\phi}$e-kí-[$_{\omega}$mɛr-ɔ	
*	[$_{\phi}$i-kí-[$_{\omega}$mɛr-ɔ	
	[$_{\phi}$ɔ-rɔ-[$_{\omega}$hɔɔŋg-ɔ́	'sieve' (c11)
*	[$_{\phi}$o-ru-[$_{\omega}$hɔɔŋg-ɔ́	
*	[$_{\phi}$u-ru-[$_{\omega}$hɔɔŋg-ɔ́	

The requirement that these forms have mid retracted vowels extends to the prepositional prefixes.

Table 5.13: Retracted prepositions

	Form	Gloss
	[$_{\phi}$**kɔ́ɔ́**-mɔ-[$_{\omega}$tɔɔŋg-ɔ	'on string' (c3)
*	[$_{\phi}$**kóó**-mu-[$_{\omega}$tɔɔŋg-ɔ	
*	[$_{\phi}$**kúú**-mu-[$_{\omega}$tɔɔŋg-ɔ	
	[$_{\phi}$**nɔ́-ɔ́**-mɔ-[$_{\omega}$tɔɔŋg-ɔ	'and string' (c3)
*	[$_{\phi}$**nó-ó**-mu-[$_{\omega}$tɔɔŋg-ɔ	
*	[$_{\phi}$**nú-ú**-mu-[$_{\omega}$tɔɔŋg-ɔ	
	[$_{\phi}$**mɔ́-∅**-mɔ-[$_{\omega}$tɔɔŋg-ɔ	'of no string' (c3, c3)
*	[$_{\phi}$**mó-∅**-mu-[$_{\omega}$tɔɔŋg-ɔ	
*	[$_{\phi}$**mú-∅**-mu-[$_{\omega}$tɔɔŋg-ɔ	

This pattern has an additional wrinkle. Not every stem that includes a retracting suffix surfaces with retracted prefixes. Consider data in Table 5.14, which includes the suffix '-ɔ' that we've seen, but surface with high vowel class prefixes. Because the class prefixes are high and advanced, the determiner need not raise; likewise any other prepositional prefixes need not be mid retracted or raised.

Table 5.14: Non-retracted forms

	Form	Gloss
	[$_{\phi}$ **o-mú-**[$_{\omega}$tɛg-ɔ	'trap' (c3)
*	[$_{\phi}$ **ɔ-mɔ́-**[$_{\omega}$tɛg-ɔ	
	[$_{\phi}$ **móó-mu-**[$_{\omega}$tɛg-ɔ	'in trap' (c3)
*	[$_{\phi}$ **mɔ́ɔ́-mɔ-**[$_{\omega}$tɛg-ɔ	

It may appear that no phonological factor distinguishes between environments like [$_{\phi}$ ɛ-kɛ́-mɛr-ɔ] 'throat' (c7) and [$_{\phi}$ o-mu-tɛg-ɔ] 'trap' (c3); however, Gambarage and Pulleyblank, 2017 observe that for all retracted stems that surface with retracted determiners and prefixes, those stems contain roots that have both advanced and retracted allomorphs. On the other hand, retracted stems that surface with advanced determiners and prefixes contain roots that only have retracted allomorphs.

This is illustrated by comparing the same stems with different suffix vowels. In Table 5.15, roots are bolded; the first two pairs illustrate non-alternating roots (a.-d.), while the second pair illustrate alternating roots (e.-h.).

Table 5.15: Root types: alternating and non-alternating

	Form	Gloss
a.	[$_\phi$ o-mú-[$_\omega$**tɛg**-ɔ	'trap' (c3)
b.	[$_\phi$ ɣu-[$_\omega$**téɣ**-a	'to trap'
c.	[$_\phi$ o-mú-[$_\omega$**tɔɔs**-ɔ	'an abuse' (c3)
d.	[$_\phi$ ɣu-[$_\omega$**tɔ́ɔs**-a	'to abuse'
e.	[$_\phi$ ɔ-mɔ́-[$_\omega$**tɔɔng**-ɔ	'string' (c3)
f.	[$_\phi$ ɣo-[$_\omega$**tóong**-a	'to pierce'
g.	[$_\phi$ ɛ-kɛ́-[$_\omega$**mɛr**-ɔ	'throat' (c7)
h.	[$_\phi$ ko-[$_\omega$**mér**-a	'to swallow'

The data presented in this section illustrate that a particular suffix in combination with a particular type of root result in a distinct repair to the general problem of advanced mid vowels followed by retracted vowels. Forms like the pair in (109g. & h.) illustrate that vowel harmony is not enforced in the same way within the ω as it is outside ω but within ϕ. Given that these roots have mid advanced and mid retracted allomorphs, but no high allomorphs, they are similar to the associative prefix. Recall from (5.10) that the associative prefix occurs retracted when followed by low vowels (as well as when followed by mid retracted vowels, but those are all cases including the [-ɔ] suffix.) I analyze this distinction in behaviour via the restrictor clause in the ϕ-HARMONY constraint, as alluded to previously.

The chart below illustrates the types of surface allomorphs for the class prefix, determiner, and locative, given the contexts we have discussed in the preceding sections: the vowel preceding the vowel of interest (outside of the ω, but inside ϕ), if the root is alternating or not, and if the form includes the retracting suffix [-ɔ].

Table 5.16: ϕ Harmony summary

	Prefix	Following V	Root	Suffix	Form
a.	[+ATR]/mid	[+ATR]	non-alternating	[+ATR]	[$_\phi$o-m**ó**-[$_\omega$rem-i
b.	[+ATR]/high	[-ATR]	non-alternating	-	[$_\phi$o-m**u**-[$_\omega$kári
c.	[+ATR]/high	[-ATR]	non-alternating	[-ATR]	[$_\phi$o-m**ú**-[$_\omega$tɔɔs-ɔ
d.	[-ATR]/mid	[-ATR]	alternating	[-ATR]	[$_\phi$ɔ-m**ɔ́**-[$_\omega$tɔɔng-ɔ

In summary, the retracting suffix [-ɔ] imposes a distinct repair to the general prohibition on advanced mid vowels followed by retracted vowels. For forms with the retracting suffix, vowels to the left of the stem containing the suffix must be mid; this requirement in combination with the ϕ-HARMONY constraint results in the prefixes surfacing with mid retracted allomorphs. The retracting suffix is dependent on a particular type of root, characterized in terms of allomorphs; when the suffix is paired with a root that has mid advanced and mid retracted allomorphs, the prefixes must have mid retracted vowels (5.16 d.). However, when the suffix is paired with a root that has only the mid retracted allomorph, the prefixes are not subject to the requirement that they be mid (5.16 c.).

Analysis

In the previous section we observed that retracting suffixes are dependant on alternating roots to cause prefix morphemes to surface with mid retracted allomorphs. There are two effects at play here: retracting suffixes must be preceded by stems with retracted vowels, and alternating roots must be preceded by mid vowels. The former is already formalized by our ω-word harmony constraint. We can encode the latter effect as a selectional restriction (Archangeli & Pulleyblank, 2017; Gambarage & Pulleyblank, 2017). It is important that all vowels within the relevant domain are mid, and not just the immediately preceding vowel; the case evaluated in (113) illustrates this.

Selectional restrictions are a general property of morphemes; on top of phonotactics (such as for harmony), individual morphemes may have specific phonological requirements. See §2.2.2 for more information about how restrictions are modelled in Lexical Allomorphy. The alternating roots have a selectional restriction that they must be preceded only by mid vowels within the ϕ, in other words, they have a non-local selectional restriction for [-HI, -LO]. This restriction is crucial in capturing the behaviour of alternating stems when it comes to vowel harmony, as we shall see shortly.

(110) Lexical entry for alternating roots

{mer, mɛr}$_{\text{SEL: [-HI, -LO]}\phi}$	THROAT
{tooŋg, tɔɔŋg}$_{\text{SEL: [-HI, -LO]}\phi}$	STRING
⋮	
{CeC, CɛC}$_{\text{SEL: [-HI, -LO]}\phi}$	RT
SEL: [-HI, -LO]ϕ:	Vowels within the same ϕ as this morpheme must be mid.

Note that the lexical entry for the nominalizer suffix has no selectional restriction.

(111) Lexical entry for nominalizer suffix

{ɔ} NOM

Alternating stems have the special property of selection; like the individual allomorphs and the redundancy relations between them (see Section 2.2.2), the selection restriction is learned as a property of these types of stems. Because the selectional restriction is a property of alternating stems, we correctly predict that non alternating stems which have retracted mid vowels only cause raising in prefixes in order to satisfy the phonotactic on advanced mid vowels followed by retracted vowels.

(112) Evaluation of a non-alternating stem with retracting suffix

	[{o, ɔ, u}+{mɔ, mu, mo...} +{tɛɣ}+{ɔ}]	SEL	ϕ-HARM	ω-HARM	*[-ATR]	*[+HI]
	a. [$_{\phi}$o-mó-[$_{\omega}$tɛg-ɔ		*!			
	b. [$_{\phi}$o-mɔ́-[$_{\omega}$tɛg-ɔ		*!		*(mɔ́)	
	c. [$_{\phi}$ɔ-mɔ́-[$_{\omega}$tɛg-ɔ				*!(mɔ́), *(ɔ)	
	d. [$_{\phi}$u-mú-[$_{\omega}$tɛg-ɔ					*(mú),*!(u)
☞	e. [$_{\phi}$o-mú-[$_{\omega}$tɛg-ɔ					*(mú)

The alternating stems limit the solutions to this prohibition by requiring mid vowels to their left. Therefore, the best surface forms in these cases will have retracted mid vowels.

Compare the candidate in (112e.) above with the analogous candidate with an alternating root in (113f.) below; the latter candidate fails exactly because it does not satisfy the selectional restriction of the stem {tooŋg, tɔɔŋg}$_{\text{SEL: [mid]}\phi}$. The tableau below illustrates the activity of the ω-word level harmony constraint: candidates in (113a.-c.) are all ruled out by this phonotactic. The only way to satisfy the ϕ-phrase harmony constraint while satisfying selection is the optimal candidate in (113h.).

(113) Evaluation of a alternating root with retracting suffix

Based on Gambarage and Pulleyblank, 2017 (20)

[{o, ɔ, u}+{mɔ, mu, mo...} +{tooŋg, tɔɔŋg}$_{\text{SEL: [-HI, -LO]}\phi}$+{ɔ}]	SEL	ϕ-HARMONY	ω-HARM	*[-ATR]	*[+HI]
a. [$_\phi$ o-mó-[$_\omega$ tooŋg-ɔ			*!		
b. [$_\phi$ o-mɔ́-[$_\omega$ tooŋg-ɔ		*!*	*	*(mɔ́)	
c. [$_\phi$ o-mú-[$_\omega$ tooŋg-ɔ	*!		*		*(mú)
d. [$_\phi$ o-mó-[$_\omega$ tɔɔŋg-ɔ		*!			
e. [$_\phi$ o-mɔ́-[$_\omega$ tɔɔŋg-ɔ		*!		*(mɔ́)	
f. [$_\phi$ o-mú-[$_\omega$ tɔɔŋg-ɔ	*!				*(mú)
g. [$_\phi$ ɔ-mó-[$_\omega$ tɔɔŋg-ɔ		*!		*(ɔ)	
☞ h. [$_\phi$ ɔ-mɔ́-[$_\omega$ tɔɔŋg-ɔ				*(ɔ), *(mɔ́)	
i.[$_\phi$ ɔ-mú-[$_\omega$ tɔɔŋg-ɔ	*!	*		*(ɔ)	*(mú)
j. [$_\phi$ u-mɔ́-[$_\omega$ tɔɔŋg-ɔ	*!			*(mɔ)	*(u)

Compare the candidates in (113i. and j.) to the optimal candidate in (113h.): both fail to satisfy the selectional restriction of the retracted stem allomorph, repeated below from (110).

(114) SEL: [-HI, -LO]ϕ: Vowels within the same ϕ as this morpheme must be mid.

The form in (114j.) illustrates that the distance between the allomorph which selects is not measured by immediate precedence, but instead by precedence within the ϕ domain. If precedence was measured by syllable adjacency, then the candidate in (114j.) would be optimal, as it wouldn't violate this version of the selectional restriction.[2] This is because the vowel immediately precedence the retracting suffix is retracted.

[2]This evaluation is consistent with a phase based interpretation of local allomorphy, such as Embick and Marantz, 2008, where

In this analysis, "retracting" suffixes formally have no special condition associated with them. The effect of a retracting suffix is a combination of the phonotactic prohibiting advanced mid vowels that are followed by retracted vowels. We can confirm this by considering the optimal forms if the selectional restriction in (114) were a property of the suffix and not the stem; lexical entries for this alternative are shown below.

(115) Alternative lexical entries for alternating roots and nominalizer suffix

{mer, mɛr}	THROAT
{tooŋg, tɔɔŋg}	STRING
⋮	
{CeC, CɛC}	RT
$\{ɔ\}_{\text{SEL: [-HI, -LO]}\phi}$	NOM

The problem with this alternative becomes immediately clear if we consider cases with non-alternating stems, like we saw in (112). In such cases, the observed surface form has an advanced high vowel in the prefix (116c.). The alternative analysis which attributes the selection of mid vowels to the nominalizer suffix incorrectly predicts that the prefix (and determiner) should be mid and retracted (116f.), as shown below.

(116) Alternative evaluation of a non-alternating stem with retracting suffix

	[{o, ɔ, u}+{mɔ, mu, mo...} +{tɛɣ}+$\{ɔ\}_{\text{SEL: [-HI, -LO]}\phi}$]	SEL	ϕ-HARM	ω-HARM	*[-ATR]	*[+HI]
	a. $[_\phi$o-mó-$[_\omega$tɛg-ɔ		*!			
	b. $[_\phi$o-mɔ́-$[_\omega$tɛg-ɔ		*!		*(mɔ́)	
☹	c. $[_\phi$o-mú-$[_\omega$tɛg-ɔ	*!				*(mú)
	d. $[_\phi$u-mú-$[_\omega$tɛg-ɔ	*!				*(mú), *(u)
	e. $[_\phi$u-mɔ́-$[_\omega$tɛg-ɔ	*!			*(mɔ́)	*(u)
☞	f. $[_\phi$ɔ-mɔ́-$[_\omega$tɛg-ɔ				*(ɔ), *(mɔ́)	

A-categorical roots are interesting in the context of the morph set relations we have examined thus far. This group of morphemes do not pattern like class and locative prefixes or like associative prefixes with

cyclic, category defining, heads (such as *n*), can influence allomorph selection for morphemes that are within their domain. In this paper the same effect is derived by reference to phonological domains that are reflexes of syntactic domains (which are defined by syntactic heads).

respect to their morph sets. Consider the types of morph sets that these morphemes can have.

(117) Lexical entry for a-categorical roots

{mer, mɛr}$_{\text{SEL: [mid]}\phi}$	THROAT
{tooŋg, tɔɔŋg}$_{\text{SEL: [-HI, -LO]}\phi}$	STRING
⋮	
{CeC, CɛC}$_{\text{SEL: [-HI, -LO]}\phi}$	RT
{tɛg, }	TRAP
{tɔɔs}$_{\text{SEL: [-HI, -LO]}\phi}$	ABUSE
⋮	
{CɛC}	RT

These two distinct morph sets share the same tongue root relation as nominal prefixes: there is a correspondence between mid advanced and mid retracted allomorphs.

(118) Morph set relation: tongue root (a-categorical roots)

MSR_{TR}: Pairs of otherwise identical a-categorical root allomorphs differ only with respect to a mid advanced vowel in one being mid retracted in the other.

$\{M_i, M_j\}$ M_i: [+ATR, -HI, -LO]

M_j: [-ATR, -HI, -LO]

Unlike nominal prefixes, which have a bidirectional condition on morphs, as shown in (103), a retracted morph can occur without a corresponding advanced morph in the same set.

(119) Morph set condition: TR (a-categorical roots)

With respect to MSR_{TR}, an a-categorical root morph set is ill-formed if M_i is present and there is no corresponding M_j.

MSC_{TR}: $*\{M_i, \neg M_j\}$

This condition will prohibit morph sets which have an advanced morph but no retracted morph, but they do not penalize a morph set with an unpaired retracted allomorph. For this reason, a-categorical roots can either be alternating, or invariably retracted, but not invariably advanced. Note that noun stems in general have no such relation; for an underived stem, a learner would not acquire any particular relation between morphs nor would they learn a condition, precisely because these stems do not vary with respect to vowel quality.

5.4 Summary and Conclusion

In this section I will list and review the vowel harmony generalizations we've observed in this chapter, how they are accounted for, and future directions for research.

Table 5.17: Vowel Harmony Observations

i.	Within stems, mid vowels are all advanced or all retracted.
ii.	Generally, vowels in the prefix, determiner, and locative morphemes are advanced mid vowels unless they are followed by a retracted vowel in which case they will be advanced high vowels.
iii.	The nominalizing suffix, [-ɔ], only occurs preceded by retracted mid vowels (i.e. no advanced mid vowels precede this suffix).
iv.	When preceding a consonant initial DP, associative markers with non-low vowels alternate between advanced and retracted vowel quality.

We observed that stems are restricted to either having advanced or retracted mid vowels. Considering the material inside of the ϕ we observed that the vowels outside of the stem are generally advanced (either mid or high); mid vowels are more common, and the high variants occur preceding retracted vowels (either mid or low). Observations (5.17 iii.) and (iv.) pertain to particular morphemes which condition alternations from the general patterns observed in (i.-ii.)

Considering the analysis of these observations, the first observation is true of ω; the second observation is the general pattern of harmony in the ϕ. Both of these observations are the result of phonotactics prohibiting non-identical values of [±ATR] for a particular set of vowels within a domain. These phonotactics are modelled using two co-occurrence constraints which penalize disagreeing features of [±ATR]. The ω level constraint only penalizes mid vowels that differ in [±ATR], while the ϕ level constraint penalizes vowels that differ in [±ATR] regardless of height; however, it does not consider vowels inside of the ω.

The analysis of forms including stems with the [-ɔ] suffix depends on one of two types of a-categorical roots. Stems composed of an a-categorical root and suffix are distinct from non-alternating stem, which have no vowel harmony allomorphs, because the a-categorical roots have allomorphs with advanced mid vowels and allomorphs with retracted mid vowels; in addition, the retracted allomorphs bear a selectional restriction which prohibits high vowels from preceding them. Not all a-categorical roots alternate, and the non-alternating set do not bear the same selectional restriction; therefore the result is that the presence of both an alternating a-categorical root and the [-ɔ] suffix results in a unique harmonic configuration for nominal ϕ, where all mid vowels are retracted.

The associative prefix is distinct from other prefixes (class marker, locative, determiner) in that it does not have a high vowel allomorph. This distinction in the type of allomorphs available for this prefix in contrast to other prefixes accounts for the associative prefix's distinct response to the harmony phonotactic. In terms of analysis, a learner would need to observe that the associative prefix is exceptionally not subject to MSC_{Hi} (104).

Chapter 6

Discussion

The focus of this discussion is to evaluate what the emergent approach to morphology and phonology contribute to the study of Language and more specifically to the study of Nata. I will begin in 6.1 by answering broadly why I chose to use an emergent approach. In 6.2, I consider how emergence differs from a more traditional auto-segmental phonology approach and the future directions that we can explore via emergence. Finally, in 6.3, I compare the tonal analysis of Nata with a simple analysis of Jita, as described by Downing, 1990; this final case bolsters comparisons with other tonal examples, and provides a more similar language comparison.

6.1 Why emergence?

Tone and vowel harmony have been investigated for a relativity long time in the long span of generative linguistics. Considering these phonological phenomenon in Nata from the perspective of emergent grammar is worthwhile because we already have an arsenal of tools to model them. Emergence offers to pare down all of these abstract mechanisms in place of surface forms, as modelled in lexical allomorphy.

One central question is: how much abstract structure do we need to add back to account for tone and harmony? The conclusion is that the emergent approach is capable of explaining long distance movement, as seen in tonal alignment, as well as distinct phonological classes, as seen in tone classes. What is also clear is that for Nata abstract underlying forms, specifically floating tones and spreading harmonic vowel features, are not required for an analysis of tone or vowel harmony.

In the following section I will consider a number of approaches that are similar to lexical allomorphy, in so far as they are mechanisms to handle allomorphy. Setting aside underlying forms, the major distinction between lexical allomorphy and other approaches to allomorphy is that in lexical allomorphy all forms are listed allomorphs; in other approaches to allomorphy only some types of forms are listed as allomorphs, while others are generated via a phonological mechanism.

6.2 Emergence contrasted

Bonet and Harbour, 2012 review a number of sources of allomorphy, concluding that there is a broad range of triggers, and relations between morphs, all of which could be described as allomorphy. Generally, they observe that allomorphy describes the relation between phonological forms of a morpheme that are not systemically predicted via phonology.

Regardless of the details, the relation to lexical allomorphy is simple: all surface forms are listed in the lexicon, as allomorphs would be treated. The choice of surface forms is still determined by phonotactic considerations (the ranking of phonotactic constraints and evaluation of potential surface forms.); however, the special selectional properties of allomorphs also are a regular feature of lexical allomorphy, not an exceptional property of only those allomorphs without sufficient phonological similarity to be reevaluated via a singular underlying form.

Adopting lexical allomorphy ultimately removes the questions regarding where on the scale of predictable-to-listed a particular type of form is. Likewise, there is no real question as to what the nature of allomorphs is: they are surface forms. This removes the possibility of floating or other abstract features listed as allomorphs. As we have seen, this limitation does not hinder the analysis of Nata. Bonet and Harbour, 2012 point out that theories of allomorphy typically lack bounds on the number of allomorphs, and in this sense, lexical allomorphy is the same. In fact, being a Bantu language with an extensive class system, Nata generally illustrates that a single morpheme may have upwards of ten allomorphs, as is the case for any of the nominal prefixes examined in this work.

As an emergent approach to grammar, lexical allomorphy does not restrict the types of generalizations learners can draw regarding locality and position of conditioning context. As we shall see, some approaches to allomorphy distinguish between stems/affixes in their ability to trigger morph selection. As we have seen in the case of the associative prefix, affixes can select allomorphs of stems (albeit under direct tonal adjacency). From the case of the retracting suffix and alternating stems, we can observe that stems can select for properties of their prosodic domain, which is not a segmentally adjacent context (one morph of the alternating stem morpheme type selects for all mid vowels within ϕ).

The emergent approach to grammar, as realized via lexical allomorphy, shares some similarities with sub-categorization frames proposed by Paster, 2009, 2015; Paster, 2006 to account for phonologically conditioned suppletive allomorphy (PCSA). Although this approach still retains underlying forms, the comparison is of interest because lexical allomorphy treats all alternations as suppletive allomorphy, in the sense that individual morphs are chosen via the phonology; this is contrasted with an approach in which underlying forms are changed via the phonology in order to respect phonotactics resulting in the observed surface forms. In this section I will examine some of the ways in which Paster's (2006) approach to PCSA is similar to and different from an emergent approach.

Paster, 2006 observes that PCSA is sensitive to underlying forms, and not to surface forms. This finding is of interest in the context of an emergent approach to allomorphy precisely because there is no distinction between underlying and surface forms. To begin with, let us understand what PCSA refers to. The sense in which PCSA is phonologically conditioned is that allomorphs of affixes can be subcategorized by phonological properties of stems. The sense in which PCSA is suppletive is that particular allomorphs are deemed to be too different in structure for a phonological rule or constraint to relate them via a single underlying form.

Underlying forms are not available in an emergent approach. Two immediate consequences are that i) it is not possible to judge if two allomorphs are in a suppletive relationship; and ii) emergent allomorphy must be sensitive to surface forms.

As we have seen, it is not the case that emergence has nothing to say about how allomorphs are related. In fact, relating allomorphs is a crucial portion of how a learner productively fills their lexicon, via morph set relations and morph set conditions. Nevertheless, morphs need not be related; some must simply be observed by a learner because no systematic relation will produce them: they are arbitrary members of a morph set.

In the emergent approach, the only types of phonological forms a learner can access are surface forms: snippets of spoken language they have perceived. It is not the case that there is no abstract information stored along with these surface forms. As we have seen, selectional restrictions are required to model arbitrary alternations; in other words, alternations which are not predictable from the general set of (ranked) phonological constraints.

Given this way of aligning properties of PCSA with the emergent approach adopted in this work, it is possible to compare the tonal cases in Nata to the cases Paster, 2006 considered. It is worth noting that of

137 examples of PCSA, only two are tonal. The first example is from Zahao, as described in Yip, 2004. Zahao verb stems have two forms, primary and secondary, the surface distribution of which is conditioned by syntactic or prosodic factors.

Table 6.1: Zahao verb stems

	Primary	Secondary	
a.	hmaan L	hmaan L	'be correct'
	hreen L	hren H	'lock up, close'
b.	laam LH	laam L	'dance'
	hmaan L	hmaan L	'be correct'
	ŋaan H	ŋaan L	'write'

The primary form of a stem is not predictive of the secondary form it will have; some primary L stems have identical secondary forms, while others have H secondary forms. Secondary forms are not predictive of primary forms; some secondary L stems have identical primary forms, while other have LH or H primary forms. For an emergent approach, this would mean learners must encounter a stem in both forms, and will never be able to predict for a novel form if it does or does not alternate. Where this type of split behaviour between stems is problematic for generative or optimizing approaches, it is neither problematic nor exceptional for an emergent approach.

Yip, 2004 proposes each stem that alternates has two underlying forms; a constraint requiring all underlying forms to be realized in some environment then requires each of them surface. In addition to these mechanisms, Yip proposes a scale of phonotactic constraints which limits how allomorphs of a stem can vary. Interestingly, the analysis proposed by Yip has many properties in common with how lexical allomorphy analyses the predictable relationships between allomorphs via morph set relations and morph set constraints. This case is significant to emergent grammar in that it poses a set of problems for generative and optimizing models of phonology that just do not exist in the lexical allomorphy approach. This is precisely because lexical allomorphy lists all allomorphs, and makes no distinction between those that are very clearly phonologically related and those that are opaque to such an analysis. In addition, this approach shares with lexical allomorphy that learners make generalizations about how morphs are related.

The second example is from Yucunany dialect of Mixtepec Mixtec, as described in Paster, 2006. The 1sg subject/possessor morpheme alternates between two forms depending on the tone of the preceding stem.[1]

Table 6.2: Yucunany 1sg subject/possessor

nàmá	'soap'	nàmá**à**	'my soap'
vílú	'cat'	vílú**ù**	'my cat'
yùúti	'sand'	yùúti**ì**	'my sand'
sòkò	'shoulder'	sòkò yù	'my shoulder'
tutù	'paper'	tutù yù	'my paper'
chá'à	'short'	chá'à yù	'I am short'
ve'e	nchá'ì 'black house'	ve'e nchá'ì yù	'my black house'

One form is analyzed as a floating L tone, the other form is [yù]. The [yù] form is used following low tone final stems, while the floating L is used following H and M final stems.

An area where emergence differs from an ASR approach is in handling tonal morphemes. If two morphemes or constructions are distinguished by only tone, then that tonal difference must be morphological. In a system where morphemes can be individual tones, a morpheme could correspond to an unassociated tone. However, in a surface oriented system like emergence, a tone is never observed without a vowel to be realized on (or other TBU). This does not mean such an alternation cannot be accounted for; learners can distinguish the two environments and generalize which allomorph corresponds to which morphological context.

In terms of lexical allomorphy, the 1sg subject/possessor has a number of allomorphs corresponding to each vowel hosting that low tone (in addition to the [yù] morph): {à, ù, ì, yù}. The low tone vowel morphs are predictably related via an MSR, which may or may not be more generally active with respect to other morphemes. The choice of which low tone vowel is decided by a phonotactic preventing dissimilar sequences of vowels within the same syllable (see Appendix A) for a treatment of such sequences in Nata). The [yù] morph is not predictable from a general morph set relation which would predict that every morph set could have such a morph instead of just the 1sg subject/possessor. This morph must simply be observed

[1] V=Mid tone, V́=H tone, V̀=L tone

and learned.

Regarding the [yù] allomorph, Paster, 2006 proposes that it is subcategorized for a final L stem. In terms of lexical allomorphy, a phonotactic which penalizes long vowels with low tone (either globally, or in word/phrase final position) would account for the distribution of 1sg subject/possessor allomorphs. In contexts where the possessor is preceded by a H or M tone, the V̀ form is used, with the appropriate matching of vowel features. In contexts where the possessor is preceded by a L tone, the [yù] allomorph is used. In order to prohibit over usage of the [yù] form, a constraint penalizing structure would need to invoked; such a constraint would prefer V forms to CV forms. This is similar to the notion of faithfulness penalizing epenthetic structure in classical Optimality Theory, as in Prince and Smolensky, 1993/2004. However, it is clearly not directly analogous given the different assumptions about underlying forms being made in the current work.

Paster, 2006 relies on comparison with a more conservative dialect of Mixtepec Mixtec in which the two distinct 1sg subject/possessor morphs are not members of the same lexical entry, but are actually the polite and informal variants. Paster proposes that the polite/informal register distinction was lost in the Yucunany dialect of Mixtepec Mixtec, leading to free variation between the forms. Because the tonal form is difficult to perceive after a low tone stem, the segmental variant was preferred there. At some point, the variants ceased to be in free variation, and the segmental variant was only found after low tone stems. This analysis is consistent with the proposal sketched above where the [yù] allomorph is only tolerated when it avoids a particular phonologically illicit sequence.

Paster, 2006 predicts we should not find cases where an affix influences the surface form of a root; however, the analysis of prepositional prefixes includes a selectional restriction which impacts the optimal surface form of the root, this was shown in Section 4.6. Note that both the stem and affix select for each other; it is nevertheless crucial that the affix select for the stem. Regardless, this property is not compatible with Paster's predictions. Moreover, it is not clear Paster would allow for long range effects like that proposed for roots that alternate between mid advanced and mid retracted, as shown in Section 5.3. In some sense domain membership could be considered adjacency, but it certainly is not identical to segmental, or syllabic, adjacency.

Like PCSA, lexical allomorphy allows for a singular method of morph selection, as well as allowing for non-phonologically optimizing outputs. The first property arises from considering all alternations to be allomorphy. The second property is due to the lack of restriction on what kind of selection constraints a morph may have; additionally, there is no meta-condition on MSR's which limits what kind of morphs may be related in a morph set for a particular lexical entry.

Regarding the relationship between morphological and phonological constraints, in Nata we observed that selection outranked phonotactics. There is nothing about emergent grammar, nor indeed about lexical allomorphy, that predicts this to be the case for every language.

With respect to prosodic domains, emergence does not provide any unique insights. What is crucial for the analysis of Nata is that certain morphemes are parsed together by the phonology. Namely, the entire ϕ must be available, as shown by the effects that the associative prefix can have on stem morphs as well as by the effect that alternating roots can have on prepositional prefixes with respect to vowel harmony. The weakest conclusion here is that phonology parses at least the ϕ as a "chunk". There is no reason to believe that whole utterances are not parsed as a whole, with their internal prosodic structure simultaneously available for evaluation.

Concerning Bantu languages, there is a general question regarding how right edges of syllables align with syntactic domains. In Nata this arises with respect to alignment of H tone on onsetless syllables. In this work, we have analyzed ϕ as being licit with an initial vowel; however, this vowel is not phonotactically licit to host a H tone. Another interpretation is that the initial vowel stands outside of the ϕ, which is why it is not a valid host for H tone. One piece of evidence in support of this position is the observation that when preceded by a verb, and in fast speech, the initial vowel of a noun (in other words, the determiner) will coalesce with the final vowel of the verb (see Appendix A for more on coalescence.) This suggests that the initial vowel can be parsed into the same ϕ as the verb, outside of the ϕ of the noun to which it (syntactically) belongs. This is not particularly problematic if we assume that the phonology has available to it entire utterances (which would contain both the verbal and nominal ϕ's).

As a general note on phonological learning, Lexical Allomorphy does not prescribe an order to what learners must encode first: constraints, or allomorphs. Specific events can trigger the learning of a new allomorph, such as observing a novel form at a high enough threshold; however, this can occur at any point in phonotactic learning. Likewise, a phonotactic can be learned before the lexicon is (nearly) fully populated, or after a large amount of forms have been learned; and can be based on generalizations over large numbers of forms. In short, learning is not thought of as serial, but rather parallel. Moreover, it need not be the case that a learner obtains a ranking for a constraint and never changes it; additional allomorphs or contexts may show that a particular constraint needs to be re-ranked. The model of phonological represented here is an idealized final state.

6.3 Nata and Jita

Other Bantu languages have a similar inventory of nominal tone patterns; Jita (Downing, 1990) has the same three surface stem classes as Nata when considering bisyllabic noun stems.

Table 6.3: Tone patterns of bisyllabic noun stems in Jita (Adapted from Downing, 1990 (69))

Class	Example (D-NUM-*n*)	Gloss
Low (0 tone)	o-mu-saani	'friend' (c1)
Initial H	o-mu-gási	'woman' (c1)
Final H	o-mu-tuuŋgâ	'rich person' (c1)

The comparable Nata forms are provided in Table 6.4:

Table 6.4: Stem tone class in Nata

Class	Example (D-NUM-*n*)	Gloss
Low	o-mó-rem-i	'farmer' (c1)
Initial H	o-mu-kári	'woman' (c1)
Final H	e-ɣi-sɛɛrɔ́	'the/a hide' (c7)

H tone on Jita noun stems is far more variable depending on phrasal position than the Nata analogues. Both the Initial H and Final H classes alternate between phrase final and phrase medial forms; note that the forms in the examples above are phrase final. In phrase medial position, the initial H class surfaces with H tone on the final syllable, as illustrated below.

(120) Tone variation by phrase position in Jita

o-mu-**nyéé**mbe 'mango tree' (c3)

o-mu-nyee**mbé** gwaatémwa ‘the mango tree was cut’

In phrase medial position, the final H class will surface without H tone on the stem.

(121) Tone variation by phrase position in Jita

o-mu-tuuŋ**gâ** ‘rich person’ (c1), múmúji ‘in town’

o-mu-tuuŋga múmúji ‘rich person in town’

Trisyllabic stems have three types in phrase final position. These correspond to the three classes identified for bisyllabic stems; however, instead of an Initial H class, trisyllabic stems have an Penultimate H class. In the context of a bisyllabic stem, initial and penultimate positions are identical.

Table 6.5: Tone patterns of trisllabic nouns in Jita

Class	Example (D-NUM-*n*)	Gloss
Low (0 tone)	o-mu-lamusi	‘judge’ (c1)
Penultimate H	e-βi-tuuŋgúru	‘onions’ (c8)
	o-mu-kwaarúújo	‘scalp scratcher’ (c3)
Final H	li-darinâ	‘tangerine’ (c5)

The penultimate H stem class splits into two subclasses when considered in a medial context. This is analyzed as an underlying distinction in where H tone is linked. Downing, 1990 proposes a general shifting rule that applies to underlying H tones, moving them one syllable to the right. The effect of this rule is clear in the medial contexts, as shown by the locative constructions below.

(122) Antepenultimate stems in medial positions: shifting v. nonshifting

Derivation of shifting form iiβustaní mumúji ‘garden in town’

Underlying	iiβus**tá**ni mumúji
Shift & Delink	iiβusta**ní** mumú(ji)
Surface	iiβustaní mumúji

Derivation of nonshifting form eβituuŋgúru mutʃikápo 'onion in basket'

Underlying	eβi**túu**ŋguru mutSikápo
Shift & Delink	eβituuŋ**gú**ru mutSiká(po)
Surface	eβituuŋgúru mutʃikápo

The tone shifting rule is comprised of two independent rules: one which adds an association line one syllable to the right of a H tone, and a second rule, ordered after the first, which deletes all but the rightmost association line associated to a H tone; this is refereed to as shifting and delinking. Regarding the final syllable of the locative modifiers, these are considered to be extra tonal, and are not candidates for landing sites of shifted tones; Downing, 1990 considers all utterance final syllables to be extra tonal.

The shifting rule applies to the head nominals in the locative construction; however, tone shift does not apply to both types of stems when the head nominals occur unmodified. This is because the final syllable of these forms is considered extra tonal, as it is utterance final. The shifting rule and extra tonality of phrase final syllables accounts for the asymmetrical behaviour of shifting and non shifting stems.

(123) Antepenultimate H stems in final position

Derivation of iiβustaní 'garden'

Underlying	iiβus**tá**ni
Shift & Delink	iiβus**tá**(ni)
Surface	iiβustáni

Derivation of eβituuŋgúru 'onion'

Underlying	eβi**túu**ŋguru
Shift & Delink	eβituuŋ**gú**(ru)
Surface	eβituuŋgúru

Because our analysis of Nata is not formulated in terms of deriving surface forms from underlying forms, we will consider the Jita data in terms of Lexical Allomorphy. Jita has three types of nominal stems: Low stems, Initial(2σ)/Penultimate(3σ) H, Antepenultimate H, and Final H. In Jita, there are two non-alternating stems: Low, and Antepenultimate H. Penultimate H and Final H both alternate and are considered to have more than one tonal allomorph, in terms of LA. Note that the stem labels are misleading from the perspective of a surface oriented theory like LA; however, I will continue using them for the sake of continuity from our presentation of the data, and in following with Downing, 1990.

Table 6.6: Lexical entries for Jita stems

Tone class	Lexical Entry	
Low	{saani}	FRIEND
Initial H	{gási, gasí}	WOMAN
Penultimate H	{βustáni, βustaní}	GARDEN
Antepenultimate H	{tuuŋgúru}	ONION
Final H	{darinâ, darina}	TANGERINE

In Nata, the final H stem class is unique in that the only allomorph available to morphemes from this class is the final H allomorph. This allomorph is never optimal in any context except when it is the only allomorph available for a stem.

Although the forms of the invariable stems in Jita and Nata are distinct, their relationship to the tone system is similar. In both Nata and Jita, there is a pressure to align H tone to an edge. In Nata, it is the left edge, as we have seen in the previous chapter. In Jita, H tones shift rightward, albeit the shifting is limited to the adjacent syllable. The Nata Final H and Jita Antepenultimate stems represent morphemes which always violate the basic rule of alignment in those languages, precisely because they lack any allomorphs which would satisfy the requirements of alignment.

Of course, there are a number of other distinctions in the tone systems of Nata and Jita. One striking difference is that words in Jita do not require an H toned syllable. Therefore low stems do not interact with c9 morphology in the same way that their Nata counterparts do; Downing, 1990 lists numerous forms in c9 which occur with a low stem and no H tone on the prefixal material. Likewise, forms with final H stems in medial positions surface without an H tone. In conclusion, Jita does not support the same type of morpheme-based tonal requirements that Nata does; c9 prefixes have no special effect on any stem, and neither do c5 prefixes. This is partially related to the lack of mandatory H on every word, and partially related to the rightward (*i.e.* away from the prefixal material) shifting in Jita.

6.4 Conclusion

In this work I have illustrated a number of tonal and vowel quality alternations in Nata, primarily focusing on the nominal system. I have extended previous analysis of the tone system to consider the effects of prefixes, and likewise have considered these same domains in vowel harmony. I have developed an account of tone and vowel harmony that foregoes underlying forms, and instead focuses of surface allomorphs and the relationships between them. One significant conclusion of this study is that lexical allomorphy has the capacity to account for aspects of prosodic phonology without access to abstract forms. Furthermore, with respect to the study of allomorphy, this study illustrates that affixes can select for stem allomorphs, and that long distance effects are possible given reference to prosodic domains.

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Appendix A

Vowel hiatus

In this appendix I will examine hiatus between vowels within the nominal prefix domain. The effect of vowel hiatus is to prohibit syllables from surfacing with a sequence of distinct vowel features, such as [iu] or [ei]. In Nata, there are no such observed sequences; however, morphology leaves the possibility open if no intervening phonotactic penalizes non-identical vowel sequences.

Vowel hiatus occurs when a morpheme with a vowel final allomorph ([...V]) is followed by a morpheme with a vowel initial allomorph ([V...]). In such cases, the output would be a sequence of potentially non-identical vowels. In Nata, surface forms only exist long vowels of a single quality. In cases where V_1 and V_2 are not identical, coalescence occurs, resulting in one set of vowel features taking over both timing slots. In Nata, both $V_1V_2 \rightarrow V_1V_1$ and $V_1V_2 \rightarrow V_2V_2$ are attested; however, $V_1V_2 \rightarrow V_2V_2$ appears to be more common, as we shall see.

This area of research is also known as hiatus resolution, or vowel elision, depending on which part of the metaphor is being focused on: the problematic sequence (hiatus), or the repair (coalescence, elision).

A.1 Prepositional prefixes

The associative and comitative prefixes generally have a CV- shape, and occur preceding the determiner, which generally has a V- shape; thus, forms with a preposition and overt determiner could potentially surface as ϕ with a sequence of two adjacent but non-identical vowels. However, such sequences are wholly unattested in Nata.

In order to examine coalesce, we will compare determiners on nouns without any prepositions to those same nouns with the class 2 associative prefix and with the comitative prefix. We begin with the forms without prepositions.

Table A.1: Determiner vowel quality

e-βé-tore	'cucumbers.c8'
o-mó-sikera	'someone who enters.c1' (derived)
o-βu-sɔ́oh-u	'greediness.c14' (derived)
o-mu-tɛ́rɛbi	'wooden ladle.c3'
o-mw-iiká	'pressure/gas.c3'
u-mw-áana	'child.c1'
u-mw-ɛɛrí́	'moon.c3'
i-kj-ɔ́ɔndɛ	'honey badger.c7'

In these forms, the determiner is either a mid advanced or high advanced vowel, depending on the [±ATR] value of the following vowel.

Recall that the c2 associative surfaces as [βa-] before a consonant. Similarly, the comitative surfaces as [na-] in such contexts, illustrated with a form with a c10 determiner, and a form with a phonologically null determiner.

Table A.2: CV- comitative

na-tʃaa-∅-m-βaráhɛ	'. . . and Thompson's Gazelles.c10'
na-∅-ki-ɣɛ́rɔ	'. . . and not any thing.c7'

We will now consider the nouns above with prepositions.

Table A.3: Associative vowel quality

a-βa-kári	β**e-e**-βé-tore	'women.c2 of cucumbers.c8'
a-βa-kári	β**o-o**-mó-sikera	'women.c2 of someone who enters.c1'
a-βa-kári	β**o-o**-βú-sɔ́ɔh-u	'women.c2 of greediness.c14'
a-βa-kári	β**o-o**-mu-tɛ́rɛbi	'women.c2 of wooden ladle.c3'
a-βa-kári	β**o-o**-mw-iiká	'women.c2 of pressure/gas.c3'
a-βa-kári	β**ú-ú**-mw-aana	'women.c2 of child.c1'
a-βa-kári	β**u-u**-mw-ɛɛrí́	'women.c2 of moon.c3'
a-βa-kári	β**i-i**-kj-ɔ́ɔndɛ	'women.c2 of honey badger.c7'

Table A.4: Comitative vowel quality

a-βa-kári	n**e-e**-βé-tore	'women.c2 and cucumbers.c8'
a-βa-kári	n**o-o**-mó-sikera	'women.c2 and someone who enters.c1'
a-βa-kári	n**o-o**-βú-sɔ́ɔh-u	'women.c2 and greediness.c14'
a-βa-kári	n**o-o**-mu-tɛ́rɛbi	'women.c2 and wooden ladle.c3'
a-βa-kári	n**o-o**-mw-iiká	'women.c2 and pressure/gas.c3'
a-βa-kári	n**ú-ú**-mw-aana	'women.c2 and child.c1'
a-βa-kári	n**u-u**-mw-ɛɛrí́	'women.c2 and moon.c3'
a-βa-kári	n**i-i**-kj-ɔ́ɔndɛ	'women.c2 and honey badger.c7'

The important observation regarding forms with an associative or comitative prefix is that the quality of the determiner does not alternate depending on the absence or presence of the prepositional prefix. In terms of the coalescence patterns mentioned earlier, this represents the $V_1V_2 \rightarrow V_2V_2$ pattern.

A phonotactic *HIATUS penalizes adjacent non-identical vowels. In addition, the same vowel quality phonotactics we utilized in Chapter 5 account for which V-V sequence surfaces, much like the ϕ-HARMONY constraints. For the sake of simplicity, forms that violate harmony or tone phonotactics are omitted.

(124) Evaluation of coalescense

[{na, no, nu, nɔ, ne, ni, nɛ, . . . } +{ o, u, ɔ. . . } +{mo, mu, mɔ. . . }+{tɛ́rɛbi . . . }]	HIATUS	*[-ATR]	*[+HI]
☞ a. [$_\phi$no-o-mu-[$_\omega$tɛ́rɛbi			
b. [$_\phi$na-o-mu-[$_\omega$tɛ́rɛbi	*!		
c. [$_\phi$ne-o-mu-[$_\omega$tɛ́rɛbi	*!		
c. [$_\phi$nu-u-mu-[$_\omega$tɛ́rɛbi			*!
c. [$_\phi$nɔ-ɔ-mu-[$_\omega$tɛ́rɛbi		*!	

A.2 Locative prefixes

There are two additional prefixes that bear mentioning with respect to coalescence: the locatives [koo-] and [moo-]; 'on', and 'in' respectively. These forms differ from the associative and comitative in that the quality of the vowel in the initial syllable is not determined by the determiner, but rather by the locative prefix. In terms of coalescence, they are the $V_1V_2 \rightarrow V_1V_1$ pattern.

We will begin by considering nouns without the locative prefixes.

Table A.5: Unprefixed nouns

o-mu-kári	‘woman.c1’
o-mo-sísi	‘tamarind tree.c3’
e-me-sísi	‘tamarind trees.c4’
e-ɣe-kúβa	‘chest.c7’
e-βe-kúβa	‘chests.c8’
o-ro-síri	‘on rope.c11’
a-βa-kári	‘women.c2’
u-mw-ɛɛrí	‘moon.c3’
a-ma-βuri	‘feathers.c6’
i-kj-ɔ́ɔndɛ	‘village.c7’
a-tʃaa-ntʃoɣu	‘elephants.c10’

Compare the forms above to those with a locative prefix, below.

Table A.6: Locative vowel quality

koo-mu-kári	‘on woman.c1’
koo-mo-sísi	‘on tamarind tree.c3’
koo-me-sísi	‘on tamarind trees.c4’
koo-ɣe-kúβa	‘on chest.c7’
koo-βe-kúβa	‘on chests.c8’
koo-ro-síri	‘on rope.c11’
kuu-βa-kári	‘on women.c2’
kuu-mw-ɛɛrí	‘on moon.c3’
kúú-ma-βuri	‘on feathers.c6’
kuu-kj-ɔ́ɔndɛ	‘on village.c7’
kú-tʃaa-ntʃoɣu	‘on elephants.c10’

Forms with the locative can never be interpreted as having a phonological null determiner. The determiner still encodes existence in the way determiners have been found to (Gambarage, 2019).

The problem with analyzing such a case is that determiners for class 7, 8, and others, do not generally have back vowel allomorphs; they are distinct from c1, 3, 4, and others in that they occur with front vowels. Therefore, these allomorphs must be limited to just the post-locative position. The other option is that there is a null allomorph of the determiner that still encodes existence, distinct from the null determiner which signifies a non-existential entity.

Appendix B

Tone Evaluation Tableaux

B.1 Low tone class

B.1.1 General

(125) Evaluation of L-tone roots with overt determiner

[$_{\text{DP}}${e, é}$_{\text{L}}$+[$_{\text{NumP}}${ɣe, ɣé}+[$_{\text{n}}${seku}]]]

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highϖ	MP:Rt-CM	Al(H,ϕ)
	a. [$_\phi$e$_{\text{L}}$-ɣe-[$_\omega$seku]]		*!								*		
☞	b. [$_\phi$e$_{\text{L}}$-ɣé-[$_\omega$seku]]						*		*		*		*
	c. [$_\phi$é$_{\text{L}}$-ɣé-[$_\omega$seku]]	*!		*			*		*		*		
	d. [$_\phi$é$_{\text{L}}$-ɣe-[$_\omega$seku]]			*!					*		*		

(126) Evaluation of L-tone roots with null determiner

$[_{DP}[_{NumP}\{$ɣe, ɣé$\}+[_{n}\{$seku$\}]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
a. $[_{\phi}$ɣe-$[_{\omega}$seku]]		*!						*		*		
☞ b. $[_{\phi}$ɣé-$[_{\omega}$seku]]								*		*		

(127) Evaluation of associative L-tone root with overt determiner

$[_{PP}\{$kjo$_H$, kjó$\}+[_{DP}\{$o, ó$\}_L+[_{NumP}\{$mo, mó$\}+[_{nP}\{$rem$\}+\{$i$\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
a. $[_{\iota}[_{\phi}$kjo$_H$-o$_L$-mo-$[_{\omega}$remi]]		*!						*	*	*		
b. $[_{\iota}[_{\phi}$kjo$_H$-o$_L$-mó-$[_{\omega}$remi]]						*!		*		*		*
c. $[_{\iota}[_{\phi}$kjo$_H$-ó$_L$-mó-$[_{\omega}$remi]]	*!			*		*		*		*		*
d. $[_{\iota}[_{\phi}$kjó-o$_L$-mó-$[_{\omega}$remi]]	*!			*		*		*		*		
e. $[_{\iota}[_{\phi}$kjó-ó$_L$-mó-$[_{\omega}$remi]]	*!					*		*		*		
f. $[_{\iota}[_{\phi}$kjo-ó$_L$-mo-$[_{\omega}$remi]]				*!				*		*		*
g. $[_{\iota}[_{\phi}$kjó-o$_L$-mo-$[_{\omega}$remi]]				*!				*		*		
☞ h. $[_{\iota}[_{\phi}$kjó-ó-mo-$[_{\omega}$remi]]								*		*		

(128) Evaluation of associative L-tone root with null determiner

[$_{\text{PP}}${ke$_{\text{H}}$, ké}+[$_{\text{DP}}$[$_{\text{NumP}}${mo, mó}+[$_{\text{nP}}${rem}+{i}}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞ a. [$_\iota$[$_\phi$ké-mo-[$_\omega$remi]]								*		*		
b. [$_\iota$[$_\phi$ke$_{\text{H}}$-mó-[$_\omega$remi]]								*		*		*!
c. [$_\iota$[$_\phi$ké-mó-[$_\omega$remi]]	*!							*		*		
d. [$_\iota$[$_\phi$ke$_{\text{H}}$-mo-[$_\omega$remi]]		*!						*	*	*		

B.1.2 Class 5

(129) Evaluation of L-tone c5 root with overt determiner

[$_{\text{DP}}${ri, rí}$_{\text{L}}$+[$_{\text{NumP}}${i, í}+[$_{\text{nP}}${βuri}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. [$_\iota$[$_\phi$ri$_{\text{L}}$-i-[$_\omega$βuri]]		*!						*		*		
b. [$_\iota$[$_\phi$ri$_{\text{L}}$-í-[$_\omega$βuri]]			*!					*		*		*
☞ c. [$_\iota$[$_\phi$rí$_{\text{L}}$-í-[$_\omega$βuri]]								*		*		
d. [$_\iota$[$_\phi$rí$_{\text{L}}$-i-[$_\omega$βuri]]			*!					*		*		

(130) Evaluation of L-tone c5 root with null determiner

[$_{\text{DP}}$[$_{\text{NumP}}${i, í}+[$_{\text{nP}}${βuri}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. [$_\iota$[$_\phi$i-[$_\omega$βuri]]		*!						*		*		
☞ b. [$_\iota$[$_\phi$í-[$_\omega$βuri]]			*					*		*		

(131) Evaluation of associative L-tone c5 root with overt determiner

$[_{PP}\{wo_H, wó\}+[_{DP}\{ri, rí\}_L+[_{NumP}\{i, í\}+[_{nP}\{rem\}+\{i\}\}]]]]$

	MonoH	HighΦ	$*(_\sigma\acute{V}$	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	$*\emptyset$Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. $[_\iota[_\phi$wo$_H$-ri$_L$-i-$[_\omega$remi]]		*!						*	*	*		
b. $[_\iota[_\phi$wo$_H$-rí$_L$-i-$[_\omega$remi]]				*!				*		*		*
☞ c. $[_\iota[_\phi$wó-ri$_L$-i-$[_\omega$remi]]								*		*		
d. $[_\iota[_\phi$wó-rí$_L$-i-$[_\omega$remi]]	*!			*				*		*		
e. $[_\iota[_\phi$wo$_H$-ri$_L$-í-$[_\omega$remi]]				*!				*		*		*
g. $[_\iota[_\phi$wo$_H$-rí$_L$-í-$[_\omega$remi]]								*		*		*!
h. $[_\iota[_\phi$wó-ri$_L$-í-$[_\omega$remi]]	*!			*				*		*		
i. $[_\iota[_\phi$wó-rí$_L$-í-$[_\omega$remi]]	*!							*		*		

(132) Evaluation of associative L-tone c5 root with null determiner

$[_{PP}\{wi_H, wí\}+[_{DP}[_{NumP}\{i, í\}+[_{nP}\{rem\}+\{i\}\}]]]]$

	MonoH	HighΦ	$*(_\sigma\acute{V}$	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	$*\emptyset$Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. $[_\iota[_\phi$wi$_H$-i-$[_\omega$remi]]		*!						*	*	*		
b. $[_\iota[_\phi$wí-i-$[_\omega$remi]]				*!				*		*		
c. $[_\iota[_\phi$wi$_H$-í-$[_\omega$remi]]				*!				*	*	*		*
☞ d. $[_\iota[_\phi$wí-í-$[_\omega$remi]]								*		*		

B.1.3 Class 9/10

(133) Evaluation of L-tone c9 root with overt determiner

$[_{DP}\{\text{a, á}\}_{L}+[_{NumP}\{\text{N}, \emptyset\}_{L}+[_{nP}\{\text{βaata, βáata}_{c9}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
	a. $[_{\iota}[_{\phi}\text{a}_{L}\text{-m}_{L}\text{-}[_{\omega}\text{βaata}]]$		*!						*		*		
	b. $[_{\iota}[_{\phi}\text{á}_{L}\text{-m}_{L}\text{-}[_{\omega}\text{βaata}]]$			*!					*		*		
☞	c. $[_{\iota}[_{\phi}\text{a}_{L}\text{-m}_{L}\text{-}[_{\omega}\text{βáata}_{c9}]]$						*						*
	d. $[_{\iota}[_{\phi}\text{á}_{L}\text{-m}_{L}\text{-}[_{\omega}\text{βáata}_{c9}]]$	*!		*			*						

(134) Evaluation of L-tone c9 root with null determiner

$[_{DP}+[_{NumP}\{\text{N}, \emptyset\}_{L}+[_{nP}\{\text{βaata, βáata}_{c9}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
	a. $[_{\iota}[_{\phi}\text{m}_{L}\text{-}[_{\omega}\text{βaata}]]$		*!						*				
☞	b. $[_{\iota}[_{\phi}\text{m}_{L}\text{-}[_{\omega}\text{βáata}_{c9}]]$						*						*

(135) Evaluation of L-tone c10 root with overt determiner

$[_{DP}\{$tʃaa, tʃáá, tʃáa$\}_L$+$[_{NumP}\{N, \emptyset\}_L$+$[_{nP}\{$βaata, βáata$_{c9}\}]]]]$

		MonoH	HighΦ	*(σ V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
	a. $[_{\iota}[_{\phi}$tʃaa$_L$-m$_L$-$[_{\omega}$βaata]]		*!						*		*		
☞	b. $[_{\iota}[_{\phi}$tʃáá$_L$-m$_L$-$[_{\omega}$βaata]]								*		*		
	c. $[_{\iota}[_{\phi}$tʃáa$_L$-m$_L$-$[_{\omega}$βaata]]				*!				*		*		
	d. $[_{\iota}[_{\phi}$tʃaa$_L$-m$_L$-$[_{\omega}$βáata$_{c9}$]]						*!	*				*	*
	e. $[_{\iota}[_{\phi}$tʃáá$_L$-m$_L$-$[_{\omega}$βáata$_{c9}$]]	*!					*	*				*	
	f. $[_{\iota}[_{\phi}$tʃáa$_L$-m$_L$-$[_{\omega}$βáata$_{c9}$]]	*!			*		*	*				*	

(136) Evaluation of L-tone c10 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_L$+$[_{nP}\{$βaata, βáata$_{c9}\}]]]]$

		MonoH	HighΦ	*(σ V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☹	a. $[_{\iota}[_{\phi}$m$_L$-$[_{\omega}$βaata]]		*!						*		*		
☞	b. $[_{\iota}[_{\phi}$m$_L$-$[_{\omega}$βáata$_{c9}$]]						*					*	*

(137) Evaluation of associative L-tone c9 root with overt determiner

$[_{PP}\{wa_H, wá\}+[_{DP}\{a, á\}_L+[_{NumP}\{N, \emptyset\}_L+[_{nP}\{βaata, βáata_{c9}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highϖ	MP:Rt-CM	Al(H,ϕ)
	a. $[_\iota[_\phi$ wa$_H$-a$_L$-m$_L$-$[_\omega$βaata]]		*!						*	*	*		
	b. $[_\iota[_\phi$ wá-a$_L$-m$_L$-$[_\omega$βaata]]				*!				*		*		
	c. $[_\iota[_\phi$ wa$_H$-á$_L$-m$_L$-$[_\omega$βaata]]				*!				*	*	*		*
☞	d. $[_\iota[_\phi$ wá-á$_L$-m$_L$-$[_\omega$βaata]]								*		*		
	e. $[_\iota[_\phi$ wa$_H$-a$_L$-m$_L$-$[_\omega$βáata$_{c9}$]]						*						*
	g. $[_\iota[_\phi$ wá-a$_L$-m$_L$-$[_\omega$βáata$_{c9}$]]	*!			*		*						
	h. $[_\iota[_\phi$ wa$_H$-á$_L$-m$_L$-$[_\omega$βáata$_{c9}$]]	*!			*		*						*
	i. $[_\iota[_\phi$ wá-á$_L$-m$_L$-$[_\omega$βáata$_{c9}$]]	*!					*						

(138) Evaluation of associative L-tone c9 root with null determiner

$[_{PP}\{wɔ_H, wɔ́\}+[_{DP}[_{NumP}\{N, \emptyset\}_L+[_{nP}\{βaata, βáata_{c9}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highϖ	MP:Rt-CM	Al(H,ϕ)
	a. $[_\iota[_\phi$ wɔ$_H$-m$_L$-$[_\omega$βaata]]		*!						*	*	*	*	
☞	b. $[_\iota[_\phi$ wɔ́-m$_L$-$[_\omega$βaata]]								*		*	*	
	c. $[_\iota[_\phi$ wɔ$_H$-m$_L$-$[_\omega$βáata$_{c9}$]]						*!						*
	d. $[_\iota[_\phi$ wɔ́-m$_L$-$[_\omega$βáata$_{c9}$]]	*!					*						

(139) Evaluation of associative L-tone c10 root with overt determiner

[$_{PP}${wɔ$_H$, wɔ́}+[$_{DP}${tʃaa, tʃáá}$_L$+[$_{NumP}${N, ∅}$_L$+[$_{nP}${βaata, βáata$_{c9}$}]]]]

		MONOH	HIGHΦ	*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,φ)
	a. [$_\iota$[$_\phi$ wɔ$_H$-tʃaa$_L$-m$_L$-[$_\omega$βaata]]		*!						*	*	*		
☞	b. [$_\iota$[$_\phi$ wɔ́-tʃaa$_L$-m$_L$-[$_\omega$βaata]]								*		*		
	c. [$_\iota$[$_\phi$ wɔ$_H$-tʃáá$_L$-m$_L$-[$_\omega$βaata]]								*		*		*!
	d. [$_\iota$[$_\phi$ wɔ́-tʃáá$_L$-m$_L$-[$_\omega$βaata]]	*!							*		*		
	e. [$_\iota$[$_\phi$ wɔ$_H$-tʃaa$_L$-m$_L$-[$_\omega$βáata$_{c9}$]]						*!	*		*		*	*
	g. [$_\iota$[$_\phi$ wɔ́-tʃaa$_L$-m$_L$-[$_\omega$βáata$_{c9}$]]	*!					*	*				*	
	h. [$_\iota$[$_\phi$ wɔ$_H$-tʃáá$_L$-m$_L$-[$_\omega$βáata$_{c9}$]]	*!					*	*				*	*
	i. [$_\iota$[$_\phi$ wɔ́-tʃáá$_L$-m$_L$-[$_\omega$βáata$_{c9}$]]	*!					*	*				*	

(140) Evaluation of associative L-tone c10 root with null determiner

[$_{PP}${wɔ$_H$, w´ɔ}+[$_{DP}$[$_{NumP}${N, ∅}$_L$+[$_{nP}${βaata, βáata$_{c9}$}]]]]

		MONOH	HIGHΦ	*(σV́	VV-TONE	SEL:H_	SEL:L	MP:RT-DET	*∅RT	SEL:H	HIGHω	MP:RT-CM	AL(H,φ)
	a. [$_\iota$[$_\phi$ wɔ$_H$-m$_L$-[$_\omega$βaata]]		*!						*	*	*		
☞	b. [$_\iota$[$_\phi$ wɔ́-m$_L$-[$_\omega$βaata]]								*		*		
	c. [$_\iota$[$_\phi$ wɔ$_H$-m$_L$-[$_\omega$βáata$_{c9}$]]						*!					*	*
	d. [$_\iota$[$_\phi$ wɔ́-m$_L$-[$_\omega$βáata$_{c9}$]]	*!					*					*	

B.2 Final H tone class

(141) Evaluation of final H tone root with overt determiner

$[_{DP}\{$e, é$\}_L+[_{NumP}\{$ ɣi, ɣé$\}+[_n\{$teeté$\}]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_\phi$ e$_L$-ɣi-$[_\omega$teeté]]								*				*
b. $[_\phi$ e$_L$-ɣé-$[_\omega$teeté]]	*!					*		*				*
c. $[_\phi$ é$_L$-ɣé-$[_\omega$teeté]]	*!		*			*		*				
d. $[_\phi$ é$_L$-ɣe-$[_\omega$teeté]]	*!		*					*				

(142) Evaluation of final H tone root with null determiner

$[_{DP}[_{NumP}\{$ ɣi, ɣí$\}+[_n\{$teeté$\}]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. $[_\phi$ ɣe-$[_\omega$teeté]]								*				*
b. $[_\phi$ ɣé-$[_\omega$teeté]]	*!							*				

(143) Evaluation of associative final H-tone root with overt determiner

$[_{PP}\{kjo_H, kjó, \}+[_{DP}\{o, ó\}_L+[_{NumP}\{mo, mó\}+[_{nP}\{sirikaré\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞ a. $[_\iota[_\phi kjo_H\text{-}o_L\text{-mo-}[_\omega sirikaré]]$								*	*			*
b. $[_\iota[_\phi kjo_H\text{-}o_L\text{-mó-}[_\omega sirikaré]]$	*!					*		*				*
c. $[_\iota[_\phi kjo_H\text{-ó}_L\text{-mo-}[_\omega sirikaré]]$	*!							*	*			*
d. $[_\iota[_\phi kjó\text{-}o_L\text{-mo-}[_\omega sirikaré]]$	*!							*				
e. $[_\iota[_\phi kjó\text{-ó}_L\text{-mo-}[_\omega sirikaré]]$	*!							*				
f. $[_\iota[_\phi kjó\text{-ó}_L\text{-mó-}[_\omega sirikaré]]$	*!					*		*				
g. $[_\iota[_\phi kjó\text{-}o_L\text{-mó-}[_\omega sirikaré]]$	*!					*		*				
h. $[_\iota[_\phi kjo_H\text{-ó}_L\text{-mó-}[_\omega sirikaré]]$	*!					*		*				*

(144) Evaluation of associative final H-tone root with null determiner

$[_{PP}\{ke_H, ké, \}+[_{DP}[_{NumP}\{mo, mó\}+[_{nP}\{sirikaré\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞ a. $[_\iota[_\phi ke_H\text{-mo-}[_\omega sirikaré]]$								*	*			*
b. $[_\iota[_\phi ke_H\text{-mó-}[_\omega sirikaré]]$	*!							*				*
c. $[_\iota[_\phi ké\text{-mo-}[_\omega sirikaré]]$	*!							*				
d. $[_\iota[_\phi ké\text{-mó-}[_\omega sirikaré]]$	*!							*				

B.2.1 Class 5

(145) Evaluation of Final H-tone c5 root with overt determiner

$[_{DP}${ri, rí}$_{L}$+$[_{NumP}${i, í}+$[_{nP}${βiriká}]]]]

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞	a. $[_{\iota}[_{\phi}$ri-i-$[_{\omega}$βiriká]]								*				*
	b. $[_{\iota}[_{\phi}$ri$_{L}$-í-$[_{\omega}$βiriká]]	*!			*				*				
	c. $[_{\iota}[_{\phi}$rí$_{L}$-í-$[_{\omega}$βiriká]]	*!							*				
	d. $[_{\iota}[_{\phi}$rí$_{L}$-i-$[_{\omega}$βiriká]]	*!			*				*				

(146) Evaluation of Final H-tone c5 root with null determiner

$[_{DP}[_{NumP}${i, í}+$[_{nP}${βiriká}]]]]

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞	a. $[_{\iota}[_{\phi}$i-$[_{\omega}$βiriká]]								*				*
	b. $[_{\iota}[_{\phi}$í-$[_{\omega}$βiriká]]	*!		*					*				

(147) Evaluation of associative final H-tone c5 root with overt determiner

[$_{PP}$\{wo$_H$, wó\}+[$_{DP}$\{ri, rí\}$_L$+[$_{NumP}$\{i, í\}+[$_{nP}$\{tooká\}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_\iota$[$_\phi$wo$_H$-ri$_L$-i-[$_\omega$tooká]]								*	*			*
b. [$_\iota$[$_\phi$wo$_H$-rí$_L$-i-[$_\omega$tooká]]	*!			*				*				*
c. [$_\iota$[$_\phi$wo$_H$-rí$_L$-í-[$_\omega$tooká]]	*!							*				*
d. [$_\iota$[$_\phi$wo$_H$-ri$_L$-í-[$_\omega$tooká]]	*!			*				*				*
e. [$_\iota$[$_\phi$wó-ri$_L$-i-[$_\omega$tooká]]	*!							*				
f. [$_\iota$[$_\phi$wó-rí$_L$-i-[$_\omega$tooká]]	*!			*				*				
g. [$_\iota$[$_\phi$wó-rí$_L$-í-[$_\omega$tooká]]	*!							*				
h. [$_\iota$[$_\phi$wó-ri$_L$-í-[$_\omega$tooká]]	*!			*				*				

(148) Evaluation of associative final H-tone c5 root with null determiner

[$_{PP}$\{wi$_H$, wí\}+[$_{DP}$[$_{NumP}$\{i, í\}+[$_{nP}$\{tooká\}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_\iota$[$_\phi$wi$_H$-i-[$_\omega$tooká]]								*	*			*
b. [$_\iota$[$_\phi$wi$_H$-í-[$_\omega$tooká]]	*!			*				*	*			*
c. [$_\iota$[$_\phi$wí-i-[$_\omega$tooká]]	*!			*				*				
d. [$_\iota$[$_\phi$wí-í-[$_\omega$tooká]]	*!							*				

Class 9/10

(149) Evaluation of Final H-tone c9 root with overt determiner

$[_{DP}\{a, á\}_L+[_{NumP}\{N, \emptyset\}_L+[_{nP}\{akwaahá\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞	a. $[_\iota[_\phi a_L$-$ɲ_L$-$[_\omega$akwaahá]]								*				*
	b. $[_\iota[_\phi á_L$-$ɲ_L$-$[_\omega$akwaahá]]	*!		*					*				

(150) Evaluation of Final H-tone c9 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_L+[_{nP}\{akwaahá\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞	a. $[_\iota[_\phi ɲ_L$-$[_\omega$akwaahá]]								*				*

(151) Evaluation of Final H-tone c10 root with overt determiner

[$_{DP}${tʃaa, tʃáá, tʃáa}+[$_{NumP}${N, ∅}$_L$+[$_{nP}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞ a. [$_\iota$[$_\phi$tʃaa-ɲ$_L$-[$_\omega$akwaahá]]								*				*
b. [$_\iota$[$_\phi$tʃáá-ɲ$_L$-[$_\omega$akwaahá]]	*!							*				
c. [$_\iota$[$_\phi$tʃáa-ɲ$_L$-[$_\omega$akwaahá]]	*!			*				*				

(152) Evaluation of Final H-tone c10 root with null determiner

[$_{DP}$[$_{NumP}${N, ∅}$_L$+[$_{nP}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞ a. [$_\iota$[$_\phi$ɲ$_L$-[$_\omega$akwaahá]]								*				*

(153) Evaluation of associative Final H-tone c9 root with overt determiner

[$_{PP}${kja$_H$, kjá}+[$_{DP}${a, á}$_L$+[$_{NumP}${N, ∅}$_L$+[$_{nP}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
☞ a. [$_\iota$[$_\phi$kja$_H$-a$_L$-ɲ$_L$-[$_\omega$akwaahá]]								*	*			*
b. [$_\iota$[$_\phi$kjá-a$_L$-ɲ$_L$-[$_\omega$akwaahá]]	*!			*				*				
c. [$_\iota$[$_\phi$kja$_H$-á$_L$-ɲ$_L$-[$_\omega$akwaahá]]	*!			*				*	*			
d. [$_\iota$[$_\phi$kjá-á$_L$-ɲ$_L$-[$_\omega$akwaahá]]	*!							*				

(154) Evaluation of associative Final H-tone c9 root with null determiner

[$_{PP}${kɛ$_{H}$, kɛ́}+[$_{DP}$[$_{NumP}${N, ∅}$_{L}$+[$_{nP}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_{ι}$[$_{φ}$kɛ$_{H}$-ɲ$_{L}$-[$_{ω}$akwaahá]]								*	*			*
b. [$_{ι}$[$_{φ}$kɛ́-ɲ$_{L}$-[$_{ω}$akwaahá]]	*!							*				

(155) Evaluation of associative Final H-tone c10 root with overt determiner

[$_{PP}${ɣɛ$_{H}$, ɣɛ́}+[$_{DP}${tʃaa, tʃáá, tʃáa}$_{L}$+[$_{NumP}${N, ∅}$_{L}$+[$_{nP}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_{ι}$[$_{φ}$ɣɛ$_{H}$-tʃaa$_{L}$-ɲ$_{L}$-[$_{ω}$akwaahá]]								*	*			*
b. [$_{ι}$[$_{φ}$ɣɛ$_{H}$-tʃáá$_{L}$-ɲ$_{L}$-[$_{ω}$akwaahá]]	*!							*				*
c. [$_{ι}$[$_{φ}$ɣɛ$_{H}$-tʃáa$_{L}$-ɲ$_{L}$-[$_{ω}$akwaahá]]	*!			*				*				*
d. [$_{ι}$[$_{φ}$ɣɛ́-tʃaa$_{L}$-ɲ$_{L}$-[$_{ω}$akwaahá]]	*!							*				
e. [$_{ι}$[$_{φ}$ɣɛ́-tʃáá$_{L}$-ɲ$_{L}$-[$_{ω}$akwaahá]]	*!							*				
f. [$_{ι}$[$_{φ}$ɣɛ́-tʃáa$_{L}$-ɲ$_{L}$-[$_{ω}$akwaahá]]	*!			*				*				

(156) Evaluation of associative Final H-tone c10 root with null determiner

[$_{PP}${kɛ$_{H}$, kɛ́}+[$_{DP}$[$_{NumP}${N, ∅}$_{L}$+[$_{nP}${akwaahá}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_{ι}$[$_{φ}$kɛ$_{H}$-ɲ-[$_{ω}$akwaahá]]								*	*			*
b. [$_{ι}$[$_{φ}$kɛ́-ɲ-[$_{ω}$akwaahá]]	*!							*				

B.3 Initial H tone class

B.3.1 General

(157) Evaluation of Initial H-tone root with overt determiner

$[_{DP}$\{e, é\}$_L$+$[_{NumP}$\{ ɣe, ɣé\}+$[_{nP}$\{síma, simá$_{c5}$, sima$_{H_}$\}]]]

		MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
	a. [$_\phi$e$_L$-ɣe-[$_\omega$sima$_{H_}$]]		*!			*			*		*		
	b. [$_\phi$e$_L$-ɣe-[$_\omega$simá$_{c5}$]]							*				*!	*
☞	c. [$_\phi$e$_L$-ɣe-[$_\omega$síma]]								*				*
	d. [$_\phi$e$_L$-ɣé-[$_\omega$sima$_{H_}$]]						*!		*		*		*
	e. [$_\phi$e$_L$-ɣé-[$_\omega$simá$_{c5}$]]	*!					*	*				*	*
	f. [$_\phi$e$_L$-ɣé-[$_\omega$síma]]	*!					*		*				*
	g. [$_\phi$é$_L$-ɣe-[$_\omega$sima$_{H_}$]]			*!		*			*		*		
	h. [$_\phi$é$_L$-ɣe-[$_\omega$simá$_{c5}$]]	*!		*				*				*	
	i. [$_\phi$é$_L$-ɣe-[$_\omega$síma]]	*!		*					*				
	j. [$_\phi$é$_L$-ɣé-[$_\omega$sima$_{H_}$]]	*!		*			*		*		*		
	k. [$_\phi$é$_L$-ɣé-[$_\omega$simá$_{c5}$]]	*!		*			*	*				*	
	l. [$_\phi$é$_L$-ɣé-[$_\omega$síma]]	*!		*			*		*				

(158) Evaluation of Initial H-tone root with null determiner

$[_{DP}[_{NumP}\{$ ɣe, ɣé$\}+[_{nP}\{$síma, simá$_{c5}$, sima$_{H_}\}]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. [$_{\phi}$ ɣe-[$_{\omega}$sima$_{H_}$]]		*!			*			*		*		*
	b. [$_{\phi}$ ɣe-[$_{\omega}$simá$_{c5}$]]							*				*!	*
☞	c. [$_{\phi}$ ɣe-[$_{\omega}$síma]]								*				*
	d. [$_{\phi}$ ɣé-[$_{\omega}$sima$_{H_}$]]								*		*!		
	e. [$_{\phi}$ ɣé-[$_{\omega}$simá$_{c5}$]]	*!						*				*	
	f. [$_{\phi}$ ɣé-[$_{\omega}$síma]]	*!							*				

(159) Evaluation of associative Initial H-tone root with overt determiner

$[_{PP}\{\text{kjo}_H, \text{kjó}\}+[_{DP}\{\text{o, ó}\}_L+[_{NumP}\{\text{mu, mú}\}+[_{nP}\{\text{kári}, \text{kari}_{H\_}, \text{karí}_{c5}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. $[_\iota[_\phi \text{kjo}_H\text{-o}_L\text{-mu-}[_\omega \text{kari}_{H\_}]]$		*!			*			*	*	*		
	b. $[_\iota[_\phi \text{kjo}_H\text{-o}_L\text{-mu-}[_\omega \text{karí}_{c5}]]$							*		*		*!	*
☞	c. $[_\iota[_\phi \text{kjo}_H\text{-o}_L\text{-mu-}[_\omega \text{kári}]]$								*	*			*
	d. $[_\iota[_\phi \text{kjo}_H\text{-o}_L\text{-mú-}[_\omega \text{kari}_{H\_}]]$								*		*!		*
	e. $[_\iota[_\phi \text{kjo}_H\text{-o}_L\text{-mú-}[_\omega \text{karí}_{c5}]]$	*!						*				*	*
	f. $[_\iota[_\phi \text{kjo}_H\text{-o}_L\text{-mú-}[_\omega \text{kári}]]$	*!							*				*
	g. $[_\iota[_\phi \text{kjo}_H\text{-ó}_L\text{-mu-}[_\omega \text{kari}_{H\_}]]$				*!	*			*	*	*		*
	h. $[_\iota[_\phi \text{kjo}_H\text{-ó}_L\text{-mu-}[_\omega \text{karí}_{c5}]]$	*!			*			*		*		*	*
	i. $[_\iota[_\phi \text{kjo}_H\text{-ó}_L\text{-mu-}[_\omega \text{kári}]]$	*!			*				*	*			*
	j. $[_\iota[_\phi \text{kjó–o}_L\text{-mu-}[_\omega \text{kari}_{H\_}]]$				*!	*			*		*		
	k. $[_\iota[_\phi \text{kjó–o}_L\text{-mu-}[_\omega \text{karí}_{c5}]]$	*!			*			*				*	
	l. $[_\iota[_\phi \text{kjó–o}_L\text{-mu-}[_\omega \text{kári}]]$	*!			*				*				
	m. $[_\iota[_\phi \text{kjo}_H\text{-ó}_L\text{-mú-}[_\omega \text{kari}_{H\_}]]$	*!			*				*		*		*
	n. $[_\iota[_\phi \text{kjo}_H\text{-ó}_L\text{-mú-}[_\omega \text{karí}_{c5}]]$	*!			*			*				*	*
	o. $[_\iota[_\phi \text{kjo}_H\text{-ó}_L\text{-mú-}[_\omega \text{kári}]]$	*!			*				*				*
	p. $[_\iota[_\phi \text{kjó–ó}_L\text{-mu-}[_\omega \text{kari}_{H\_}]]$					*!			*		*		
	q. $[_\iota[_\phi \text{kjó–ó}_L\text{-mu-}[_\omega \text{karí}_{c5}]]$	*!						*				*	
	r. $[_\iota[_\phi \text{kjó–ó}_L\text{-mu-}[_\omega \text{kári}]]$	*!							*				
	s. $[_\iota[_\phi \text{kjó–ó}_L\text{-mú-}[_\omega \text{kari}_{H\_}]]$	*!							*	*	*		
	t. $[_\iota[_\phi \text{kjó–ó}_L\text{-mú-}[_\omega \text{karí}_{c5}]]$	*!						*				*	
	u. $[_\iota[_\phi \text{kjó–ó}_L\text{-mú-}[_\omega \text{kári}]]$	*!							*	*			

(160) Evaluation of associative Initial H-tone root with null determiner

$[_{PP}\{$ke$_H$, ké$\}[_{DP}[_{NumP}\{$mu, mú$\}$+$[_{nP}\{$kári, kari$_{H_}$, karí$_{c5}\}]]]]$

		MonoH	HighΦ	*(σ V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. $[_\iota[_\phi$ke$_H$-mu-$[_\omega$kari$_{H_}$]]		*!			*			*	*	*		*
	b. $[_\iota[_\phi$ke$_H$-mu-$[_\omega$karí$_{c5}$]]									*!		*	*
	c. $[_\iota[_\phi$ke$_H$-mu-$[_\omega$kári]]								*	*!			*
☞	d. $[_\iota[_\phi$ke$_H$-mú-$[_\omega$kari$_{H_}$]]								*		*		*
	e. $[_\iota[_\phi$ke$_H$-mú-$[_\omega$karí$_{c5}$]]	*!										*	*
	f. $[_\iota[_\phi$ke$_H$-mú-$[_\omega$kári]]	*!							*				*
	g. $[_\iota[_\phi$ké–mu-$[_\omega$kari$_{H_}$]]					*!			*		*		
	h. $[_\iota[_\phi$ké–mu-$[_\omega$karí$_{c5}$]]	*!										*	
	i. $[_\iota[_\phi$ké–mu-$[_\omega$kári]]	*!							*				
	j. $[_\iota[_\phi$ké–mú-$[_\omega$kari$_{H_}$]]	*!							*		*		
	k. $[_\iota[_\phi$ké–mú-$[_\omega$karí$_{c5}$]]	*!										*	
	l. $[_\iota[_\phi$ké–mú-$[_\omega$kári]]	*!							*				

B.3.2 Class 5

(161) Evaluation of Initial H-tone c5 root with overt determiner

[$_{DP}${ri, rí}$_L$+[$_{NumP}${i, í}+[$_{nP}${βúruuŋga, βuruuŋga$_H$, βurúuŋga$_{c5}$}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. [$_\iota$[$_\phi$ri$_L$-i-[$_\omega$βúruuŋga]]						*!		*				*
b. [$_\iota$[$_\phi$ri$_L$-í-[$_\omega$βúruuŋga]]	*!			*		*		*				
c. [$_\iota$[$_\phi$rí$_L$-í-[$_\omega$βúruuŋga]]	*!					*		*				
d. [$_\iota$[$_\phi$rí$_L$-i-[$_\omega$βúruuŋga]]	*!			*		*		*				
e. [$_\iota$[$_\phi$ri$_L$-i-[$_\omega$βuruuŋga$_{H_}$]]		*!			*			*		*		*
f. [$_\iota$[$_\phi$ri$_L$-í-[$_\omega$βuruuŋga$_{H_}$]]				*!				*		*		
g. [$_\iota$[$_\phi$rí$_L$-í-[$_\omega$βuruuŋga$_{H_}$]]								*!		*		
h. [$_\iota$[$_\phi$rí$_L$-i-[$_\omega$βuruuŋga$_{H_}$]]				*!				*		*		
☞ i. [$_\iota$[$_\phi$ri$_L$-i-[$_\omega$βurúuŋga$_{c5}$]]												*
j. [$_\iota$[$_\phi$ri$_L$-í-[$_\omega$βurúuŋga$_{c5}$]]	*!			*								
k. [$_\iota$[$_\phi$rí$_L$-í-[$_\omega$βurúuŋga$_{c5}$]]	*!											
l. [$_\iota$[$_\phi$rí$_L$-i-[$_\omega$βurúuŋga$_{c5}$]]	*!			*								

(162) Evaluation of Initial H-tone c5 root with null determiner

$[_{DP}[_{NumP}\{$i, í$\}$+$[_{nP}\{$βúruuŋga, βuruuŋga$_{H_}$, βurúuŋga$_{c5}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. $[_{\iota}[_{\phi}$i-$[_{\omega}$βúruuŋga]]								*!				*
	b. $[_{\iota}[_{\phi}$í-$[_{\omega}$βúruuŋga]]	*!		*					*				
	c. $[_{\iota}[_{\phi}$i-$[_{\omega}$βuruuŋga$_{H_}$]]		*!			*			*		*		
	d. $[_{\iota}[_{\phi}$í-$[_{\omega}$βuruuŋga$_{H_}$]]			*!					*		*		
☞	e. $[_{\iota}[_{\phi}$i-$[_{\omega}$βurúuŋga$_{c5}$]]												*
	f. $[_{\iota}[_{\phi}$í-$[_{\omega}$βurúuŋga$_{c5}$]]	*!		*									

(163) Evaluation of associative initial H-tone c5 root with overt determiner

[$_{PP}${wo$_{H}$, wó}+[$_{DP}${ri, rí}$_{L}$+[$_{NumP}${i, í}+[$_{nP}${βúruuŋga, βuruuŋga$_{H_}$, βurúuŋga$_{c5}$}]]]]

		MonoH	HighΦ	*(σ V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highϖ	MP:Rt-CM	Al(H,φ)
	a. [$_{\iota}$[$_{\phi}$wo$_{H}$-ri$_{L}$-i-[$_{\omega}$βúruuŋga]]						*!		*	*			*
	b. [$_{\iota}$[$_{\phi}$wo$_{H}$-ri$_{L}$-í-[$_{\omega}$βúruuŋga]]	*!			*		*		*				*
	c. [$_{\iota}$[$_{\phi}$wo$_{H}$–rí$_{L}$-í-[$_{\omega}$βúruuŋga]]	*!					*		*				*
	d. [$_{\iota}$[$_{\phi}$wo$_{H}$–rí$_{L}$-i-[$_{\omega}$βúruuŋga]]	*!			*		*		*				*
	e. [$_{\iota}$[$_{\phi}$wo$_{H}$-ri$_{L}$-i-[$_{\omega}$βuruuŋga$_{H_}$]]		*!			*			*	*	*		*
	f. [$_{\iota}$[$_{\phi}$wo$_{H}$-ri$_{L}$-í-[$_{\omega}$βuruuŋga$_{H_}$]]				*!				*		*		*
	g. [$_{\iota}$[$_{\phi}$wo$_{H}$–rí$_{L}$-í-[$_{\omega}$βuruuŋga$_{H_}$]]								*!		*		*
	h. [$_{\iota}$[$_{\phi}$wo$_{H}$–rí$_{L}$-i-[$_{\omega}$βuruuŋga$_{H_}$]]				*!				*		*		*
☞	i. [$_{\iota}$[$_{\phi}$wo$_{H}$-ri$_{L}$-i-[$_{\omega}$βurúuŋga$_{c5}$]]									*			*
	j. [$_{\iota}$[$_{\phi}$wo$_{H}$-ri$_{L}$-í-[$_{\omega}$βurúuŋga$_{c5}$]]	*!			*								*
	k. [$_{\iota}$[$_{\phi}$wo$_{H}$–rí$_{L}$-í-[$_{\omega}$βurúuŋga$_{c5}$]]	*!											*
	l. [$_{\iota}$[$_{\phi}$wo$_{H}$–rí$_{L}$-i-[$_{\omega}$βurúuŋga$_{c5}$]]	*!			*								*
	m. [$_{\iota}$[$_{\phi}$wó-ri$_{L}$-i-[$_{\omega}$βúruuŋga]]	*!							*				
	n. [$_{\iota}$[$_{\phi}$wó-ri$_{L}$-í-[$_{\omega}$βúruuŋga]]	*!			*				*				
	o. [$_{\iota}$[$_{\phi}$wó–rí$_{L}$-í-[$_{\omega}$βúruuŋga]]	*!							*				
	p. [$_{\iota}$[$_{\phi}$wó–rí$_{L}$-i-[$_{\omega}$βúruuŋga]]	*!			*				*				
	q. [$_{\iota}$[$_{\phi}$wó-ri$_{L}$-i-[$_{\omega}$βuruuŋga$_{H_}$]]					*!			*		*		
	r. [$_{\iota}$[$_{\phi}$wó-ri$_{L}$-í-[$_{\omega}$βuruuŋga$_{H_}$]]	*!			*				*		*		
	s. [$_{\iota}$[$_{\phi}$wó–rí$_{L}$-í-[$_{\omega}$βuruuŋga$_{H_}$]]	*!							*		*		
	t. [$_{\iota}$[$_{\phi}$wó–rí$_{L}$-i-[$_{\omega}$βuruuŋga$_{H_}$]]	*!			*				*		*		
	u. [$_{\iota}$[$_{\phi}$wó-ri$_{L}$-i-[$_{\omega}$βurúuŋga$_{c5}$]]	*!											
	v. [$_{\iota}$[$_{\phi}$wó-ri$_{L}$-í-[$_{\omega}$βurúuŋga$_{c5}$]]	*!			*								
	w. [$_{\iota}$[$_{\phi}$wó–rí$_{L}$-í-[$_{\omega}$βurúuŋga$_{c5}$]]	*!											
	x. [$_{\iota}$[$_{\phi}$wó–rí$_{L}$-i-[$_{\omega}$βurúuŋga$_{c5}$]]	*!			*								

(164) Evaluation of associative initial H-tone c5 root with null determiner

[$_{PP}${wi$_{H}$, wí}+[$_{DP}$[$_{NumP}${i, í}+[$_{nP}${βúruuŋga, βuruuŋga$_{H_}$, βurúuŋga$_{c5}$}]]]]

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
☞ a. [$_{\iota}$[$_{\phi}$ wi$_{H}$-i-[$_{\omega}$βúruuŋga]]								*				*
b. [$_{\iota}$[$_{\phi}$ wi$_{H}$-í-[$_{\omega}$βúruuŋga]]	*!			*				*				*
c. [$_{\iota}$[$_{\phi}$ wí-í-[$_{\omega}$βúruuŋga]]	*!							*				
d. [$_{\iota}$[$_{\phi}$ wí-i-[$_{\omega}$βúruuŋga]]	*!			*				*				
e. [$_{\iota}$[$_{\phi}$ wi$_{H}$-i-[$_{\omega}$βuruuŋga$_{H_}$]]		*!			*			*	*	*		
f. [$_{\iota}$[$_{\phi}$ wi$_{H}$-í-[$_{\omega}$βuruuŋga$_{H_}$]]				*!				*	*	*		*
g. [$_{\iota}$[$_{\phi}$ wí-í-[$_{\omega}$βuruuŋga$_{H_}$]]								*		*!		
h. [$_{\iota}$[$_{\phi}$ wí-i-[$_{\omega}$βuruuŋga$_{H_}$]]				*!				*		*		
i. [$_{\iota}$[$_{\phi}$ wi$_{H}$-i-[$_{\omega}$βurúuŋga$_{c5}$]]									*!			*
j. [$_{\iota}$[$_{\phi}$ wi$_{H}$-í-[$_{\omega}$βurúuŋga$_{c5}$]]	*!			*					*			*
k. [$_{\iota}$[$_{\phi}$ wí-í-[$_{\omega}$βurúuŋga$_{c5}$]]	*!											
l. [$_{\iota}$[$_{\phi}$ wí-i-[$_{\omega}$βurúuŋga$_{c5}$]]	*!			*								

B.3.3 Class 9/10

(165) Evaluation of Initial H-tone c9 root with overt determiner

$[_{DP}\{$a, á$\}_L$+$[_{NumP}\{$N, $\emptyset\}_L$+$[_{nP}\{$barahe$_{H_}$, bárahe, baráhe$_{c9/10}\}]]]]$

	MonoH	HighΦ	*(σV́)	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. $[_\iota[_\phi$ a$_L$-m$_L$-$[_\omega$barahe$_{H_}]]$		*!			*			*		*		
b. $[_\iota[_\phi$ a$_L$-m$_L$-$[_\omega$bárahe$]]$						*!		*				*
☞ c. $[_\iota[_\phi$ a$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}]]$												*
d. $[_\iota[_\phi$ á$_L$-m$_L$-$[_\omega$barahe$_{H_}]]$			*!					*				
e. $[_\iota[_\phi$ á$_L$-m$_L$-$[_\omega$bárahe$]]$	*!		*			*		*				
f. $[_\iota[_\phi$ á$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}]]$	*!		*									

(166) Evaluation of Initial H-tone c10 root with overt determiner

$[_{DP}\{$tʃaa, tʃáá, tʃáa$\}_L$+$[_{NumP}\{$N, $\emptyset\}_L$+$[_{nP}\{$barahe$_{H_}$, bárahe, baráhe$_{c9/10}\}]]]]$

	MonoH	HighΦ	*(σV́)	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
a. $[_\iota[_\phi$ tʃaa$_L$-m$_L$-$[_\omega$barahe$_{H_}]]$		*!			*			*		*		
b. $[_\iota[_\phi$ tʃaa$_L$-m$_L$-$[_\omega$bárahe$]]$						*!		*				*
☞ c. $[_\iota[_\phi$ tʃaa$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}]]$												*
d. $[_\iota[_\phi$ tʃáa$_L$-m$_L$-$[_\omega$barahe$_{H_}]]$				*!				*		*		
e. $[_\iota[_\phi$ tʃáa$_L$-m$_L$-$[_\omega$bárahe$]]$	*!			*		*		*				
f. $[_\iota[_\phi$ tʃáa$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}]]$	*!			*								
g. $[_\iota[_\phi$ tʃáá$_L$-m$_L$-$[_\omega$barahe$_{H_}]]$								*!		*		
h. $[_\iota[_\phi$ tʃáá$_L$-m$_L$-$[_\omega$bárahe$]]$	*!					*		*				
i. $[_\iota[_\phi$ tʃáá$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}]]$	*!											

(167) Evaluation of Initial H-tone c9 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_{L}+[_{nP}\{barahe_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
a. $[_{\iota}[_{\phi} m_{L}\text{-}[_{\omega} barahe_{H\_}]]$		*!						*		*		
b. $[_{\iota}[_{\phi} m_{L}\text{-}[_{\omega} \text{bárahe}]]$						*!		*				
☞ c. $[_{\iota}[_{\phi} m_{L}\text{-}[_{\omega} \text{baráhe}_{c9/10}]]$												*

(168) Evaluation of Initial H-tone c10 root with null determiner

$[_{DP}[_{NumP}\{N, \emptyset\}_{L}+[_{nP}\{barahe_{H\_}, \text{bárahe}, \text{baráhe}_{c9/10}\}]]]]$

	MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
a. $[_{\iota}[_{\phi} m_{L}\text{-}[_{\omega} barahe_{H\_}]]$		*!						*		*		
b. $[_{\iota}[_{\phi} m_{L}\text{-}[_{\omega} \text{bárahe}]]$						*!		*				
☞ c. $[_{\iota}[_{\phi} m_{L}\text{-}[_{\omega} \text{baráhe}_{c9/10}]]$												*

(169) Evaluation of associative Initial H-tone c9 root with overt determiner

$[_{PP}\{$rja$_{H}$, rjá$\}$+$[_{DP}\{$a, á$\}_{L}$+$[_{NumP}\{$N, ∅$\}_{L}$+$[_{nP}\{$barahe$_{H_}$, bárahe, baráhe$_{c9/10}\}]]]]$

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. $[_\iota[_\phi$rja$_H$-a$_L$-m$_L$-$[_\omega$barahe$_{H_}$]]		*!						*	*	*		
	b. $[_\iota[_\phi$rjá-a$_L$-m$_L$-$[_\omega$barahe$_{H_}$]]				*!				*		*		
	c. $[_\iota[_\phi$rja$_H$-á$_L$-m$_L$-$[_\omega$barahe$_{H_}$]]				*!				*		*		
	d. $[_\iota[_\phi$rjá-á$_L$-m$_L$-$[_\omega$barahe$_{H_}$]]								*!		*		*
	e. $[_\iota[_\phi$rja$_H$-a$_L$-m$_L$-$[_\omega$bárahe]]						*!		*				
	f. $[_\iota[_\phi$rjá-a$_L$-m$_L$-$[_\omega$bárahe]]	*!			*		*		*				
	g. $[_\iota[_\phi$rja$_H$-á$_L$-m$_L$-$[_\omega$bárahe]]	*!			*		*		*				
	h. $[_\iota[_\phi$rjá-á$_L$-m$_L$-$[_\omega$bárahe]]	*!					*		*				
☞	i. $[_\iota[_\phi$rja$_H$-a$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}$]]									*			*
	j. $[_\iota[_\phi$rjá-a$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}$]]	*!			*								
	k. $[_\iota[_\phi$rja$_H$-á$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}$]]	*!			*								
	l. $[_\iota[_\phi$rjá-á$_L$-m$_L$-$[_\omega$baráhe$_{c9/10}$]]	*!											

(170) Evaluation of associative Initial H-tone c10 root with overt determiner

[$_{PP}${rɛ$_H$, rɛ́}+[$_{DP}${tʃaa, tʃáá, tʃáa}$_L$+[$_{NumP}${N, ∅}$_L$+[$_{nP}${barahe$_{H_}$, bárahe, baráhe$_{c9/10}$}]]]]

		MonoH	HighΦ	*($_\sigma$V́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,ϕ)
	a. [$_\iota$[$_\phi$rɛ́-tʃaa$_L$-m$_L$-[$_\omega$barahe$_{H_}$]]					*!			*		*		
	b. [$_\iota$[$_\phi$rɛ́-tʃáa$_L$-m$_L$-[$_\omega$barahe$_{H_}$]]	*!			*				*		*		
	c. [$_\iota$[$_\phi$rɛ́-tʃáá$_L$-m$_L$-[$_\omega$barahe$_{H_}$]]	*!							*		*		
	d. [$_\iota$[$_\phi$rɛ$_H$-tʃaa$_L$-m$_L$-[$_\omega$barahe$_{H_}$]]		*!						*	*	*		
	e. [$_\iota$[$_\phi$rɛ$_H$-tʃáa$_L$-m$_L$-[$_\omega$barahe$_{H_}$]]				*!				*		*		*
	f. [$_\iota$[$_\phi$rɛ$_H$-tʃáá$_L$-m$_L$-[$_\omega$barahe$_{H_}$]]								*!		*		*
	g. [$_\iota$[$_\phi$rɛ́-tʃaa$_L$-m$_L$-[$_\omega$bárahe]]	*!					*		*				
	h. [$_\iota$[$_\phi$rɛ́-tʃáa$_L$-m$_L$-[$_\omega$bárahe]]	*!					*		*				
	i. [$_\iota$[$_\phi$rɛ́-tʃáá$_L$-m$_L$-[$_\omega$bárahe]]	*!					*		*				
	j. [$_\iota$[$_\phi$rɛ$_H$-tʃaa$_L$-m$_L$-[$_\omega$bárahe]]						*!		*	*			*
	k. [$_\iota$[$_\phi$rɛ$_H$-tʃáa$_L$-m$_L$-[$_\omega$bárahe]]	*!			*		*		*				*
	l. [$_\iota$[$_\phi$rɛ$_H$-tʃáá$_L$-m$_L$-[$_\omega$bárahe]]	*!					*		*				*
	m. [$_\iota$[$_\phi$rɛ́-tʃaa$_L$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!											
	n. [$_\iota$[$_\phi$rɛ́-tʃáa$_L$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!											
	o. [$_\iota$[$_\phi$rɛ́-tʃáá$_L$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!											
☞	p. [$_\iota$[$_\phi$rɛ$_H$-tʃaa$_L$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]									*			*
	q. [$_\iota$[$_\phi$rɛ$_H$-tʃáa$_L$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!			*								*
	r. [$_\iota$[$_\phi$rɛ$_H$-tʃáá$_L$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!											*

(171) Evaluation of associative Initial H-tone c9 root with null determiner

[$_{PP}${rɛ$_H$, rɛ́}+[$_{DP}$+[$_{NumP}${N, ∅}$_L$+[$_{nP}${barahe$_{H_}$, bárahe, baráhe$_{c9/10}$}]]]]

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. [$_\iota$[$_\phi$rɛ$_H$-m$_L$-[$_\omega$barahe$_{H_}$]]		*!			*			*	*	*		
	b. [$_\iota$[$_\phi$rɛ́-m$_L$-[$_\omega$barahe$_{H_}$]]								*!		*		
☹	c. [$_\iota$[$_\phi$rɛ$_H$-m$_L$-[$_\omega$bárahe]]						*!		*				*
	d. [$_\iota$[$_\phi$rɛ́-m$_L$-[$_\omega$bárahe]]	*!					*		*				
👍	e. [$_\iota$[$_\phi$rɛ$_H$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]									*			*
	f. [$_\iota$[$_\phi$rɛ́-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!											

(172) Evaluation of associative Initial H-tone c10 root with null determiner

[$_{PP}${rɛ$_H$, rɛ́}+[$_{DP}$+[$_{NumP}${N, ∅}$_L$+[$_{nP}${barahe$_{H_}$, bárahe, baráhe$_{c9/10}$}]]]]

		MonoH	HighΦ	*(σV́	VV-Tone	Sel:H_	Sel:L	MP:Rt-Det	*∅Rt	Sel:H	Highω	MP:Rt-CM	Al(H,φ)
	a. [$_\iota$[$_\phi$rɛ$_H$-m$_L$-[$_\omega$barahe$_{H_}$]]		*!			*			*	*	*		
	b. [$_\iota$[$_\phi$rɛ́-m$_L$-[$_\omega$barahe$_{H_}$]]								*!		*		
☹	c. [$_\iota$[$_\phi$rɛ$_H$-m$_L$-[$_\omega$bárahe]]						*!		*				*
	d. [$_\iota$[$_\phi$rɛ́-m$_L$-[$_\omega$bárahe]]	*!					*		*				
👍	e. [$_\iota$[$_\phi$rɛ$_H$-m$_L$-[$_\omega$baráhe$_{c9/10}$]]									*			*
	f. [$_\iota$[$_\phi$rɛ́-m$_L$-[$_\omega$baráhe$_{c9/10}$]]	*!											