

The verbal morphotonology of Nata

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Abstract: This paper argues that the prime determiner of tone patterns in Nata finite verb forms is tense, aspect and mood (TAM), which is encoded by a combination of segmental and tonal morphemes. High tone is realized at the edges of the macrostem or the word. Adopting an optimality-theoretic framework, I show that the output high tone of TAMs of non-indicative moods corresponds to a tonal morpheme in the input, while most indicative ones do not have an input high tone. Alignment constraints play a major role in the selection of optimal output.

1 Introduction

This study has two goals. First, it describes tone patterns of finite verb forms in Nata¹, an endangered Eastern Bantu language spoken in the districts of Serengeti and Bunda in northwestern Tanzania. I describe five tone patterns that reference edges of morphological domains, namely the macrostem and the word. The second goal of this paper is to provide an optimality-theoretic account of these tone patterns. I propose that the output high tone is the result of phonological or morphological operations, conditioned by tense, aspect, and mood (TAM). The interaction of alignment constraints contributes to the edge-based tone patterns. I conclude the study by suggesting areas for further research. In the remainder of this introductory section, I lay down basic information of the Nata language.

1.1 The sound inventory of Nata

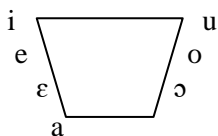
There are 15 phonemic consonants in Nata (Johannes 2007), which are in boldface in (1). The consonants in parentheses only occur in certain phonological environments and are not phonemic. Nata has seven phonemic vowels (Johannes 2007), as in (2).

(1) The consonant inventory of Nata

	Bilabial	Alveolar	Alveopalatal	Postalveolar	Palatal	Velar	Glottal
Plosive	(b)	t (d)				k (g)	
Nasal	m	n			ɲ	ŋ	
Trill		r					
Fricative	β	s		f		ɣ	
Affricate			tʃ				h
Approximant	w				j		

¹ Nata is also referred to as Ki-Nata, which is classified as E45 (Zone E, Group 40, Index 5) by both Guthrie (1948) and Maho (2003). The same code is shared with Ikoma and Isenye, which are closely related, mutually intelligible languages.

(2) The vowel inventory of Nata



1.2 Convention for tone-marking

A prominent high pitch, which is subsequently analyzed as a high tone, is orthographically marked with an acute accent (í, é, é, á, ú, ó, ó). Elsewhere cases which lack a prominent high pitch are unmarked (i, e, ε, a, u, o, ɔ).

1.3 Defining verbal domains

Bantu languages are agglutinative with complex morphology. Since generalizations in the subsequent sections reference boundaries of morphological constituents, a definition of these units should be given. (3) presents the template of a finite verb form in Bantu based on Myers (1987) and Nurse (2008). The lowest domain, namely the *verb stem*, refers to the combination of a verb root with a final vowel (FV), which are the two obligatory elements to form a minimal verb. In (3), all elements in parentheses are optional, such as extension suffixes (EXT) that attach to the verb root. Examples of such suffixes include the applicative (APPL) and the reciprocal (RECP). Object markers precede the verb root, and multiple object markers are possible. The leftmost object marker defines the left edge of the *macrostem*, an important domain for a variety of processes in Bantu, such as reduplication in Ndebele (Downing 2001) and tone assignment in Kuria (Mwita 2008). Preceding the macrostem, the *inflection (INFL) stem*² consists of the subject marker (SM), negation (NEG) and tense/aspect/mood (TAM) marker. SM is obligatory in finite verbs except in mandatory imperatives. The whole string of morphemes encompassing SM, (NEG), (TAM), (OM), V_{ROOT}, (EXT) and FV is called a *word*. In some Bantu languages, certain morphemes can precede SM, such as the focus morpheme in Tharaka (E54) (Nurse 2008). It attaches to a word to form a larger word. As a Bantu language, Nata has the same structure of finite verb forms. For example, the verbal word *uyakémutaandorera* ‘You tore it for him/her’ has the structure illustrated in (4).

(3) The template of a finite verbal word in Bantu

[Word (Pre-SM)[Word[INFLstem SM (NEG)(TAM)]]MacroStem(OM) [VStem V_{ROOT} (EXT) FV]]]

(4) Example of a finite verbal word in Nata

[Word [Word[INFLstem u- ya-]Macrostem ké- mu- [VStem taandor -er -a]]]
 2sgSM- PST- OM7- OM1- tear -APPL -FV
 ‘You tore it for him/her.’

1.4 Segmental phonology of Nata

Since the subsequent tonal analysis focuses on suprasegmental behaviour, various segmental phonological rules are simply collapsed as segmental processes. These include the Dahl’s law, glide formation, compensatory lengthening and vowel harmony, which are defined in (5)–(7). An

² Nurse (2008) calls this constituent *INFL*. To avoid confusion with the syntactic head *INFL*, I adopt the term *INFL stem* proposed by Myers (1987).

awareness of these mechanisms is useful for understanding data sets presented in the next section. For detailed discussion of these rules, see Johannes (2007).

(5) a. Dahl's law

A voiceless velar stop /k/ changes to a voiced velar fricative [ɣ] if it precedes a syllable with a voiceless consonant.

- b. /a- ka- ke- mu- h -a/ → [aɣakémuha] ‘He gave it to him.’
 3sgSM- PST OM7- OM1 give -FV

(6) a. Glide formation followed by compensatory lengthening

A high back vowel changes into a glide [w] when followed by a non-identical vowel across morpheme boundary. The freed mora from the target vowel is then gained by the following vowel, thus becoming lengthened.

- b. /mo- iβ -ε/ → [mwiiβé] ‘(Please) steal.’
 2plSM- steal -FV_{SUBJ}

(7) a. Vowel harmony

Vowels in a given domain must have the same value of the advanced tongue root (ATR) feature. [i, u, e, o] are [+ATR], while [ɛ, ə, a] are [-ATR].

- b. /mo- βin -er -an -ε/ → [moβinéranε] ‘(Please) dance for each other.’
 2plSM- dance -APPL -RECP -FV_{SUBJ}

2 An optimality-theoretic account for Nata verbal morphotonology

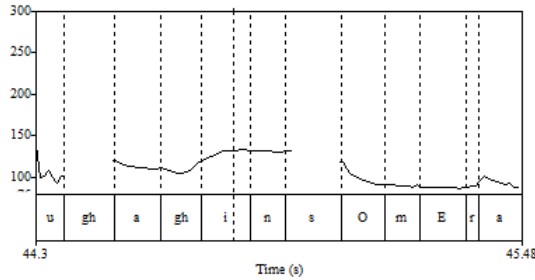
This section begins with a description of how I locate high tone in the data³. Section 2.2 and Section 2.3 lay down the foundation of the subsequent analysis by stating the justification for using the optimality-theoretic (OT) framework, and investigating the role of the vowel and the syllable. An overview of the five tone patterns is given in Section 2.4, followed by the OT analysis in Section 2.5–2.9. The last subsection Section 2.10 summarizes the discussion.

2.1 Determining where high tone (H) falls

Focusing on Nata nominal tone, Anghelescu (2013) posits that a canonical Nata word has exactly one high-toned syllable. This generalization holds true for most of the verb forms except negative imperative forms, which will be elaborated in Section 2.9. During data transcription, I determine the position of the high tone by acoustic measurements on *Praat* (Boersma 2001). The transcriptions are then verified by the consultant. As an example, the pitch contour of *uyakínsɔmera* ‘You read it for me’ is shown in (8). Among all vowels in the word, the vowel [i] has the highest pitch of 131.4 Hz. An acute accent is therefore marked on [i] in the transcription.

³ All data were elicited from one male native speaker of Nata, who was born and raised in Tanzania.

(8) The pitch contour of *uyakínsɔmɛra* ‘You read it for me.’



u- ka- ki- ni- sɔm -er -a
 2sgSM- PST- OM7- OM1- read -APPL -FV
 ‘You^{SG} read it for me.’

2.2 Optimality theory and Bantu typology

The choice of the OT framework over a rule-based approach is induced by the universality and violability of OT constraints. As Cassimjee and Kisseberth (1998:37) argue, the diversity of tone patterns in closely-related Bantu languages in fact reflects a “core sameness”. In a rule-based model, differences between languages can be observed by radically distinct rule inventories; comparison based on the ordering of the same rules is rare. In the OT framework, however, variations across Bantu languages can simply be seen as a consequence of different rankings of a set of universal but violable constraints. It provides a single ground for cross-linguistic comparison.

2.3 Assumptions on the role of the syllable and the vowel

A tone can only be realized on an entity, which can be a syllable, a mora or a vowel. In tonology, this entity is known as the *tone-bearing unit* to which a tone associates. In my subsequent analysis, H docks to vowels, although H assignment references syllable count⁴. This assumption has to be clarified via the behaviour of tone on long vowels, where high tone can be level CVV (9) or falling CVV **Error! Reference source not found.**. To facilitate discussion, words are aligned to the right edge, and syllable boundaries are marked with a period.

(9) Examples of the level high on long vowels

	σ	σ	σ	σ	σ
a. ta andor-a tear-FV ‘Tear!’			táá.	ndo.	ra
b. ɔβ ɔk-a build-FV ‘Build!’			óó.	βɔ.	ka
c. mo-ki- ju -er-an-ε 2plSM-OM7-drink-APPL-RECP-FV _{SUBJ} ‘(Please) Drink it for each other.’	mo.	ki.	ɰwéé.	ra.	nε
d. n-a -ki-mu-h-ire N-3sgSM-OM7-OM1-give-PFV ‘S/he (just) gave it to him.’	náá.	ke.	mu.	hee.	re

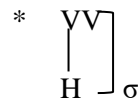
⁴ Referencing vowel count loses generalization. For example, (9a) and (10a) are both mandatory imperative forms. Vowel count stipulates that (9a) has H on V1+V2, and (10a) has H on V1 only, which are two distinct patterns. But in a syllable count approach, both fall onto the same tone type (H on σ1).

(10) Examples of the falling high on long vowels

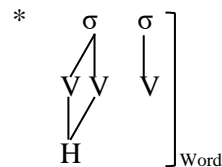
	σ σ σ σ
a. saan -a make.friends-FV 'Make friends!'	$\underline{\text{sáa.}}$ na
b. βoor -i ask-FV 'Ask!'	$\beta\acute{o}o.$ ri
c. noo-ni- pu -er-ε 2sgSM-SM1-drink-APPL-FV _{subj} '(Please) Drink for me.'	nuu. $\mu\mu w\acute{\epsilon}\epsilon.r\epsilon$
d. no-ki- sεε γ-ε 2sgSM-OM7-like-FV _{subj} '(Please) Like it (on Facebook).'	no. γi. $s\acute{\epsilon}\epsilon.$ γε

The two datasets show that the level high and falling high never occur in the same phonological environment: the level high is only found in non-penultimate long vowels, whereas the falling high is only found in penultimate long vowels⁵. There is no evidence that the falling high is a contrastive unit. In other words, tonal contrast in Nata is not a three-way one of H vs non-H vs falling. The falling high can thus be analyzed as a sequence of H and non-H, which only stands if H is docked to vowels. The tonal behaviour of long vowels can be seen as a consequence of constraint interaction of (11)–(14), illustrated in (14) and (16). In both tableaux, candidate (a) is maximally faithful to the input, but violates the undominated constraint *FLOAT. It is crucial that *PENULT $\acute{V}\acute{V}$ outranks *CONTOUR, selecting a penultimate falling high (15b) as the optimal output. Also, *CONTOUR must dominate *ASSOCIATE, resulting in non-penultimate level high tone (16c).

(11) *CONTOUR: Assign a violation mark to each sequence of H and non-H on the tautosyllabic level. (based on Yip 2002:83)



(12) *PENULTIMATE LEVEL HIGH: Assign a violation mark to each high-toned long vowel in the penultimate position.




(13) *FLOAT: Assign a violation mark to each tone that is not associated to a TBU. (Yip 2002:83)


(14) *ASSOCIATE: Assign a violation mark to each new association line. (Yip 2002:83)

⁵ The same generalization is observed in Ekegusii (Nash 2011).

(15) Constraint interaction resulting in falling high on a long vowel⁶

s a a. n a H	*FLOAT	*PENULT $\check{V}\check{V}$	*CONTOUR	*ASSOCIATE
a. s a a. n a H	*!			
b.  s a a. n a | H			*	*
c. s a a. n a / H		*!		**

(16) Constraint interaction resulting in level high on a long vowel

t a a. n d o. r a H	*FLOAT	*PENULT $\check{V}\check{V}$	*CONTOUR	*ASSOCIATE
a. t a a. n d o. r a H	*!			
b. t a a. n d o. r a | H			*!	*
c.  t a a. n d o. r a / H				**

2.4 Overview: five tone patterns and the categorization by mood

Having laid down the assumptions, I shift the focus to the five tone patterns summarized in (17). Each of these patterns references the left or right edge of the macrostem or the word. The symbols ‘+’ and ‘-’ in the TAM column signify ‘affirmative’ and ‘negative’ respectively. All TAMs with Type I tone pattern, namely the narrative past, the habitual and the progressive, fall into one semantic natural class—the *indicative mood*. It expresses that the speaker considers a state or event a known state of affairs. I posit that the indicative mood is semantically *unmarked*. On the other hand, most TAMs of Type II–V are of *non-indicative moods*, meaning that a state or event is not known to have happened at the point of speech time. Cross-linguistically, negative assertions and irrealis assertions tone pattern share semantic properties, and can be grouped together under ‘non-fact’ (Miestamo 2005), as in the TAMs in Type II. Other non-indicative TAMs include the imperative and the subjunctive. Belonging to the realm of the non-realized, they are all semantically *marked*. To sum up, the classification of TAMs by mood generally aligns with the classification by tone pattern. The only exception is the near past. Although it expresses the indicative mood, it does not exhibit Type I tone pattern.

⁶ Alignment constraints will be proposed in the next section to stop H from associating to the vowel of a non-initial syllable.

(17) An overview of the five tone patterns

Category	TAM	Tone pattern
Indicative	+narrative past, +habitual, +progressive	Type I: [Mstem σ
	+near past	Type III: [Word σ
Non-indicative	+past conditional, -past conditional, -habitual, -progressive	Type II: ... σ']Word
	+mandatory imperative	Type III: [Word σ
	+hortatory subjunctive	Type IV: [Mstem σ σ
	-imperative	Type V: [Word σ σ

2.5 Type I: H on the first syllable of the macrostem ([MacrosteSm σ')

The first tone pattern is H on the first syllable of the macrostem. Three TAMs fall into this type, namely the narrative past, the habitual and the progressive. The templates of these TAMs are summarized in (18). Square brackets [] indicate the edges of the macrostem. All of the three TAMs have an overt and distinct TAM marker, which are *ka-*, *haa-* and *ku-* respectively.

(18)	Pre-SM	SM	TAM	[Mstem	OM	V _{ROOT}	EXT	FV]
+Narrative past		SM	<i>ka</i>	[	(OM)	V _{ROOT}	(EXT)	<i>a</i>]
+Habitual		N SM	<i>haa</i>	[	(OM)	V _{ROOT}	(EXT)	<i>a</i>]
+Progressive		N SM	<i>ku</i>	[	(OM)	V _{ROOT}	(EXT)	<i>a</i>]

2.5.1 Description of the data

The narrative past can refer to events that occurred before speech time, whether recently or remotely. It is usually used in a sequence of events⁷. Paradigms (19)–(21) present the full paradigm of the narrative past. For each data set, the leftmost column shows the number and person of SM, followed by the morphemic breakdown. The word is repeated for readers' convenience, followed by the translation. The verb root *ɔm* 'read' is chosen as an example, because it has the canonical CVC structure, the most common shape of verb roots.

In (19), H consistently falls on the first syllable of the macrostem, which happens to be the first syllable of the verb root. The ambiguity in the generalization is resolved by cases with one OM (20) and two OMs (21). When there is one OM, H falls on the OM instead of the verb root. When there are two OMs, H falls on the leftmost OM. These examples show that H always falls on the first syllable of the macrostem.

The fact that H is only sensitive to its position on the macrostem implies two other generalizations that hold true across all Nata verb forms collected so far. First, H is insensitive to which morpheme it falls onto; it can fall on an OM as in (20) and (21), a verb root (19), or a FV (22a). Second, the number or person of SM does not condition H, contrary to other Bantu languages like Cilungu (Bickmore 2007). In the rest of this paper, due to limited space, I will not give the full paradigm for every verb with all the six SMs and combination with multiple OMs. Only forms that are relevant to the particular topic of discussion will be listed.

⁷ For a detailed discussion on the semantics of Nata TAMs, see Osa-Gómez & Walters (2013).

(19) Narrative past tense with the verb root *səm* ‘read’

	<u>Morphemic breakdown</u>	<u>Word</u>	<u>Gloss</u>
a. <i>SM 1sg</i>	ni- ka- [səm -a]	ɲgasóma	‘I read.’
b. <i>SM 2sg</i>	u- ka- [səm -a]	uɣasóma	‘You ^{SG} read.’
c. <i>SM 3sg</i>	a- ka- [səm -a]	aɣasóma	‘S/he read.’
d. <i>SM 1pl</i>	tu- ka- [səm -a]	tuɣasóma	‘We read.’
e. <i>SM 2pl</i>	mu-ka- [səm -a]	muɣasóma	‘You ^{PL} read.’
f. <i>SM 3pl</i>	βa- ka- [səm -a]	βaɣasóma	‘They read.’

SM- NAR- read-FV

(20) Narrative past tense with the verb root *səm* ‘read’ and one OM

a. <i>SM 1sg</i>	ni- ka- [ki- sɔm -a]	ɲkayísoma	‘I read it.’
b. <i>SM 2sg</i>	u- ka- [ki- sɔm -a]	ukayísoma	‘You ^{SG} read it.’
c. <i>SM 3sg</i>	a- ka- [ki- sɔm -a]	akayísoma	‘S/he read it.’
d. <i>SM 1pl</i>	tu- ka- [ki- sɔm -a]	tukayísoma	‘We read it.’
e. <i>SM 2pl</i>	mu-ka- [ki- sɔm -a]	mukayísoma	‘You ^{PL} read it.’
f. <i>SM 3pl</i>	βa- ka- [ki- sɔm -a]	βakayísoma	‘They read it.’

SM- NAR- OM7-read-FV

(21) Narrative past tense with the verb root *səm* ‘read’ and two OMs

a. <i>SM 1sg</i>	ni- ɣa- [ke- mu- sɔm -er -a]	ɲɣakémusɔmɛra	‘I read it for him/her.’
b. <i>SM 2sg</i>	u- ɣa- [ke- mu- sɔm -er -a]	uɣakémusɔmɛra	‘You ^{SG} read it for him/her.’
c. <i>SM 3sg</i>	a- ɣa- [ke- mu- sɔm -er -a]	aɣakémusɔmɛra	‘S/he read it for him/her.’
d. <i>SM 1pl</i>	tu- ɣa- [ke- mu- sɔm -er -a]	tuɣakémusɔmɛra	‘We read it for him/her.’
e. <i>SM 2pl</i>	mu-ɣa- [ke- mu- sɔm -er -a]	muɣakémusɔmɛra	‘You ^{PL} read it for him/her.’
f. <i>SM 3pl</i>	βa- ɣa- [ke- mu- sɔm -er -a]	βaɣakémusɔmɛra	‘They read it for him/her.’

SM- NAR- OM7-OM1-read-APPL-FV

The generalization that H falls on the first syllable of the macrostem is applicable to verb roots of other CV structures as well. For example, the verb root *h* ‘give’ comprises of a consonant only, while *sukur* ‘dump out’ has a structure of CVCVC. Patterns in (22) and (23) are consistent with those of (19)–(21). They provide additional evidence that H is only sensitive to its position in the macrostem.

(22) Narrative past with verb roots of different shapes

	<u>Morphemic breakdown</u>	<u>Word</u>	<u>Gloss</u>
a.	u- ka- [h -a]	ukahá	‘You ^{SG} gave.’
b.	u- ka- [mu- h -a]	ukamúha	‘You ^{SG} gave it.’
c.	u- ka- [ki- mu- h -a]	uɣakémuha	‘You ^{SG} gave it to him/her.’

2sgSM-NAR-OM7-OM1-give-FV

(23) Morphemic breakdown

	<u>Morphemic breakdown</u>	<u>Word</u>	<u>Gloss</u>
a.	u- ka- [sukur -a]	uɣasúkura	‘You ^{SG} dumped out.’
b.	u- ka- [ki- sukur -a]	ukayésukura	‘You ^{SG} dumped it out.’
c.	u- ka- [ki- ni- sukur -er -a]	ukayénusukurera	‘You ^{SG} dumped it out for me.’

2sgSM-NAR-OM7-OM1-dump.out-APPL-FV

The second TAM of this tone type, the habitual, is used for events or actions that occur on a regular basis. Example (24) shows that H always falls on the first syllable of the macrostem.

(24) The habitual

a.	n-	u-	haa-	[	h	-a	]	nuhaa há	‘You ^{SG} always give.’
b.	n-	u-	haa-	[	pu	-a	]	nuhaa pwá	‘You ^{SG} always drink.’
c.	n-	u-	haa-	[	səm	-a	]	nuhaa sóma	‘You ^{SG} always read.’
d.	n-	u-	haa-	[	sukur	-a	]	nuhaa súkura	‘You ^{SG} always dump out.’
	N-	2sgSM-HAB-	V _{ROOT-FV}						

Lastly, the progressive is used when event time overlaps with speech time. In (25), H always falls on the first syllable of the macrostem.

(25) The progressive

a.	n-	u-	ku-	[	h	-a	]	nooku há	‘You ^{SG} are giving.’
b.	n-	u-	ku-	[	pu	-a	]	nooku pwá	‘You ^{SG} are drinking.’
c.	n-	u-	ku-	[	səm	-a	]	nooyu sóma	‘You ^{SG} are reading.’
d.	n-	u-	ku-	[	sukur	-a	]	nooyu súkura	‘You ^{SG} are dumping out.’
	N-	2sgSM-PROG-	V _{ROOT-FV}						

2.5.2 Analysis for Type I: the toneless input

The crux of the analysis for Type I is that the semantically unmarked TAMs (+narrative past, +habitual, +progressive) are also tonally unmarked, meaning that there is no H in the input of these TAMs. Rather, the H on the left edge of the macrostem in the output is a result of two undominated constraints. First, each Nata word has a minimum of one high tone, which is observed in nouns (Anghelescu 2013). This requirement is represented by (26). Second, in Bantu languages, it is common that tone functions to demarcate domains (Kisseberth & Odden 2003, Hyman 2012), facilitating the parsing of prosodic and morphological structures, such as the macrostem. The alignment constraint in (27) ensures that a high tone aligns to the left edge of the macrostem. Both constraints outrank the faithfulness constraint against tone insertion in (28).

(26) OBLIGATORINESS: Assign a violation mark to each word that does not have at least one high-toned syllable.

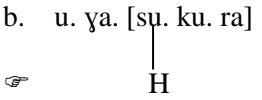
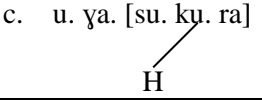
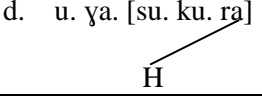
(27) ALIGN (H, L, Macrostem, L)

For every H, the left edge of H must coincide with the left edge of the macrostem. Assign a violation mark for each syllable intervening between the left edge of H and the left edge of the macrostem.

(28) DEP-T-IO: Assign a violation mark to each output tone that does not have an input correspondent. (based on Yip 2002:83)

(29) Constraint interaction resulting in H-insertion

u-ya-súkur-a 2sgSM-NAR-dump.out-FV ‘You^{SG} dumped out.’

u. ya. [su. ku. ra]	OBLIGATORINESS	ALIGN (H, L, Macrostem, L)	DEP-T-IO
a. u. ya. [su. ku. ra]	*!		
b. u. ya. [su. ku. ra] 			*
c. u. ya. [su. ku. ra] 		*!	*
d. u. ya. [su. ku. ra] 		*!*	*

In tableau (29), candidate (a) is identical to the input, but incurs a fatal violation of OBLIGATORINESS. Candidates (c) and (d) fail to align H to the left edge of the macrostem, violating ALIGN (H, L, Macrostem, L). Candidate (b) only violates DEP-T-IO, which is the lowest ranked constraint; it is thus selected as the optimal output.

2.6 Type II: H on the final syllable of the word ($\acute{\sigma}$ _{Word})

Type II has H on the right edge, and is exhibited in the ‘non-fact’ group of TAMs, which includes the past conditional and most negative TAMs. Their templates are presented in (30). Tonal morphemes H_{NEG} and H_{PC} will be explained in the analysis section. Since the tonal morpheme is part of the word but not part of the macrostem, the description of Type II tone pattern is ‘H on the last syllable of the word’ but not ‘H on the last syllable of the macrostem’. Note that the negative narrative past is non-existent, because the narrative morpheme *ka-* renders ungrammatical when negated (Osa & Walters 2013).

(30) Templates of +past conditional, -habitual, -progressive, -near past, -past conditional

	Pre-SMSM	NEG	TAM	[_{Mstem} OM V _{ROOT} EXT FV/suff]
+Past conditional		SM	<i>a nga</i> H _{PC}	[(OM) V _{ROOT} (EXT) <i>ire</i>]
- Near past	N	SM	<i>ta</i> H _{NEG}	[(OM) V _{ROOT} (EXT) <i>ire</i>]
- Habitual		SM	<i>ta</i> H _{NEG} <i>ha</i>	[(OM) V _{ROOT} (EXT) <i>a</i>]
- Progressive		SM	<i>ta</i> H _{NEG} <i>ku</i>	[(OM) V _{ROOT} (EXT) <i>a</i>]
- Past conditional		SM	<i>ta</i> H _{NEG} <i>a nga</i> Ø	[(OM) V _{ROOT} (EXT) <i>ire</i>]

2.6.1 Description of the data

The past conditional is used to refer to counterfactual contexts, states and events that are impossible to happen. It is marked by a combination of *a-* (past), *nga-* (conditional) and the suffix *-ire* (perfective). All the forms in (31) have the context of *If I were you, I would...* H is always on the last syllable.

(31) The past conditional

a. ni-	a-	ŋga-	[h -ire]	ɲaŋgaheeré	‘I would give.’
b. ni-	a-	ŋga-	[ɲu -ire]	ɲaŋgaɲwiiré	‘I would drink.’
c. ni-	a-	ŋga-	[sɔm -ire]	ɲaŋgasɔmiré	‘I would read.’
d. ni-	a-	ŋga-	[sukur -ire]	ɲaŋgasukwiiré	‘I would dump out.’

1sgSM- PST- COND- V_{ROOT} -PFV

Negative forms of the near past, habitual, progressive, and past conditional exhibit the same tone pattern, having H on the last syllable of the word, as in (32)–(35).

(32) Negation of the near past

a. n-	ni-	ta-	[h -ire]	ɲtiheeré	‘I didn’t give (just now).’
b. n-	ni-	ta-	[ɲu -ire]	ɲteɲwiiré	‘I didn’t drink (just now).’
c. n-	ni-	ta-	[sɔm -ire]	ɲtisɔmiré	‘I didn’t read (just now).’
d. n-	ni-	ta-	[sukur -ire]	ɲtesukwiiré	‘I didn’t dump out (just now).’

N- 1sgSM- NEG- V_{ROOT} -PFV

(33) Negation of the habitual

a. ni-	ta-	haa-	[h -a]	ɲtihaahá	‘I don’t (always) give.’
b. ni-	ta-	haa-	[ɲu -a]	ɲtihaaɲwá	‘I don’t (always) drink.’
c. ni-	ta-	haa-	[sɔm -a]	ɲtihaasɔmá	‘I don’t (always) read.’
d. ni-	ta-	ha-	[sukur -a]	ɲtihaasukurá	‘I don’t (always) dump out.’

1sgSM- NEG- HAB- V_{ROOT} -FV

(34) Negation of the progressive

a. ni-	ta-	ku-	[h -a]	ɲteekuhá	‘I am not giving.’
b. ni-	ta-	ku-	[ɲu -a]	ɲteekuɲwá	‘I am not drinking.’
c. ni-	ta-	ku-	[sɔm -a]	ɲteeyusɔmá	‘I am not reading.’
d. ni-	ta-	ku-	[sukur -a]	ɲteeyosukurá	‘I am not dumping out.’

1sgSM- NEG- PROG- V_{ROOT} -FV

(35) Negation of the past conditional

a. ni-	ta-	a-	ŋga-	[h -ire]	ɲtjaŋgaheeré	‘I would not give.’
b. ni-	ta-	a-	ŋga-	[ɲu -ire]	ɲtjaŋgaɲwiiré	‘I would not drink.’
c. ni-	ta-	a-	ŋga-	[sɔm -ire]	ɲtjaŋgasɔmiré	‘I would not read.’
d. ni-	ta-	a-	ŋga-	[sukur -ire]	ɲtjaŋgasukwiiré	‘I would not dump out.’

1sgSM- NEG- PST- COND- V_{ROOT} -PFV

2.6.2 Analysis for Type II: grammatical high for ‘non-fact’ (H_{NEG} and H_{PC})

Cross-linguistically, negation is marked, while the affirmative is unmarked (Miestamo 2005). This can be reflected by morphology: a NEG morpheme is always needed for negation, but languages rarely need an affirmative morpheme. Negative verbs in Nata can be analyzed as tonally marked, in addition to the morpheme *ta*. In other words, the inflection of negative TAMs involves both a segmental morpheme *ta* and a tonal morpheme H_{NEG}.

Tonal morphemes are not unique to Nata. In Bantu phonology, certain tenses and aspects may contribute high tone, which is often referred to as the *grammatical high*. For example, in Kuria, H is assigned to V1, V2, V3, V4, or V1+V4 of the macrostem, depending on the TAM (Mwita 2008).

In Ekegusii, certain TAMs contribute to a floating grammatical high that docks to V2 of the verb stem (Nash 2011). In Shona, H is assigned to all negative and subordinate clause verb tenses (Kisseberth & Odden 2003). Therefore, tone patterns are predictable. Seeing that the tonal behaviour of Nata is similar to that of many Bantu languages, I posit that the marked TAMs, including most of the negative forms, subjunctive and imperative, are morphologically marked by a floating grammatical high tone morpheme in the input.

The alignment constraint (36) requires that these tonal morphemes align to the right edge of the word. This constraint, together with *FLOAT and MAX-T (37), outranks the general tone alignment constraint (27), which is illustrated in (38).

(36) ALIGN ($\{H_{\text{NEG}}, H_{\text{PC}}\}$, R, Word, R):

For every H_{NEG} or H_{PC} , the right edge of the high tone must coincide with the right edge of the word. Assign a violation mark for each syllable intervening between the right edge of the high tone and the right edge of the word.

(37) MAX-T: Assign a violation mark to each input tone that does not have an output correspondent. (based on Yip 2002:79)

(38) Constraint interaction for the negative habitual

ŋ-ti.haa-sukur-á 1sgSM-NEG-HAB-dump.out-FV ‘I don’t always dump out.’

η .ti.haa.[su.ku.ra] H_{NEG}	*FLOAT	ALIGN ($\{H_{\text{NEG}}, H_{\text{PC}}\}$, R, Wd, R)	MAX-T	ALIGN (H, L, Macrostem, L)
a. η .ti.haa.[su.ku.ra] H_{NEG}	*!			
b. η .ti.haa.[su.ku.ra] H_{NEG} H			*!	
c. η .ti.haa.[su.ku.ra] H_{NEG}		*!*		
d. η .ti.haa.[su.ku.ra] H_{NEG}				**

In (38), there is a floating grammatical H in the input, contrary to the input in (29). Candidate (a) is identical to the input, but violates *FLOAT, which is undominated. Candidate (b) deletes the grammatical H in the input. Since there is no H_{NEG} or H_{PC} to align to the right edge, it does not violate ALIGN ($\{H_{\text{NEG}}, H_{\text{PC}}\}$, R, Wd, R). However, it violates the undominated faithfulness constraint MAX-T. Candidate (c) satisfies the general tone alignment constraint ALIGN (H, L, Macrostem, L), but incurs a fatal violation of ALIGN ($\{H_{\text{NEG}}, H_{\text{PC}}\}$, R, Wd, R). The optimal candidate (d), which docks the high tone from the input to the right edge, only violates the lowest ranked constraint in the hierarchy. The same constraint set and ranking applies to the past conditional and the negative progressive.

2.6.3 Tonal allomorphy: the negative past conditional and negative near past

Given that the past conditional introduces the tonal morpheme H_{PC} and negation involves H_{NEG} , the attentive reader may have the following questions: are there two grammatical Hs in the negation of the past conditional? Why is there only one H in (35)?

Following Pulleyblank's (2013) analysis of L-toned and H-toned allomorphs in Kinande, I propose that tonal morphemes in Nata, just like any other segmental morphemes, can have allomorphs. As such, H_{PC} has two allomorphs $\{H_{PC}, \emptyset\}$. Similarly, H_{NP} (the grammatical H for the near past, to be introduced in the next subsection) can have two allomorphs $\{H_{NP}, \emptyset\}$. The allomorphs in each case are in complementary distribution. The morpheme is realized as allomorph \emptyset in the context of negation, while H_{PC} or H_{NP} is the elsewhere case. The environments are summarized as rules in (39). No new constraint is necessary in the tableau (40).

(39) Tonal allomorphy

- a. $H_{NP} \rightarrow \emptyset$ / H_{NEG} ____
 $\rightarrow H_{NP}$ / elsewhere
 b. $H_{PC} \rightarrow \emptyset$ / H_{NEG} ____
 $\rightarrow H_{PC}$ / elsewhere

(40) Constraint interaction for the negative past conditional

ŋ-tj-a-ŋga-sukwi-iré 1sgSM-NEG-PST-COND-dump.out-PFV 'I would not dump out.'

$\eta.tja.ŋga.[su.kwii.re]$ $H_{NEG} \emptyset$	ALIGN ($\{H_{NEG}, H_{PC}\}, R, Wd, R$)	ALIGN (H, L, Macrostem, L)
a. $\eta.tja.ŋga.[su.kwii.re]$ $H_{NEG} \emptyset$	*!	*
b. $\eta.tja.ŋga.[su.kwii.re]$ $H_{NEG} \emptyset$	*!*	
c. $\eta.tja.ŋga.[su.kwii.re]$ $H_{NEG} \emptyset$		**

2.7 Type III: H on the first syllable of the word ([Word $\acute{\sigma}$])

In Type III, H is outside the macrostem; it falls on the first syllable of the word. Members of this type include the near past and the mandatory imperative. As shown in the template in (41), no segmental morphemes occupy the TAM position.

(41) Templates of the near past and mandatory imperative

	Pre-SM	SM	NEG	TAM	[_{Mstem} OM V _{ROOT} EXT FV/suffix]
+Near past	N	SM		H_{NP}	[(OM) V _{ROOT} (EXT) <i>ire</i>]
+Mandatory imp				H_{IMP}	[V _{ROOT} <i>a</i>]

2.7.1 Description of the data

The near past is used when event time slightly precedes speech time. The near past has the nonsyllabic homorganic nasal and the final suffix *-ire*, as in (42).

(42) The near past

a. <i>SM 1sg</i>	n-	ni-	[h -ire]	nníheere	‘I (just) gave.’
b. <i>SM 2sg</i>	n-	u-	[h -ire]	núúheere	‘You ^{SG} (just) gave.’
c. <i>SM 3sg</i>	n-	a-	[h -ire]	nááheere	‘S/he (just) gave.’
d. <i>SM 1pl</i>	n-	tu-	[h -ire]	ntúheere	‘We (just) gave.’
e. <i>SM 2pl</i>	n-	mu-	[h -ire]	mmúheere	‘You ^{PL} (just) gave.’
f. <i>SM 3pl</i>	n-	βa-	[h -ire]	mbáheere	‘They (just) gave.’
	<i>N-</i>	<i>SM-</i>	<i>give-PFV</i>		

In Nata, there are two ways to ask an addressee to perform an action. The less polite one is the mandatory imperative⁸ form that has the same morphemic structure as a bare verb (V_{ROOT}-FV). In (43), SM and OM are not allowed. This imperative form can be used only when the addressee is singular. The more polite way to request is the hortatory subjunctive (Section 2.8). It can be used when the addressee is either singular or plural; SM is obligatory, and OMs are allowed. The mandatory imperative, hortatory subjunctive and negative imperative show characteristics of a relation of suppletion; they form the imperative paradigm.

(43) The mandatory imperative

a.	[səm	-a]	sóma	‘Read!’ ⁹
b.	[βin	-a]	βína	‘Dance!’
c.	[sukur	-a]	súkura	‘Dump out!’
d.	[taandor	-a]	táándora	‘Tear!’
	V _{ROOT}	-FV		

2.7.2 Analysis for Type III: grammatical high (H_{NP} and H_{IMP})

Although the near past is indicative, it does not pattern with other indicative TAMs, such as the narrative past, habitual and progressive, and the reason is unknown. As commented by Kisseberth and Odden (2003:68), the set of TAMs selecting a particular grammatical melody is “fairly arbitrary”.

Two tonal morphemes, namely H_{NP} and H_{IMP}, are in the input for the near past and mandatory imperative respectively. Similar to other tonal morphemes, a corresponding alignment constraint (44) specifies which edge the grammatical H aligns to. In (45), constraint (44) outranks the general H alignment constraint.

⁸ The term *mandatory imperative* is used by Mwitá (2008) in the study of Kuria (E40). It refers to an imperative form that has the same morphemic structure as a bare verb. Since this type of imperatives is also found in Nata, I adopt the same term for easy comparison with Kuria.

⁹ The minimal Nata word is bisyllabic. Therefore, **nwá* and **há* are impermissible forms for ‘Drink!’ and ‘Give!’ One must use the hortatory subjunctive form for verbs with C or CV roots.

(44) ALIGN ({H_{NP}, H_{IMP}}, L, Word, L):

For every H_{NP} or H_{IMP}, the left edge of the high tone must coincide with the left edge of the word. Assign a violation mark for each syllable intervening between the left edge of the high tone and the left edge of the word.

(45) Constraint interaction for the near past

n-ú-h-eere N-2sgSM-give-PFV ‘You^{SG} (just) gave.’

nu.[hee.re] H _{NP}	*FLOAT	ALIGN ({H _{NP} , H _{IMP} }, L, Word, L)	MAX-T	ALIGN (H, L, Macrostem, L)
a. nu.[hee.re] H _{NP}	*!			
b. nu.[hee.re] | H _{NP} H			*!	
c. nu.[hee.re] /\ H _{NP}		*!		
d. nu.[hee.re] | ☞ H _{NP}				*

2.8 Type IV: H on the second syllable of the macrostem ([Macrostem σ σ´])

Only one TAM, namely the hortatory subjunctive, has H on the second syllable of the macrostem. (46) shows that the subjunctive is marked by the FV ε; there is no segmental morpheme in the TAM position.

(46) Template of the hortatory subjunctive

	Pre-SM	SM	NEG	TAM	[M _{stem}	OM	V _{ROOT}	EXT	FV/suffix]
Hortatory subj	N	SM		H _{Hsj}	[	(OM)	V _{ROOT}	(EXT)	ε]

2.8.1 Description of the data

Different from the mandatory imperative, the hortatory subjunctive is a more polite way to make requests. It has an obligatory SM, which can be singular (47) or plural (48).

(47) The hortatory subjunctive with a singular SM

a. n- u-	[h	-ε]	nuu.hé	‘(You ^{SG} please) Give.’
b. n- u-	[ju	-ε]	nuu.jwé	‘(You ^{SG} please) Drink.’
c. n- u-	[sɔm	-ε]	nuu.sɔ.mé	‘(You ^{SG} please) Read.’
d. n- u-	[sukur	-ε]	noo.su.kú.rɛ	‘(You ^{SG} please) Dump out.’

N-2sgSM- V_{ROOT}-FV_{subj}

(48) The hortatory subjunctive with a plural SM

a. n- mu-	[h -ε]	mmu. hé	‘(You ^{PL} please) Give.’
b. n- mu-	[ju -ε]	mmu. ɰwé	‘(You ^{PL} please) Drink.’
c. n- mu-	[sɔ m -ε]	mmu.sɔ. mé	‘(You ^{PL} please) Read.’
d. n- mu-	[suk ur -ε]	mmo.su. kú.rɛ	‘(You ^{PL} please) Dump out.’

N-2plSM- V_{ROOT-FVsubj}

In (47) and (48), It seems that H is sometimes on the last syllable of the word in (a)–(c), but sometimes on the second last syllable in (d). Longer forms with object markers in (49) and (50) clarify the pattern, in which H falls on the second syllable of the macrostem. When there is only one syllable in the macrostem as in (47a), (47b), (48a) and (48b), H falls on the only syllable in the macrostem.

(49) The hortatory subjunctive with one object marker

a. n- u-	[ki- h -ε]	noo.kii. hé	‘(You ^{SG} please) Give it.’
b. n- u-	[ki- ju -ε]	noo.ki. ɰwé	‘(You ^{SG} please) Drink it.’
c. n- u-	[ki- sɔ m -ε]	noo.ɣi.sɔ. mɛ	‘(You ^{SG} please) Read it.’
d. n- u-	[ki- suk ur -ε]	noo.ɣe.sú.ku.rɛ	‘(You ^{SG} please) Dump it out.’

N-2sgSM-OM7-V_{ROOT-FVsubj}

(50) The hortatory subjunctive with two object markers

a. n- u-	[ki- mu- h -ε]	noo.ke. mú .hɛ	‘(You ^{SG} please) Give it to him.’
b. n- u-	[ki- mu- ju -er -ε]	noo.ke. mú .ɰwɛɛ.rɛ	‘(You ^{SG} please) Drink it for him.’
c. n- u-	[ki- mu- sɔm -er -ε]	noo.ke. mú .sɔ.mɛ.rɛ	‘(You ^{SG} please) Read it for him.’
d. n- u-	[ki- mu- sukur -er -ε]	noo.ke. mó .su.ku.rɛ.rɛ	‘(You ^{SG} please) Dump it out for him.’

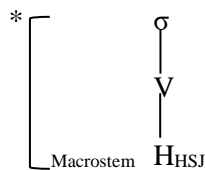
N-2sgSM-OM7-OM1-V_{Root-APPL-FV_{SUBJ}}

2.8.2 Analysis for Type IV: grammatical high for the hortatory subjunctive (H_{Hsj})

The hortatory subjunctive is non-indicative and thus semantically marked. It is also tonally marked by the morpheme H_{Hsj}. The alignment constraint (51) forbids docking of H_{Hsj} to the first syllable of the macrostem, outranking the general H alignment constraint (27). Candidate (c) in tableau (52) satisfies ALIGN (H, L, Macrostem, L) by aligning H_{Hsj} to the left edge of the macrostem, but it violates the undominated constraint of non-initiality. Candidate (d) and (e) do not incur any violation of non-initiality. H_{Hsj} in candidate (d) is two syllables away from the left edge of the macrostem, hence penalized with two violation marks for the alignment constraint. Candidate (e) with only one violation mark is selected as the optimal output.

(51) NON-INITIALITY (H_{Hsj})

Assign a violation mark to each H_{Hsj} that is docked to the vowel of the first syllable of the macrostem.



(52) Constraint interaction for the hortatory subjunctive

n-oo-ye-súkur-ε N-2sgSM-OM7-dump.out-FV_{subj} ‘(You^{SG} please) Dump out.’

noo.[ye.su.ku.rɛ] H _{Hsj}	NON-INITIALITY (H _{Hsj})	*FLOAT	MAX-T	ALIGN (H, L, Macrostem, L)
a. noo.[ye.su.ku.rɛ] H _{Hsj}				
b. noo.[ye.su.ku.rɛ] H _{Hsj} H			*!	*
c. noo.[ye.su.ku.rɛ] H _{Hsj}	*!			
d. noo.[ye.su.ku.rɛ] H _{Hsj}				*!*
e. noo.[ye.su.ku.rɛ] H _{Hsj}				*

2.9 Type V: H on the first two syllables of the word ([Word σ σ])

The negative imperative with H on *both* the first and second syllable of the word has the most puzzling tone pattern. First, it does not pattern with other negative TAMs in Type II, which have H on the right edge of the word. Second, it is the only form with two Hs within one word. This deviates from the generalization from Nata nouns that a word has exactly one high-toned syllable (Anghelescu 2013). The template of the negative imperative is given in (53).

(53) Template of negative imperative

	Pre-SM	SM	NEG	TAM	[_{Mstem}	OM	V _{Root}	EXT	FV/suffix]
Neg imperative		SM	ta H _{NEG}	H _{IMP}	[	(OM)	V _{Root}	(EXT)	a]

2.9.1 Description of the data

The negative imperative is the only way to request someone *not* do something, although an affirmative request can be done with either the mandatory imperative or the hortatory subjunctive. Although all examples in the previous subsections have only one H per word, the negative imperative is an exception. In (54) and (55), there are two high-toned syllables per word.

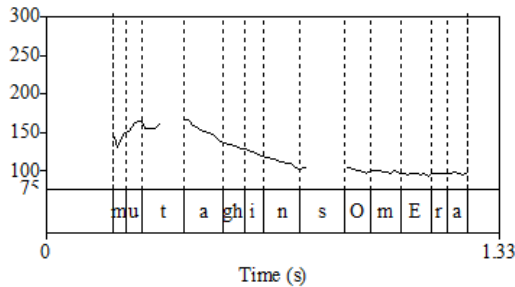
(54) Negative imperative forms with a consonant-initial SM

a. mu-	ta-	[ɲu -a]	mútáɲwa	‘(You ^{PL}) Don’t drink!’
b. mu-	ta-	[səm -a]	mútásoma	‘(You ^{PL}) Don’t read!’
c. mu-	ta-	[sukur -a]	mútásukura	‘(You ^{PL}) Don’t dump out!’
d. mu-	ta-	[taandor -a]	mútátaandora	‘(You ^{PL}) Don’t tear!’
	2plSM-NEG-	V _{Root} -FV		

(55) **mu-** **ta-** [ki-ni-səm-er-a] **mútáyinsomera** ‘(You^{PL}) Don’t read it for me!’
2plSM- NEG- OM7-OM1-read-APPL-FV

Acoustic measurements for (55) were done to confirm the transcriber’s and the consultant’s judgment. (56) shows that the F0 of the mid point of the vowel [u] of the SM *mu* is 159.6Hz, whereas that of the vowel [a] in the NEG morpheme *ta* is 152.3Hz. The F0 of the vowel [i] of the following syllable [yin] is only 124.5Hz, showing a difference of 30Hz.

(56) The pitch contour of *mútáyinsəmera* ‘(You^{PL}) Don’t read it for me!’



Negative imperative forms with a vowel-initial SM *u* are presented in (57), which have only one H on the second syllable. The lack of H on a word-initial short vowel is consistent with the observation in Anghelescu (2013)—a word-initial short vowel cannot bear a high tone.

(57) Negative imperative forms with a vowel-initial SM

a. u-	ta-	[ɲu -a]	utáɲwa	‘(You ^{SG}) Don’t drink!’
b. u-	ta-	[səm -a]	utásoma	‘(You ^{SG}) Don’t read!’
c. u-	ta-	[sukur -a]	utásukura	‘(You ^{SG}) Don’t dump out!’
d. u-	ta-	[taandor -a]	utátaandora	‘(You ^{SG}) Don’t tear!’
	2sgSM-NEG-	V _{Root} -FV		

Since the constraint on word-initial vowels is a general rule of Nata phonology but not specific to negative imperatives, I conclude that the tone pattern of negative imperatives is as follows: H falls on both the first and second syllables of the word.

2.9.2 Analysis for Type V: two grammatical Hs (H_{NEG} and H_{IMP})

In OT terms, the two high tones on negative imperative forms is a result of the constraint MAX-T, which requires that the two morphemes H_{NEG} and H_{IMP} in the input have output correspondents. In terms of linear order, H_{NEG} precedes H_{IMP} in the template in (53). To satisfy ALIGN (H_{NEG}, R, Word, R) and ALIGN (H_{IMP}, L, Word, L) simultaneously, association lines must cross, resulting in an ill-formed output with H_{IMP} on the left edge of the word and H_{NEG} on the right edge. It is crucial that LINEARITY (58) outranks ALIGN (H, L, Macrostem, L), so that candidate (a) in tableau (59) is eliminated. Another crucial ranking is that ALIGN (H_{IMP}, L, Word, L) must dominate ALIGN (H_{NEG}, R, Word, R) to stop the tones from aligning to the right edge, as in candidate (c). Although H_{NEG} of candidate (e) is four syllables away from the right edge, it incurs the fewest violations of ALIGN (H_{IMP}, L, Word, L); it is hence selected as the optimal output.

(58) LINEARITY: Preserve underlying linear order. (Yip 2002:83)

(59) Constraint interaction for the negative imperative with a 2nd person plural SM
mu-ta-yi-so-ma 2plSM-NEG-OM7-read-FV ‘(You^{PL}) Don’t read it!’

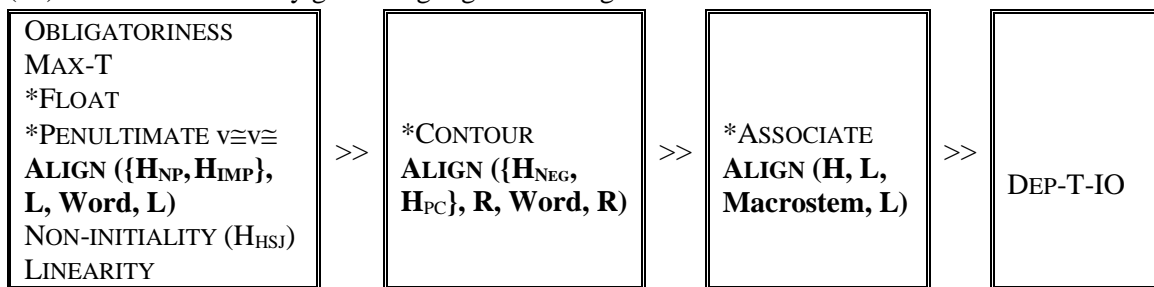
mu.ta.[yi.so.ma] H _{NEG} H _{IMP}	LINEARITY	MAX-T	ALIGN (H _{IMP} , L, Word, L)	ALIGN (H _{NEG} , R, Word, R)	ALIGN (H, L, Macrostem, L)
a. mu.ta.[yi.so.ma] H _{NEG} H _{IMP}	*!				****
b. mu.ta.[yi.so.ma] H _{NEG} H _{IMP}		*!			**
c. mu.ta.[yi.so.ma] H _{NEG} H _{IMP}			*!***	*	***
d. mu.ta.[yi.so.ma] H _{NEG} H _{IMP}			*!*	***	*
e. mu.ta.[yi.so.ma] H _{NEG} H _{IMP}			*	****	***

2.10 Summary of the analysis

Although finite verb forms of various TAMs exhibit different tone patterns, it is consistent that tone is sensitive to its position in either the macrostem or the word. However, none of the forms has two Hs on the macrostem. Also, H is either *inside* the macrostem or *outside* the macrostem. The table in (61) summarizes the five tone patterns and all TAM templates. Type I and Type II are most common, while Type III, Type IV and Type V are less common with only one or two members in each category.

In my OT analysis, I have proposed three alignment constraints to account for edge-based tone patterns. ALIGN (H, L, Macrostem, L) aligns a phonological category (PCat) to the edge of the macrostem. It is most relevant to inputs with no high tone. The second and third alignment constraints align a morphological category (MCat) to the edge of the word. Through the negative imperative forms, I have shown that ALIGN ({H_{NP}, H_{IMP}}, L, Word, L) outranks ALIGN ({H_{NEG}, H_{PC}}, R, Word, R). The collapsed hierarchy of all constraints is given in (60).

(60) Constraint hierarchy governing high tone assignment in finite verbal words



3 Conclusion and future research

In this paper, I have shown that Nata verbal tone is conditioned by TAM. Most indicative TAMs have no high tone in the input. Semantically marked TAMs, including non-factuais, subjunctives and imperatives, are marked by a grammatical high tone in the input. A markedness symmetry can be observed between semantics and tone. Inflection of polarity involves the edges of constituents: the affirmative is always associated to the left edge of a domain, while the negative is often associated to the right edge.

Nurse (2003) states that Bantu languages may encode TAM (i) pure segmentally, (ii) purely tonally, and (iii) a combination of segment and tones. The current study has elucidated that Nata belongs to the third type. Analyzing TAM melodies as tonal morphemes predicts that segmentless morphemes share commonalities with segmental morphemes. First, tonal morphemes can also have allomorphs. Second, in terms of function, both tonal morphemes and segmental TAM markers are able to draw semantic contrasts. Tonal morphemes are therefore represented on the TAM templates in (61) together with the segmental TAM markers. In the TAM column of this table, tonal morphemes and segmental markers are almost in complementary distribution. TAMs without a segmental morpheme (near past, hortatory subjunctive and mandatory imperative) are tonally marked with the grammatical H. The past conditional is an exception, which is characterized by both a tonal and segmental TAM marker. Data of more TAMs are needed to conclude the distribution of tonal and segmental morphemes.

Discussing phonology-morphology interface of African languages, Hyman (2012:22) points out that tone can be an exponent of a morpheme by being an “arbitrary co-exponent” or a “systematic co-exponent”. In Nata, nominal tone belongs to the former, whereas verbal tone corresponds to the latter. Anghelescu (2013) concludes that Nata nominal tone is lexically specified on noun stems. It is thus unpredictable which one of the three tone patterns a noun stem falls into. However, Nata verbal tone is not specified on verb stems. High tone assignment is predictable by a single ranking of constraints posited in (60), contrary to the three co-phonologies in nouns. Another difference between nominal and verbal tone is the maximum number of high-toned syllables per word. In nouns, a word has exactly one high-toned syllable, but in verbs, two Hs within one word is permissible, as in the negative imperative forms. Such noun-verb split is consistent with general observations in the Niger-Congo family.

Tonal behaviour of vowel-initial roots, infinitive forms and deverbal nouns should also be investigated to complete the current study. The initial vowel of a verb root often coalesces with the vowel of the preceding morpheme. Understanding these patterns can help fine-tuning the description of interaction between segmental processes and tonal processes. Moreover, infinitive verb forms and deverbal nouns have a similar morphological template --- they both have a noun class prefix. Analyses of these forms will shed light on both nominal and verbal tone.

The current analysis assumes that morphemes in the TAM column of (61) are most important in the inflection of TAM, without assessing the role of suffixes (*-ire*) and final vowels (*-ε* in the subjunctive). The morphosyntactic status of these morphemes on the right edge is yet to be investigated. Also, the morphological templates of TAMs presented so far are linear. More language-internal evidence, such as patterns of vowel harmony, is necessary to confirm the hierarchical structure of various morphological constituents. An understanding of Nata morphosyntax may inspire other approaches to analyzing tone patterns.

As commented by Crane (2011), Bantu languages have the most complex TAM systems among world languages, and Nata is no exception. The current study has only included a subset of TAMs. The tonal behaviour of futurate forms discussed by Osa-Gómez (2013) and periphrastic compound verbs is yet to be investigated. Even though new generalizations may be drawn in the future, I have

addressed grounding issues regarding the role of the syllable and vowel in Nata tonology, the prime determiner of tone assignment in verbs, and the contrast between nominal and verbal tone in terms of predictability. It is hoped that the current study has laid down the foundation on which further research of Nata phonology can be built.

(61) Summary of Nata TAM templates and tone patterns

TAM	Template											Tone pattern							
	[Word	Pre-SM	SM	NEG	TAM	[Mstem	OM	V _{ROOT}	EXT	Final	]]	Word	σ1	σ2	[Mstem	σ1	σ2	σ _{last}]]
+ narrative past	[Word		SM		<i>ka</i>	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>a</i>	]]	Word			[Mstem	H]]	
+ habitual	[Word	N	SM		<i>haa</i>	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>a</i>	]]	Word			[Mstem	H]]	
+ progressive	[Word	N	SM		<i>ku</i>	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>a</i>	]]	Word			[Mstem	H]]	
- habitual	[Word		SM	<i>ta</i>	H _{NEG}	<i>haa</i>	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>a</i>	]]	Word			[Mstem		H _{NEG}]]
- progressive	[Word		SM	<i>ta</i>	H _{NEG}	<i>ku</i>	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>a</i>	]]	Word			[Mstem		H _{NEG}]]
- near past	[Word	N	SM	<i>ta</i>	H _{NEG}	∅	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>ire</i>	]]	Word			[Mstem		H _{NEG}]]
- past cond.	[Word		SM	<i>ta</i>	H _{NEG}	<i>a nga</i>	∅	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>ire</i>]]	Word			[Mstem		H _{NEG}]]
+ past cond.	[Word		SM		<i>a nga</i>	H _{PC}	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>ire</i>	]]	Word			[Mstem		H _{PC}]]
+ near past	[Word	N	SM			H _{NP}	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>ire</i>	]]	Word	H _{NP}		[Mstem]]	
+ mandatory imp	[Word					H _{IMP}	[Mstem		V _{ROOT}	(EXT)	<i>a</i>	]]	Word	H _{IMP}		[Mstem]]	
+ h. subjunctive	[Word	N	SM			H _{HSJ}	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>ε</i>]]	Word			[Mstem		H _{HSJ}]]	
- imperative	[Word		SM	<i>ta</i>	H _{NEG}	H _{IMP}	[Mstem	(OM)	V _{ROOT}	(EXT)	<i>a</i>]]	Word	H _{NEG}	H _{IMP}	[Mstem]]	

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