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Hiatus resolution in Tariana pronominal prefixation

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by

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This thesis provides an Optimality Theory (OT) analysis (Prince and Smolensky 1993, McCarthy and Prince 1995) of vowel alternations that occur upon affixation across pronominal prefix-verb root boundaries in Tariana (North Arawak; Colombia/Brazil). Previously, the vowel alternations observed in these environments have been described in terms of linear analysis, as independently-motivated processes under the cover term vowel fusion (Aikhenvald 2003). I propose that the vowel alternations occur as instruments of hiatus resolution.

Three alternations, or hiatus resolution strategies, are observable in Tariana pronominal prefix-verb root affixation: no change (or diphthong formation), coalescence, and vowel elision. I propose that sonority sequencing governs the form that hiatus resolution takes. Vowel sequences that rise in sonority undergo no observable change (e.g. /d**u**-**é**ma/ → [d**ué**ma] 'she stands'). Because the domain of sonority is syllable-internal (Clements 1990, Rosenthall 1994, Blevins 1995), this analysis carries the implication that sequences exhibiting no featural change between input and output form diphthongs rather than sequences of hiatus. Sequences of falling sonority result in coalescence (e.g. /n**a**-**í**sa/ → [n**é**sa] 'they climb') or vowel elision (e.g. /w**a**-**é**ku/ → [w**eé**ku] 'we run').

I maintain that mid-vowel coalescence in Tariana is governed by adherence to ternary vowel height adjacency, as proposed by Gnanadesikan (1997). Furthermore, I submit that coalesced outputs are monomoraic when /i/ is the initial input vowel in the root, because root-initial /i/ carries no mora in Tariana. Vowel elision results in the loss of either the prefix or the root vowel upon pronominal prefixation in Tariana. I propose that the quality of the vowel output, whether it mirrors that of the prefix or root vowel in the input, is determined based on subsistence of the root vowel feature [αback], and an avoidance of the vocalic feature [+high].

The analysis presented in this thesis serves to reinterpret the previous linear analysis of vowel alternations observed across pronominal prefix-verb root boundaries in Tariana. It utilizes OT to functionally unify the vowel alternations, showing that each distinct process occurs in order to avoid hiatus formation.

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1. Introduction

Morpheme concatenation creates sequences of vowels that languages react to in a variety of ways. Such possible reactions are illustrated in (1), with periods (.) representing syllable boundary demarcation, V representing vowel segments, C and G representing consonant and glide segments respectively, subscripted numbers indicating segment correspondence between underlying and surface forms, and parenthesis (:) indicating optional vowel lengthening. Vowel sequences may be left unchanged upon concatenation, creating instances of hiatus wherein the vowels involved are independently syllabified as shown in (1a). If a language does not tolerate such sequences, vowel alternations occur as a means of avoiding them. These alternations are considered instruments of hiatus resolution, and commonly manifest as diphthong formation (1b), consonant epenthesis (1c), glide formation (1d), vowel elision (1e), and coalescence (1f) (Clements 1986, Rosenthall 1994, Casali 1996, Ngunga 2000, Pulleyblank 2003, McCarthy and Prince 2004).

(1) Schematic illustration of sound alternations

a. Hiatus:	$V_1+V_2 \rightarrow V_1.V_2.$
b. Diphthong formation:	$V_1+V_2 \rightarrow .V_1V_2.$
c. Consonant epenthesis:	$V_1+V_2 \rightarrow V_1.CV_2.$
d. Glide formation:	$V_1+V_2 \rightarrow .G_1V_2.$ or $V_1.G_1V_2.$
e. Vowel Elision:	$V_1+V_2 \rightarrow V_1(:)$ or $V_2(:)$
f. Coalescence:	$V_1+V_2 \rightarrow V_3(:)$

In Tariana, an Arawak language spoken in Colombia & Brazil, vowel sequences form when pronominal prefixes, which end in vowels, affix to verb roots beginning with vowels. Some of these vowel sequences remain unchanged upon prefix-root concatenation (e.g. /du-éma/ → [duéma] ‘she sleeps’), and others exhibit alternation (e.g. /na-ísa/ → [nésa]

‘they climb’). The goal of this thesis is to account for the vowel processes that occur when pronominal prefixes attach to verb roots in Tariana using an Optimality Theory (OT) framework (Prince and Smolensky 1993, McCarthy and Prince 1995).

Previously, the sound alternations occurring across Tariana affix boundaries have been described in terms of linear analysis. Linear analysis accounts for the data using two sets of ordered rules: *h*-metathesis and vowel fusion. My analysis provides a reinterpretation of the vowel alternations comprising vowel fusion. Where linear analysis describes the vowel fusion alternations as independent, unrelated processes, OT analysis shows that they are united in conspiracy against hiatus formation in Tariana. Furthermore, OT analysis allows for the demonstration of functional unity among pronominal prefix-verb root vowel alternations while accommodating the co-occurrence of *h*-metathesis.

I propose that vowel alternation in Tariana pronominal prefixation is controlled by the sonority condition created by the morphological prefix-root sequence. When sonority rises from the first segment in the sequence to the second, no change occurs. Conversely, sound changes occur when sonority falls within a sequence. These changes take the form of coalescence or vowel elision, depending on the vowels involved.

Coalescence is a process whereby two segments in sequence combine into a single segment, containing features of one or both of the original segments (Trask 1996). In Tariana, coalescence occurs in relation to the sequence /a/-/i/, which results in [e], and /i/-/i/, which results in [i]. My OT analysis proposes that the quality of the resultant vowel is governed by adherence to ternary vowel height adjacency. Furthermore, I propose that root-initial /i/ carries no mora in the prefix-root input sequence, producing monomoraic coalesced outputs in adherence to moraic faithfulness.

Vowel elision is a process in which phonological material of a vowel is lost from a vowel sequence (Trask 1996). Tariana employs vowel elision in order to resolve unfavorable sequences /a/-/u/ and /a/-/e/, resulting in the loss of either the prefix or the root vowel upon prefixation. I show that the quality of the vowel output, whether it mirrors that of the prefix or root vowel in the input, is determined based on subsistence of the root vowel feature [αback], and an avoidance of the vocalic feature [+high].

In addition to the vowel alternations that occur upon prefixation, Tariana also exhibits metathesis between the prefix-final vowel and root-initial /h/, which results in aspiration of the prefix consonant on the surface. While it is not directly related to the vowel alternations at issue in this thesis, the co-occurrence of this consonant-vowel metathesis is observable in the data and therefore merits discussion. I address this alternation as a strategy employed by Tariana to avoid the sequence [Vh].

This thesis is outlined as follows: in section 2, I introduce and provide background on the Tariana language. I introduce a set of data in section 3, in which vowel alternations occur, and around which my analysis revolves: Tariana pronominal prefixes and verb roots. All data in this analysis is from Aikhenvald (2003). In section 4, I discuss the previous, linear analysis of the sound alternations at issue. Section 5 presents an overview of OT, the theoretical framework I utilize. Section 6 consists of my OT analysis of the Tariana pronominal prefix-verb root sound alternations. Section 7 concludes with a summary of my analysis, discussion of its implications, and identification of questions for further research.

2. Tariana language background

In this section, I discuss background relevant to the Tariana language. I present a brief summary of its region and speakers in section 2.1, and an overview of its relevant linguistic features in section 2.2.

2.1 Tariana overview

Tariana is a North Arawak language spoken by the Tariana people along the border of Colombia and Brazil in the Vaupés basin of the Amazon. The Vaupés basin is indicated on the map in Figure 1 by the boxed region. In Figure 2, the Vaupés basin is enlarged from Figure 1, the boxed region indicating the approximate area of the basin inhabited by the Tariana people.

Figure 1. The Vaupés basin (Google maps 2014)

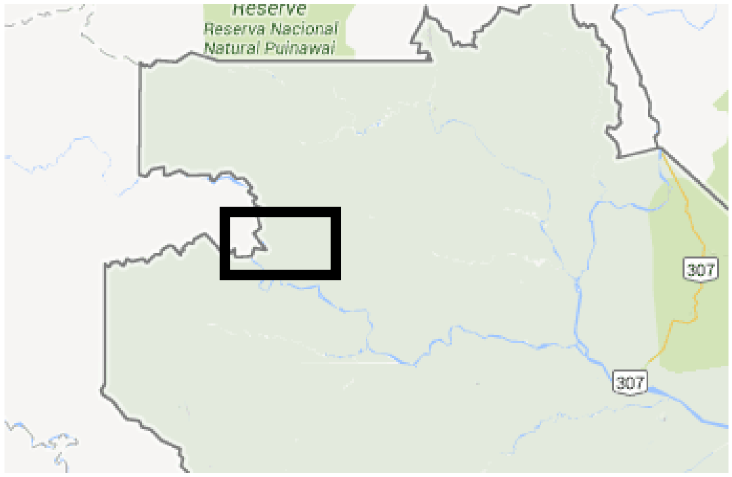

Figure 2. Tariana in the Vaupés basin (Google maps 2014)

The Arawak family is the largest on the continent, with about 40 living languages spanning 12 Central and South American countries (Dixon and Aikhenvald 1999). See Appendix A for a list of Arawak languages. The Vaupés basin region of the Amazon, where Tariana is spoken, is characterized by multilingualism and linguistic exogamy, a practice wherein individuals must not marry someone who speaks their language (Aikhenvald 1999). Languages deliniate families in this region, therefore intra-language marriage is considered akin to incest in the culture. A product of this cultural feature is extensive borrowing and convergence—lexical, phonological, and grammatical—among the languages of the Vaupés basin (Dixon and Aikhenvald 1999).

Tariana is the only Arawak language spoken in the Vaupés basin. It is surrounded geographically, and heavily influenced linguistically by East Tucano languages. These languages include Tucano, Tuyuca, Guanano, Desano, Carapana, Macuna, Barasan, and Waimaja. The East Tucano languages are a subgroup of the Tucano family, which is unrelated to the Arawak family. The Tucano language is gaining influence as a lingua franca in the Vaupés basin, as are Spanish

and Portuguese, resulting in widespread language endangerment in the region (Aikhenvald 1999). According to Ethnologue (Lewis, et al. 2013), the Tariana ethnic population numberd 1,910 as of 2002. The Tariana language is endangerd, with about 100 speakers reported at last count in 1999, none of whom are children (Aikhenvald 2003).

2.2 Linguistic overview

All background in this section is garnered from Aikhenvald (2003). Tariana has six vowel phonemes and twenty-four consonant phonemes. The language places phonotactic restrictions on the occurrences of vowels and consonants in various positions within a morpheme. In other words, certain segments may or may not be allowed in the initial, medial, or final position of a morpheme depending on whether it is a root, affix, or enclitic. The six-vowel inventory of Tariana, shown in (2), consists of high-front /i/, high-central /ɨ/, high-back /u/, mid-front /e/, mid-central /o/, and low-back /a/. All non-central vowels have a nasal and a long counterpart, both of which are phonemic in Tariana (e.g. *duma* 'she sleeps', *du:ma* 'she looks (for something)'). The vowels in (2), along with their features, are shown and referenced in this thesis as identified by Aikhenvald (2003). The phonemes in (2) that diverge from IPA representation are /o/ (/ɵ/) and /a/ (/ɑ/).

(2) Tariana vowels

	Front	Central	Back
High	i	ɨ	u
Mid	e	o	
Low			a

(Aikhenvald 2003: 32)

The vowels pertinent to the analysis given in this thesis are limited to the four involved in pronominal prefixation, based on their ability to occur in affix-final or root-initial positions: high vowels /i/ and /u/, mid vowel /e/, and low vowel /a/. The vowels /i/ and /e/ are considered [-back], and /u/ and /a/ are [+back]. A feature matrix of these vowels is shown in (3) and assumed in my analysis in section 6.

(3) Vowel feature matrix

	i	e	u	a
high	+	-	+	-
low	-	-	-	+
back	-	-	+	+

Tariana's consonant inventory is shown in (4). Phonemes are listed as identified by Aikhenvald (2003). The phonemes in (4) that diverge from IPA representation are: /ph/ (/pʰ/); /th/ (/tʰ/); /dh/ (/dʰ/); /mh/ (/mʰ/); /nh/ (/nʰ/); /kh/ (/kʰ/); /wh/ (/wʰ/); /ñ/ (/ɲ/); /ñh/ (/ɲʰ/); /g/ (/ɣ/). In this thesis, I utilize Aikhenvald's symbols rather than IPA in order to ensure that the movement of /h/ upon affixation, resulting in aspirated consonants, is visually salient. Tariana has a series of aspirated stops and nasals, and one aspirated glide. Voicing contrast occurs among bilabial and dental consonants. The dorso-velar fricative in parentheses (g) occurs only in Portuguese loanwords (e.g. *Graciliano, Gabriel*).

(4) Tariana consonants

	Bilabial	Apico-Dental	Apico-Alveo-Palatal	Lamino-Palatal	Dorso-Velar	Glottal
Stop	p b	t d			k	
Aspriated Stop	ph	th dh			kh	
Fricative			s		(g)	h
Affricate				tʃ		
Nasal	m	n		ñ		
Aspirated Nasal	mh	nh		ñh		
Flap			ɾ			
Lateral			l			
Semi Vowel	w			y		
Aspirated Semi Vowel	wh					

(Aikhenvald 2003: 26)

Tariana is a pitch-accent language in which pitch correlates with primary stress, and is contrastive. Vowels with primary stress have a higher pitch than those without, and changes in the positioning of stress can result in minimal pairs such as *píka* ‘you laugh’ and *piká* ‘you look’. Secondary stress does not have this effect. Basic syllable structure is (C)V(C), with only /h/ and /y/ allowed in the coda of a syllable. Syllables comprised solely of a vowel are usually only found in word-initial positions.

Tariana is classified as a polysynthetic language. It has a large inventory of suffixes and enclitics, and a smaller inventory of prefixes, a characteristic of most Arawak languages. Tariana is primarily head-marking, meaning grammatical agreement is marked on noun and verb roots, rather than on modifiers or dependents. Nouns host a number of grammatical categories, including number, gender, classifiers, possession, case, nominal tense and extralocality. Verbs can also cross-reference person, number and gender, and often take mood and Aktionsart enclitics.

In Tariana, some phonological processes that result from affix concatenation apply in any affixation environment, whereas others either apply only at prefix boundaries, or only at suffix boundaries. These differences in application may be partially attributed to the phonotactic restrictions on the occurrences of consonants and vowels in certain environments (i.e. root-initial, root-final, affix-initial, affix-final, etc.), which cause certain sounds to occur in suffixation that do not occur in prefixation, and vice versa. For example, /e/ is not attested prefix-finally, meaning the sequence /e/-/V/ does not materialize in prefixation. The segment /e/ can occur root-finally, however, meaning that upon suffixation the sequence /e/-/V/ occurs and results in vowel alternation.

3. Tariana prefix-root alternations

In this section, I present data relevant to the phonological processes at issue in this thesis: sound alternations that occur upon affixation of a pronominal prefix and a verb root in Tariana. To illustrate the affixation process, (5) is comprised of a conjugation of the verb root *híma* 'to hear', showing both the underlying and surface forms of the verbs. While some vowel sequences in Tariana remain upon prefixation, to be shown in (6), alternations between the underlying and surface level are apparent in each example in (5). One such change is the movement of the root-initial /h/, which results in the formation of an aspirated consonant with the prefix consonant (5a-d, f), and a word-initial /h/ if there is no prefix consonant (5e). The second change involves the prefix vowel in combination with the first vowel of the verb root, which creates an underlying V_1V_2 sequence. The conjugation in (5) shows vowel sequences at the underlying level that emerge as single vowels (5a-f), which can be different from both the prefix and root vowel (5d, f).

(5) Conjugation of *-híma*, ‘to hear’[1]

a.	1sg	/nu-híma/	→	[nhúma]
b.	3sgnf	/di-híma/	→	[dhíma]
c.	3sgf	/du-híma/	→	[dhúma]
d.	1 pl	/wa-híma/	→	[whéma]
e.	2 pl	/i-híma/	→	[híma]
f.	3 pl	/na-híma/	→	[nhéma]

(Aikhenvald 2003)

Further examples of the phonological processes that occur upon prefixation are identified in four groups, shown in (6)-(9) below. The groups in (6)-(9) are comprised of sets of verbs that I have delineated based on similarly-behaving sequences with respect to sound alternation. I show the underlying pronominal prefix (indicated by ‘pro’) and verb root (indicated by ‘root’), as well as the form that is observed on the surface. Bolded segments indicate involvement in sound alternation. Stress is marked in all examples, but as it does not appear to contribute to the sound alternations at hand, it is not addressed in my analysis (see section 7 for a discussion of stress).

Group A, shown in (6), exemplifies vowel sequences that persist across the pro-root boundary. In other words, upon affixation no change occurs in the vowels of either the prefix or the root. The vowel sequences comprising this group begin with either /i/ or /u/ when involving vowels of different quality (6a-d), or /u/ and /a/ when vowels are identical (6e-f).

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[1] Abbreviations: 1–first person, 2–second person, 3–third person, sg–singular, sgnf–singular non-feminine, pl–plural.

(6) Group A: $V_1 + V_2 \rightarrow V_1V_2$

Pro-root	Surface	Gloss
a. /nu-**á**/	[n**uá**]	I go
b. /di-**á**/	[d**iá**]	he goes
c. /di-**ú**ma/	[d**iú**ma]	he seeks
d. /du-**é**ma/	[d**ué**ma]	she stands
e. /wa-**á**ra/	[wa**á**ra]	we fly
f. /nu-**ú**ma/	[nu**ú**ma]	I seek

In Group B, shown in (7), coalescence of Tariana pro-root vowels is apparent. Coalescence is a phonological process whereby upon affixation, the sequence of segments combine into a single segment, which contains features of one or both of the original segments (Trask 1996). Note that coalescence differs from a process wherein both original vowels are deleted and a new vowel is inserted (i.e. $V_1V_2 \rightarrow V_3$). The vowel sequences involved in coalescence of Group B are /a/-/i/, which results in the form [e], and /i/-/i/, which results in [i]. The coalescence in (7b) and (7c) is accompanied by movement of the root-initial /h/, a process to be addressed in (9). Coalescence is attested when /i/ is the first vowel in the root, occurring either root-initially or following /h/.

(7) Group B: $V_1 + V_2 \rightarrow V_{1,2}$

Pro-root	Surface	Gloss
a. /n**a-í**sa/	[n**é**sa]	they climb
b. /na-h**í**ma/	[nh**é**ma]	they hear
c. /di-h**í**ma/	[dh**í**ma]	he hears

The sequence /i/-/i/, shown in (7c), can also have a long vowel variation (e.g. /di-isa/ [diisa] ‘he climbs’) (Aikhenvald 2003). This variation would be categorized in Group A, as it

involves a pro-root sequence of identical vowels that subsists upon affixation. See section 7.3 for discussion of this variation.

In Group C, shown in (8), vowel elision occurs and long vowels are produced upon affixation. I notate long vowels as a sequence of identical elements (i.e. [aa]) rather than with the IPA diacritic symbol (i.e. [aː]) in order to visually reflect my analysis (see section 6).[2] The vowel sequences resulting in long vowels are /a/-/u/, and /a/-/e/. Note that examples (6e-f) in Group A also produce long vowels, but differ from Group C because the vowel segments are identical at the underlying level. Group C shows variation with regard to the surface vowel that persists upon affixation—whether it mirrors that of the prefix or the root. In (8a) the prefix vowel appears to remain on the surface, whereas in (8b) the surface vowel reflects that of the root.

(8) Group C: $V_1+V_2 \rightarrow V_1V_1, V_2V_2$

Pro-root	Surface	Gloss
a. /na-**ú**ma/	[na**á**ma]	they seek
b. /wa-**é**ku/	[we**é**ku]	we run

Group D, shown in (9), contains examples wherein root-initial /h/ undergoes metathesis with the prefix vowel upon affixation. For example, the sequence /i/-/h/ surfaces as [hi] in (9c), and /u/-/h/ becomes [hu] in (9d). The alternation illustrated by the examples in Group D often occurs in conjunction with the vowel processes explained in groups A-C. Example (9a) shows coalescence (Group B) between the prefix and root vowels, in addition to metathesis between the prefix vowel and root-initial /h/. Example (9b) shows vowel elision and lengthening (Group C) alongside metathesis, and examples (9c) and (9d) show metathesis occurring with no change in the vowel sequence (Group A).

[2] I use the diacritic symbol in section 6.4.2 to indicate coalesced long vowels arising in near-optimal candidates (/V_1-V_2/ [$Vː_{1,2}$]), in contrast to uncoalesced long vowels (/V_1-V_2/ [V_1V_2]).

(9) Group D: (C)V+*h*→(C)*h*V

Pro-root	Surface	Gloss	
a. /na-híma/	[n**hé**ma]	they hear	(repeated from (6h))
b. /wa-hépa/	[wheépa]	we answer	
c. /i-hemátha/	[hiemátha]	you shout	
d. /du-hépa/	[dhuépa]	she answers	

Groups A-D, as identified above, are referenced as such throughout this thesis. These groupings are organized according to the patterns that emerge in my OT analysis, to be discussed in section 6. I make the following generalizations of pronominal prefix-verb root alternations in Tariana, based on the data description presented in Groups A-D:

(10) Generalizations

a. Vowel sequences exhibiting no change from input to output consist of two identical vowels (6e-f), or begin with high vowels /i/ or /u/ (6a-d). (Group A)

b. Monophthong [e] results from input sequence /a/-/i/ (7a-b), and [i] results from input sequence /i/-/i/ (7c). (Group B)

c. Long vowels emerge in the output when input sequences consist of /a/-/u/ (8a) or /a/-/e/ (8b). (Group C)

d. Metathesis occurs between the prefix vowel and /h/, when /h/ is root-initial (9a-d). Generalizations (10a-c) can co-occur with metathesis. (Group D)

4. Previous analysis

Before presenting my OT analysis of the vowel alternations described in section 3, I discuss the previous analysis of the data, as proposed by Aikhenvald (2003). Aikhenvald approaches the sound alternations that occur upon pronominal prefixation in Tariana from a linear perspective. She proposes a pair of ordered rule sets that govern the alternations: *h*-metathesis, followed by vowel fusion. One sound alternation is represented by *h*-metathesis, whereas vowel fusion is comprised of seven separate vowel processes that occur upon prefixation. The first rule, *h*-metathesis, corresponds with the data in Group D and is formalized by Aikhenvald as follows:

(11) *h*-metathesis

CV- + -*h*VX → C*h*VX → [aspirated]CVX

Ex. /du-hépa/ → [dhuépa] 'she answers'

(Aikhenvald 2003: 45-46)

Aikhenvald (2003) states that when a prefix attaches to a root beginning with /h/ at the underlying level, the prefix vowel and /h/ will invert. The metathesis of /h/ results in the aspiration of the prefix consonant. If a prefix consists only of a vowel, root-initial /h/ and the prefix vowel will still invert, producing an /h/-initial verb. For example, (9c) /i-hemátha/, beginning with the 2pl prefix /i/, results in the /h/-initial surface form, [hiemátha]. The application of this rule is shown in the derivation in (12).

(12) Derivation of [hiemátha], 'you shout'

UR	/i-hematha/
h-metathesis	hiematha
SR	[hiematha]

The second set of rules is termed vowel fusion. Unlike the common definition of vowel fusion in the literature, a process whereby two segments combine into one segment that usually retains characteristics or features of the originals (Mester 1986, Trask 1996), Aikhenvald (2003) uses vowel fusion as a cover-term for three specific rules. These rules are identified by Aikhenvald as coalescence, monophthongisation, and vowel loss, and are represented in (13). The term vowel fusion provides a means of categorizing a number of vowel-specific processes that occur when prefix vowels affix with vowel-initial roots.

(13) Vowel fusion

a. Coalescence: $V_1 + V_1 \rightarrow V_1$

Ex. /wa-**á**ra/ → [w**aá**ra] 'we fly'

b. Monophthongisation: *a* + *i* → *e*

Ex. /na-**í**sa/ → [n**é**sa] 'they climb'

c. Vowel loss: *i* + V → *i*V   *u* + V → *u*V

u + *í* → *ú*[3]

a + *u* → *aa*   *a* + *e* → *ee*

Ex. /wa-**é**ku/ → [w**eé**ku] 'we run'

(Aikhenvald 2003: 47-50)

The vowel fusion processes shown in (13) correspond loosely with Groups A-C, but correlation is not one-to-one. The divergence in correspondence emerges because within a linear analysis the alternations are categorized with respect to patterns in the input or underlying sequence, whereas in this thesis they are categorized with respect to patterns in the output.

[3] The sequence represented by this rule forms a minimal pair with its unstressed counterpart: /u/-/i/ → [ui], represented in (11c) by *u* + V → *u*V. The other vowel alternations at issue in this thesis are unaffected by stress placement. Because of this, I do not address stress in my analysis in section 6. See section 7.3 for a discussion of this alternation.

Table (14) presents a summary of the vowel fusion rules used in linear analysis as they relate to the vowel processes generalized in Groups A-C.

(14) Vowel alternation summary

Aikhenvald (2003)	This thesis
Coalescence: $V_1 + V_1 \rightarrow V_1$	Group A: No change (if [V_1:]) Group B: Coalescence (if [V_1])
Monophthongisation: $a + i \rightarrow e$	Group B: Coalescence
Vowel loss: $i + V \rightarrow iV$ $u + V \rightarrow uV$ $a + u \rightarrow aa$ $a + e \rightarrow ee$	Group A: No change Group A: No change Group C: Vowel elision Group C: Vowel elision

As shown in (14), categorization of vowel alternations differ between this thesis and the previous linear analysis. I present these differences below, as they correspond with the three vowel fusion rules formalized in (13).

First, Aikhenvald's (2003) analysis interprets coalescence as two identical vowel segments at the underlying level, manifesting on the surface as one vowel of the same quality (13a). This interpretation differs slightly from the definition of coalescence presented in section 1. As it is commonly defined, coalescence applies to sequences of both identical and non-identical segments. My analysis considers pro-root sequences of identical quality on the surface to be undergoing no change if they are long (Group A), and coalescence if they are fused into one short vowel (Group B).

Second, in Aikhenvald's (2003) analysis, sequences of non-identical segments fall under a second rule: monophthongisation. Monopthongisation is the specific process whereby /a/ and

/i/ in sequence become [e] on the surface (13b). This process is treated as coalescence in my analysis (Group B).

Third, vowel loss (13c) is made up of four vowel combinations that either persist in sequence on the surface (i + V → iV; u + V → uV), or combine into one long vowel on the surface (a + u → aa; a + e → ee). I consider the former to be instances of no change (Group A), and the latter, instances of vowel elision (Group C).

Under Aikhenvald's (2003) analysis, the three rules in outlined in (13) are grouped together as vowel fusion because they are all applied after *h*-metathesis, but do not overlap with one another in any environment. Within a linear analysis, *h*-metathesis and vowel fusion exist in a feeding relationship, as illustrated in the derivation in (15). Feeding refers to the relationship between two ordered rules wherein the first rule generates all possible inputs to which the second may apply (Trask 1996, Hayes 2011). Derivation (15) shows that *h*-metathesis must apply to the underlying form first, creating an intermediate form with prefix and root vowels aligned. Vowel fusion then applies to the intermediate form, resulting in the correct surface form (15a). If the order is reversed, as in (15b), the underlying form will not supply the appropriate vowel sequence environment for vowel fusion to apply, and an incorrect surface form will result.

(15) Derivation of [nhésa], 'they go upstream'

	a.			b.	
UR	/na-hísa/		UR	/na-hísa/
h-metathesis	nhaísa		VF	-----
VF (monophth.)	nhésa		h-metathesis	nhaísa
SR	[nhésa]		SR	[*nhaísa]

The derivation in (15) illustrates the ordering of *h*-metathesis and the vowel fusion process monophthongisation. As stated previously, no overlap in environments exists within

vowel fusion. In other words, each vowel process is linked to only one vowel fusion rule. Therefore, they need not be listed separately in a derivation because *h*-metathesis will only feed one process at a time.

Grouping the vowel fusion processes together provides a means of describing them in relation to *h*-metathesis. It is important to note, however, that the three rules comprising vowel fusion represent independent sound alternations. For example, even within one rule, vowel loss (13c), four separate alternations occur: $V_1 + V_2 \rightarrow V_1V_2$; u + í → u; a + u → aa; a + e → ee. Ultimately, because the vowel alternations contained in vowel fusion are independent, they merit independent investigation. My analysis attempts to tackle the differences among Tariana vowel alternations, generalized in 3.1 and originally described by *h*-metathesis and vowel fusion, as independent strategies for hiatus resolution across pro-root boundaries.

Section 5: Theoretical Background – Optimality Theory

In this section, I present a brief overview of Optimality Theory (OT) (Prince and Smolensky 1993, McCarthy and Prince 1995). OT is the framework I use in my analysis of Tariana hiatus resolution.

According to OT, phonological occurrences result from a language's adherence to the faithfulness of input forms, in conjunction with its avoidance of certain output forms. OT proposes a universal set of violable constraints, which are ranked in language-specific ways. The conflicting nature of constraints results in the phonological occurrences observable in the data. Faithfulness constraints, which maintain the precedence of input structures and features, oppose markedness constraints, which work to adhere to cross-linguistic patterns of phonetic

acceptability. Under this framework, from a given lexical 'input', an infinite set of 'output' forms is generated. These output forms are then evaluated by a set of ranked constraints, and one of the forms is deemed optimal.

An extended theoretical treatment of faithfulness constraints is formalized through *Correspondence Theory* (McCarthy and Prince 1994, 1995), which links input and output forms through coindexation. According to *Correspondence Theory*, whenever an output does not match an input exactly, faithfulness has been violated in some way (McCarthy 1995). Segmental faithfulness violations are incurred in relation to metathesis, coalescence, epenthesis, and deletion of input-output segments. Featural faithfulness violations occur when coindexed segments do not contain identical features. If segment input-output pairs do not exist, featural constraints are vacuously satisfied. In other words, features can only be compared between an input and output if there is a correspondence between input-output segments (Kager 1999).

OT evaluates output candidates based on constraints ranked respectively in a tableau (Prince and Smolensky 1993, McCarthy and Prince 1995). In (16) an example tableau is provided. Tableau (16) shows constraint X ranked higher than Y, as indicated by its more leftward position and the solid line dividing the two constraints. The input is listed in the tableau, along with candidates (a) and (b). Violations are marked with an asterisk (*) and fatal violations, which eliminate a candidate from evaluation, are marked with an exclamation (!). The optimal candidate is marked with a ☞ symbol, and the shaded area identifies constraints that are no longer relevant because a candidate has already been fatally eliminated. The evaluation in (16) shows candidate (16a) winning, in spite of its violation of Y, because candidate (16b) violates higher-ranked constraint X, which is deemed fatal based on the relative rank of X over Y.

(16) Example tableau

/input/	X	Y
☞ candidate a		*
candidate b	*!	

In the next section, I utilize the OT framework described above to address the vowel alternations that occur on Tariana pro-root boundaries.

6. OT analysis

In this section, I begin with an introduction to hiatus resolution in OT. In section 6.2, I continue by restating the four generalizations that can be drawn from the Tariana sound alternation data given in section 3, Groups A-D. I then present analyses of each generalization in sections 6.3-5 using OT, identifying and explaining the OT constraints involved in the vowel processes observed in the data. I address *h*-metathesis in section 6.6, in as much as it co-occurs with vowel alternations in some forms, but the focus of my analysis is on pro-root vowel interactions.

6.1 Hiatus resolution in OT

As previously stated in section 1, hiatus refers to the independent syllabification of vowels in a sequence. Within an OT analysis account, instances of hiatus violate the constraint ONSET, proposed by Prince and Smolensky (1993).

(17) ONSET: syllables must have onsets (Prince and Smolensky 1993)

Vowel sequences exhibiting hiatus violate ONSET because the second syllable in the sequence necessarily lacks an onset: (C)$V_1.V_2$. When a language demonstrates hiatus resolution strategies, such as those listed in (1), ONSET is assumed to be highly ranked (Casali 1996). In other words, candidates exhibiting independently syllabified vowels will be eliminated in favor of candidates wherein each syllable has an onset. An example of ONSET at work can be seen in relation to NODIPHTHONG (Prince and Smolensky 1993), which works to prohibit diphthong formation in vowel sequences.

(18) NODIPHTHONG: Vowel sequences must not form diphthongs (Prince and Smolensky 1993)

Tableau (19) shows the theoretical contrast between a candidate that exhibits hiatus (19a) and a candidate that avoids hiatus by employing diphthong formation (19b). Candidate (19a) violates highly-ranked ONSET and is therefore fatally eliminated. Candidate (19b) is deemed optimal, in spite of its violation of lower-ranked NODIPTHONG, because its vowel sequence comprises a single syllable with an onset.

(19) Example evaluation of /CV_1-V_2/

/CV_1-V_2/	ONSET	NODIPHTHONG
a. $CV_1.V_2$	*!	
☞ b. .CV_1V_2.		*

In my analysis of vowel alternations in Tariana pro-root environments, I focus on identifying constraints relating to the hiatus-resolving alternations directly observed in the data. Nonetheless, it is important to note that ONSET is assumed, and considered to be undominated throughout the analysis. Beyond this analysis of pro-root alternations, however, ONSET must be dominated. Recall from section 2.2, Aikhenvald (2003) identifies the basic syllable structure in

Tariana as (C)V(C), maintaining that syllables comprised solely of a vowel can occur, and are usually only found in word-initial positions. Tariana must rank ONSET low enough to allow for the occurrence of independently-syllabified vowels in certain environments, namely word-initially, but high enough to disallow their occurrence across pro-root boundaries.

6.2 Tariana pro-root generalizations

The sound alternation generalizations my analysis addresses, repeated from section 3, are comprised of the following:

(20) Generalizations

a. Vowel sequences exhibiting no change from input to output consist of two identical vowels, or begin with high vowels /i/ or /u/. (Group A)

b. Monophthong [e] results from input sequence /a/-/i/, and [i] results from input sequence /i/-/i/. (Group B)

c. Long vowels emerge in the output when input sequences consist of /a/-/u/ or /a/-/e/. (Group C)

d. Metathesis occurs between the prefix vowel and /h/, when /h/ is root-initial. Generalizations (20a-c) can co-occur with metathesis. (Group D)

6.3 Restrictions on vowel sequence sonority

In this section, I present an analysis of generalization (20a), which states that upon pro-root concatenation, Tariana only maintains vowel sequences that consist of identical vowels in the input, or begin with high vowels /i/ or /u/. I claim that input sequences that fall in sonority from V_1 to V_2 undergo change, while input sequences of rising or equal sonority do not change in the output.

The data in (21) and (22) below are divided based on input vowel sequences that exhibit no change in the output, versus those that do exhibit change. Group A is repeated in (21), showing sequences of input pro-root vowels that remain identical in the output, upholding faithfulness. The examples in (22) correspond with Group B (22a) and C (22b-c), wherein input pro-root vowel sequences differ from output sequences. Groups B and C do not uphold faithfulness, because vowels are not identical between input and output.

(21) Group A

	Input	Output	Gloss
a.	/nu-**á**/	[n**uá**]	I go
b.	/di-**á**/	[d**iá**]	he goes
c.	/di-**ú**ma/	[d**iú**ma]	he seeks
d.	/du-**é**ma/	[d**ué**ma]	she stands
e.	/wa-**á**ra/	[wa**á**ra]	we fly
f.	/nu-**ú**ma/	[nu**ú**ma]	I seek

(22) Groups B & C

	Input	Output	Gloss
a.	/n**a-í**sa/	[n**é**sa]	they climb
b.	/na-**ú**ma/	[n**aá**ma]	they seek
c.	/wa-**é**ku/	[we**é**ku]	we run

All non-identical vowel sequences in the data begin with either /i/ or /u/. These vowels differ from other Tariana vowels involved in prefixation with regard to height (see (3) in section 2.2), as well as sonority. Sonority measures the amplitude, acoustic energy, or relative loudness of a segment (Trask 1996, Blevins 1995) and is ranked on a hierarchy, with low vowels being highly sonorant and high vowels being of low sonority. The vowel sonority hierarchy is shown in

(23), as defined by Prince & Smolensky (1993), Kenstowicz (1997), and de Lacy (2004). The hierarchy illustrated below includes only those vowels at issue in Tariana.[4]

(23) Vowel sonority hierarchy

more sonorous ↑	low *a* ∧ mid *e, o* ∧ high
less sonorous	*i, u*

In reference to (23), output pro-root vowel sequences in Tariana only begin with the least sonorant vowels (21a-d), or are comprised of vowels of equal sonority (21e-f). I propose that this generalization be analyzed as a restriction on sequences of falling sonority in Tariana pro-root environments.

The proposal that sonority is at work in determining vowel sequence restrictions carries a significant implication. The domain of sonority is the syllable (Clements 1990, Zec 1995). In other words, syllables are organized based on the sonority of the sounds they contain (Blevins 1995). Therefore, by claiming that Tariana pro-root vowel sequences subsist as a result of adherence to rising sonority, my analysis also implies that they comprise a single syllable. Put plainly, I imply that the sequences of rising sonority that persist in the output are diphthongs, rather than instances of hiatus. The distinction between hiatus and diphthongs cannot be observed based on the forms provided in this thesis, and therefore remains theoretical at this

[4] See de Lacy (2004) for full hierarchy.

point. I predict, however, that acoustic analysis of the data would confirm that the sequences at issue are tautosyllabic. Further discussion of this implication is offered in section 7.3.

Rosenthall (1994) presents the constraint SONFALL, which restricts vowel sequences of rising sonority within a syllable based on data from Lenakel, Luganda, Boumaa Fijian, Spanish, and others. I propose markedness constraint *SONFALL based on generalization (20a). This constraint requires that vowel sequences involved in Tariana pronominal prefixation must not begin with a vowel of higher sonority than the preceding vowel.

(24) *SONFALL: Vowel sequences must not fall in sonority

Examples (21e-f), which are comprised of sequences of equal sonority, also persist in the output. It is not sufficient, therefore, to license only vowel sequences of rising sonority in Tariana. The constraint at work must merely disallow sequences of falling sonority. Tableau (26) shows a set of candidates evaluated by *SONFALL and faithfulness constraint IDENT-IO[F], which works to preserve featural faithfulness (McCarthy and Prince 1995). IDENT-IO[F] is defined in (25).

(25) IDENT-IO[F]: Output correspondents of an input [γF] segment are also [γF].

(McCarthy and Prince 1995)

Tableau (25) shows the evaluation of (22c) /wa-éku/. The vowel sequence in candidate (26a), merits a violation of *SONFALL because it begins with highly sonorant [a] and ends with lower sonorant [e]. Candidate (26b) exhibits a vowel sequence of equal sonority, upholding *SONFALL. Candidate (26b) violates IDENT-IO[F] because the features of its long vowel output are not identical to the input vowels. Candidate (26b) is still deemed optimal, however, indicating that *SONFALL must be ranked higher than IDENT-IO[F]: *SONFALL >> IDENT-IO[F].

(26) Evaluation of /wa-éku/ [weéku] ‘we run’[5]

/wa$_1$-e$_2$ku/	*SONFALL	IDENT-IO[F]
a. wa$_1$e$_2$ku	*!	
☞ b. we$_1$e$_2$ku		*

*SONFALL accounts for unchanged vowel sequences in Group A, because these examples do not exhibit falling sonority upon prefixation and are therefore allowed to maintain input vowel sequences in the output.

Tableau (27) illustrates the evaluation of (21e) /wa-áru/, which exhibits a pro-root vowel sequence that is equal in sonority. Optimal candidate (27a) does not exhibit alternation of the input sequence, upholding IDENT-IO[F]. Neither does it violate *SONFALL, because the persistent vowel sequence is comprised of vowels of equal sonority. Candidate (27b) violates both *SONFALL and IDENT-IO[F], causing it to be fatally eliminated.

(27) Evaluation of /wa-ára/ [waára] ‘we fly’

/wa$_1$-a$_2$ra/	*SONFALL	IDENT-IO[F]
☞ a. wa$_1$a$_2$ra		
b. wa$_1$e$_2$ra	*!	*

A feasible solution to the prohibition of sequences of falling sonority across pro-root boundaries would be to maintain only one of the problematic segments in the output. For example, in relation to tableau (26), a candidate such as [waku] would be considered optimal because it avoids violation of *SONFALL by containing only one vowel from errant input vowel sequence. Such a candidate violates MAXIMALITY (henceforth MAX) (McCarthy and Prince 1995). MAX-IO orders that if a segment is present in the input, it must have a corresponding

[5] Discussion of additional competing candidate [waaku] is offered in section 6.5.1.

segment in the output, and vice versa—in other words, do not delete segments (McCarthy and Prince 1995).

(28) MAX-IO: Every segment of the input has a correspondent in the output. (McCarthy and Prince 1995)

Tableau (29) shows the evaluation of /wa-éku/ based on *SONFALL, IDENT-IO[F] and MAX-IO. Candidate (29a) maintains all input segments and features, upholding MAX-IO and IDENT-IO[F], but fatally violates *SONFALL by virtue of its high-to-low sonority vowel sequence. Conversely, (29b) violates MAX-IO, emerging with only four segments where there were five in the input, but vacuously satisfies *SONFALL and IDENT-IO[F] because it does not maintain corresponding segments with the input. Optimal candidate (29c) violates neither *SONFALL nor MAX-IO, justifying their ranking above IDENT-IO[F]. The ranking at this juncture is therefore: *SONFALL, MAX-IO >> IDENT-IO[F], with equally ranked constraints separated by a dashed line in the tableau.

(29) Evaluation of /wa-éku/ [weéku] 'we run'

/wa_1-$e_2$ku/	*SONFALL	MAX-IO	IDENT-IO[F]
a. wa_1e_2ku	*!		
b. wa_1ku		*!	
☞ c. we_1e_2ku			*

Vowel metathesis is another conceivable means of avoiding a violation of *SONFALL. In relation to the /a/-/e/ sequence of falling sonority in tableau (29), an output candidate could simply invert the vowels so that they become a sequence of rising sonority. Vowel metathesis has not been attested among optimal candidates in Tariana, however, suggesting a highly-ranked instantiation of LINEARITY (hereafter LINEAR) (McCarthy and Prince 1995). LINEAR-IO protects

the linear structure of segments in terms of their relative order, asserting that there must be no change in segment order between the input and output.

(30) LINEAR-IO: S1 reflects the precedence structure of S2, and vice versa. (McCarthy and Prince 1995)

As shown in tableau (31) below, vowel metathesis, constrained by LINEAR-IO, is equally as intolerable as a sequence of falling sonority or segment deletion. Incorrect candidate (31c) upholds *SONFALL with its metathesis of the falling vowel sequence, but it does so by violating LINEAR-IO. Optimal candidate (31d) remains the winner, with its violation of IDENT-IO[F], further proving that IDENT-IO[F] must be ranked low. There is no evidence dictating a strict ranking between these constraints.

(31) Evaluation of /wa-éku/ [weéku] 'we run'

/wa$_1$-e$_2$ku/	*SONFALL	MAX-IO	LINEAR-IO	IDENT-IO[F]
a. wa$_1$e$_2$ku	*!			
b. wa$_1$ku		*!		
c. we$_1$a$_2$ku			*!	
☞ d. we$_1$e$_2$ku				*

In relation to the input /wa-éku/ in tableaux (26), (29), and (31), I have not yet shown why [waaku], or other candidates exhibiting alternatives to falling /a/-/e/ are not optimal. This issue falls under generalization (20c), to be discussed in depth in section 6.5.

To summarize section 6.3, upon pro-root affixation, Tariana allows sequences of rising or equal sonority to remain in the output. Sequences of falling sonority are disallowed, and therefore subject to sound alternation in the output.

6.4 Coalescence

This section of my analysis addresses generalization (20b): coalescence occurs in the output when the input sequence is comprised of /a/-/i/ and /i/-/i/, resulting in [e] and [i], respectively. In section 6.4.1, I show that the quality of the coalesced output, mid vowel [e], is a result of its height adjacency to both low /a/ and high /i/. In 6.4.2, I propose further that a monophthong results from coalescence of input sequences /a/-/i/ and /i/-/i/, because /i/ carries no mora in Tariana when it is the first vowel in a root.

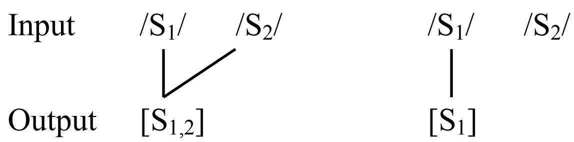
Group B, shown again in (32), exemplifies generalization (20b). Example (32c) contains an input sequence of identical vowels, /i/-/i/, which retain their quality in coalesced output [i]. Examples (32a) and (32b) contain /a/-/i/ input sequences. Because /a/-/i/ is a sequence of falling sonority, which is prohibited by *SONFALL, sound alternation is expected to occur. Coalesced output [e] results from these examples, different in quality from both input vowels.

(32) Group B: $V_1+V_2 \rightarrow V_{1,2}$

	Input	Output	Gloss
a.	/n**a-í**sa/	[n**é**sa]	they climb
b.	/n**a**-h**í**ma/	[nh**é**ma]	they hear
c.	/d**i**-h**í**ma/	[dh**í**ma]	he hears

It is important to note that there are two potential outputs behind the monophthong resulting from /a/-/i/ input sequences: either it is a coalesced version of the input vowels that preserves both input segments (33a), or a segment has been deleted and the output vowel does not correspond to both input segments (33b). When an output segment is a coalesced instantiation of two input segments, it does not violate MAX-IO, because both segments persist in the coalesced form (Kager 1999).

(33) a. <u>Coalescence</u> b. <u>Deletion</u>



As a product of the coalescence illustrated in (33a), mid vowel [e] contains features of both input vowels: low /a/, and high /i/. The shared features are indicated by the shaded portions of the matrix illustrated in (34), which shows that mid vowel [e] is comprised of the [-high] value of /a/, and the [-low] value of /i/.

(34) Shared height features

[a]	[e]	[i]
-hi	-hi	+ hi
+ low	-low	-low

Coalescence of high and low vowels to a mid-vowel is widely attested process cross-linguistically (Blackfoot (Frantz 1997), Sanskrit (Gnanadesikan 1997), Ciayo (Ngunga 2000), Japanese (Hiriyama 2003), and many Niger-Congo languages (Casali 1996)). The faithfulness constraint that bans coalescence from input to output is called UNIFORMITY (henceforth UNIFORM) (McCarthy and Prince 1995).

(35) UNIFORM-IO: No element of S2 has multiple correspondents in S1. (McCarthy and Prince 1995)

Tableau (36) illustrates the addition of UNIFORM-IO as a regulator for coalescence in relation to the input /na-ísa/. Candidates (36b) and (36c) are phonetically identical, exhibiting the same form, [nésa], but are theoretically distinct. Candidate (36b) does not contain both input vowel segments, in violation of MAX-IO. Optimal candidate (36c) does not violate MAX-IO

because it contains both segments of the input vowels, but it does violate UNIFORM-IO, illustrating the necessity of the ranking of MAX-IO over UNIFORM-IO. Critically, *SONFALL and MAX-IO both cause fatal violations, meaning they need not be ranked strictly.

(36) Evaluation of /na-ísa/ [nésa] 'they climb'

$/na_1\text{-}i_2sa/$	*SONFALL	MAX-IO	UNIFORM-IO
a. na_1i_2sa	*!		
b. ne_1sa		*!	
☞ c. $ne_{1,2}sa$			*

Based on the analysis presented thus far, a coalesced candidate is predicted to be optimal over a candidate that exhibits deletion of an input segment. At this point, no explanation has been presented substantiating the optimality of (36c), [nésa], over coalesced candidates exhibiting alternate vowels on the surface (e.g. [nisa], [nasa]). This issue is addressed in the next section.

6.4.1 Ternary vowel height adjacency

Tableau (37) shows the evaluation of /na-ísa/, considering (37d) [nésa] alongside other candidates exhibiting coalescence. Candidates (37b) and (37c) violate UNIFORM-IO, but uphold MAX-IO through coalescence of segments, making them competitors for optimality with correct candidate (37d). Candidates incorrectly evaluated as optimal, or errantly competing with optimal candidates are indicated in the tableau with the ☹ symbol.

(37) Incorrect evaluation of /na-ísa/ [nésa] ‘they climb’

/na$_1$-i$_2$sa/	*SonFall	Max-IO	Uniform-IO
a. na$_1$i$_2$sa	*!		
❽ b. na$_{1,2}$sa			*
❽ c. ni$_{1,2}$sa			*
☞ d. ne$_{1,2}$sa			*

The optimality of (37d) suggests that coalescence of a high and low vowel that results in a mid vowel must be more optimal than coalescence of a high and low vowel resulting in either a high or low vowel.

Gnanadesikan (1997) uses OT to account for a similar instance of mid vowel coalescence in Sanskrit, in which sequences of /a/-/i/ result in [ee]. She argues that the featural makeup of mid vowels, the fact that they group with low vowels in that they are [-high], and high vowels in that they are [-low], suggests that vowel height distinctions ought to be evaluated based on a ternary scale rather than with binary features. Her proposed vowel height scale is illustrated in (38).

(38) Vowel height scale:

High
Λ
Mid
Λ
Low

(Gnanadesikan 1997: 2)

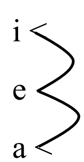
The order of the vowel height (VH) scale is based on adjacency. Mid is adjacent to both Low and High, but Low and High are not adjacent to each other. In this sense, Mid and High form a class, as do Mid and Low. Additionally, Mid represents the most logical compromise between High and Low (Gnanadesikan 1997).

Gnanadesikan (1997) explains that within a ternary scale framework, the key to coalescence in OT is the application of scalar faithfulness constraints on both segments of the input. In other words, the coalesced output that emerges does so by upholding a certain degree of faithfulness to both input segments. Gnanadesikan proposes a pair of featural faithfulness constraints Ident-Adjacency[X] and Indentity[X] (hereafter Indent-Adj[X] and Indent[X]), which work to preserve scalar adjacency. Indent[X] calls for no featural change whatsoever between input and output correspondents on the scale X. Ident-Adj[X] calls for minimal featural change between input and output correspondents on the scale X, maintaining that an output must not move more than one value on the scale X from the input.

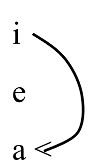
Figure (39) illustrates ternary vowel height adjacency as is relates to the output deemed optimal in both Sanskrit and Tariana, mid-vowel [e], versus a suboptimal output, high-vowel [i], from the input sequence /a/-/i/. Example (39a) shows that output [e] is adjacent on the VH scale to both of its corresponding input segments, /a/ and /i/. In (39b), [i] is identical and therefore perfectly adjacent to input segment /i/, but it is not adjacent to input /a/. Output [i] has essentially ‘moved’ more than one value away from /a/ on the VH scale.

(39) Ternary vowel height adjacency

a. [e] is adjacent to both /a/ and /i/



b. [i] is identical to /i/, but not adjacent to /a/



With respect to the VH scale, Gnanadesikan defines the constraints controlling mid-vowel coalescence as follows.

(40) IDENT[VH]: Given an input segment α and its correspondent output segment β, then α and β have identical values on the VH scale (Gnanadesikan 1997)

(41) IDENT-ADJ[VH]: Given an input segment α and its correspondent output segment β, then α and β must have related values on the VH scale, where the defined relation is adjacency (Gnanadesikan 1997)

Gnanadesikan (1997) maintains that IDENT-ADJ[VH] must be ranked higher than IDENT[VH]. Such ranking allows for neutralization between a high and low vowel sequence when IDENT[VH] cannot be perfectly preserved as dictated by other constraints.

I adopt ternary scalar faithfulness constraints, proposed by Gnanadesikan, in order to account for instances of coalescence in Tariana, as shown in tableau (42) below. The input in (42) contains a sequence of a low and high vowel, which is prohibited by high-ranking *SONFALL. Candidate (42a), by neutralizing to mid vowel [e], maintains its adjacency to both input correspondents on the VH scale, in keeping with IDENT-ADJ[VH]. Candidate (42a) earns two violations of IDENT[VH], however, because neither input segment 'heights' are identically preserved in the output. Candidate (42b), exhibiting coalescence to high vowel [i], violates IDENT-ADJ[VH] with respect to input low vowel /a/. IDENT[VH] is only violated once by (42b), however, because it preserves the height value of one of the input vowels.

(42) Evaluation of /na-ísa/ [nésa] ‘they climb’

/na_1-$i_2$sa/	IDENT-ADJ[VH]	INDENT[VH]
☞ a. $ne_{1,2}$sa		**
b. $ni_{1,2}$sa	*!	*

The optimality of candidate (42a) shows Tariana’s preference for neutralization of vowel sequences, where neither output segment is drastically far from its input on the VH scale, over preservation of their exact vowel height. This substantiates the ranking of IDENT-ADJ[VH] over IDENT[VH].

An additional candidate, [noma], deserves mention in relation to tableau (42), as [o] is also a mid-vowel ([-high, -low]) and therefore would not violate IDENT-ADJ[VH] with respect to input sequence /a/-/i/. Mid-vowel [o] (/ɵ/ in IPA) differs from [e] in Tariana in that it is a central ([-front, -back]) rather than front vowel ([+front, -back]). I limit the proposal of constraints in this analysis to pertain to the inventory of vowels attested across pro-root boundaries, which [o] is not part of (see section 2.2). However, I assume that [o] does not emerge in this environment due to a set of markedness constraints working in *Local Conjunction* (Smolensky 1993). Within *Local Conjunction*, a candidate only earns an overall violation if it violates each constraint comprising a set. With respect to the prohibition of output [o], such a set could be comprised of constraints targeting the features [-front], [-high], and [-low].

6.4.2. Moraic faithfulness

While VH adjacency accounts for the optimal quality of the output vowel [e], emerging from the low-high vowel sequence /a/-/i/, a further issue warrants explanation in relation to

generalization (20b). Recall from 6.4.1, Sanskrit /a/-/i/ sequences evaluated with IDENT-ADJ[VH] and IDENT[VH] result in bimoraic [ee] outputs (Gnanadesikan 1997). Why, in contrast, does Tariana prefer a monomoraic output over a bimoraic output in relation to the input vowel sequences /a/-/i/ and /i/-/i/? Tableau (43) illustrates this issue with respect to input /na-ísa/. Both output candidates, monomoraic (43a) and bimoraic (43b), uphold IDENT-ADJ[VH], and violate IDENT[VH] equally, with no winner emerging. This scenario suggests an additional constraint that renders the short vowel of (43a) optimal in Tariana /a/-/i/ sequences. In this thesis, bimoraic coalesced vowels are denoted by the diacritic symbol (V:$_{1,2}$), as shown in (43b).

(43) Incorrect evaluation of /na-ísa/ [nésa] 'they climb'

/na$_1$-i$_2$sa/	IDENT-ADJ[VH]	INDENT[VH]
☞ a. ne$_{1,2}$sa		**
❽ b. ne:$_{1,2}$sa		**

Crucially, coalescence resulting in a monophthong only occurs in Tariana pronominal prefixation when /i/ is the first vowel of the root in the input sequence. This pattern can be seen in the examples comprising Group B, listed again in (44) below. In (44a) and (44b), input vowel sequence /a/-/i/ results in monomoraic outputs. Notice that in (44c), /h/ is the root initial segment in the input, followed by /i/. Candidates exhibiting root-initial /h/ will be fatally eliminated, however, based on a high-ranking markedness constraint to be discussed in 6.6. The important pattern to note in (44) is that when /i/ is the root-initial vowel, in spite of intervening /h/, a monophthong emerges in the output.

(44) Group B (restated)

	Input	Output	Gloss
a.	/na-ísa/	[nésa]	they climb
b.	/na-híma/	[nhéma]	they hear
c.	/di-híma/	[dhíma]	he hears

The data in (44) show that when /i/ is the root vowel in a sequence /V/-/i/, a monomoraic, rather than bimoraic, output occurs. I propose that this pattern indicates that input sequences /V/-/i/ are monomoraic. Proposing a lack of mora in the input is allowable in OT based on *Richness of the Base*, which asserts that grammatical inputs are universal and unlimited (Prince and Smolensky 1993).

An alternative analysis could claim that these sequences are bimoraic, and that a mora is deleted between the input sequence and output monophthong. Such a scenario could be accounted for by a faithfulness constraint penalizing a candidate for mora deletion. One would then have to say, however, that each optimal monophthong output violates faithfulness because it emerges from a bimoraic input sequence. In contrast, by claiming that the input sequences are monophthongs, each optimal monomoraic output upholds moraic faithfulness. I maintain the latter claim in this analysis because it aligns with *Lexicon Optimization*, which states that languages will choose the most harmonic, or efficient mapping behind a given output (Prince and Smolensky 1993). It is more efficient to claim that the monophthongs produced by the separate sequences in (44) exhibit no change in moraicity, than to maintain that moraic change occurs in each example.

Following from the claim that the vowel sequence /V/-/i/ is monomoraic, one of the input vowel segments, either that of the prefix or the root, must not carry a mora. I ascribe the lack of

mora in /V/-/i/ sequences to the root-initial /i/, rather than the prefix-final vowel. To illustrate the alternative, in (44a) if the lack of mora were attributed to the prefix vowel /a/ in the sequence /a/-/i/, a monomoraic output would be expected from all /a/-/V/ sequences. This prediction is not upheld in the data, however. Prefix input /a/ can produce bimoraic outputs as seen in examples such as /na-úma/ (8a), which surfaces as [naáma]. If /a/-/u/ in (8b) were monomoraic, a mora would have to be added in the output in order to arrive at bimoraic output [aa]. Based on this example, and in adherence to *Lexicon Optimization,* it is more efficient to say that /i/ carries no mora as the root-initial vowel, rather than maintaining that prefix vowels carry no moras.

My claim that /i/ carries no mora when found in the root-initial position of the input in Tariana, implies that monophthongs emerging from /V/-/i/ sequences result from preservation of moraic faithfulness. Moraic faithfulness maintains that the same number of moras exist in the input as in the output (Morén 2001), as schematized in Figure (45). Figure (45a) shows the monomoraic input /a/-/i/ sequence, wherein only prefix /a/ carries a mora, resulting in monomoraic [e]. Figure (45b) shows the bimoraic sequence [e:] emerging from a heavy instantiation of /a/-/i/, wherein both /a/ and /i/ carry moras.

(45) Vowel sequence /a/-/i/: monomoraic vs. bimoraic

a. /μ/ → [μ]　　b. /$\mu\mu$ / → [$\mu\mu$]

/a/$_\mu$ /i/　　/a/$_\mu$ /i/$_\mu$

[e]$_\mu$　　[e:]$_{\mu\mu}$

Based on my proposal that /i/ is nonmoraic when it is the first vowel in a root, the sequence /a/-/i/ in Tariana patterns after (45a.) Therefore, the emergence of an extra mora in the

coalesced output [eː] would violate faithfulness in terms of moraic IDENTITY. The constraint governing this type of IDENTITY is defined in (46) below.

(46) IDENT-μ-IO: Correspondent segments have the same moraicity. (Morén 2001, Itô and Mester 1999)

Tableau (47) shows the evaluation of /na-ísa/ with IDENT-μ-IO, repairing the optimality evaluation from (43). Again, the input exhibits what is considered in Tariana a monomoraic vowel sequence upon affixation, due to the lack of mora in root /i/. Optimal candidate (47a) does not violate IDENT-μ-IO because its corresponding short vowel is also monomoraic. Candidate (47b) violates IDENT-μ-IO because it contains a bimoraic, long vowel. IDENT-μ-IO is undominated at this point.

(47) Evaluation of /na-ísa/ [nésa] 'they climb'

/na$_{\mu}$-isa/	INDENT-μ-IO	IDENT-ADJ[VH]	INDENT[VH]
☞ a. ne$_{\mu}$sa			**
b. neː$_{\mu\mu}$sa	*!		**

The coalescence of identical input vowels /i/-/i/ in example (32g) to monophthong [i] is also accounted for by IDENT-μ-IO, as seen in tableau (48). The input sequence in (48) is monomoraic, based on my proposal that input /i/ carries no mora when it is the root-initial vowel. Both output candidates (48a) and (48b) maintain featural identity with the input vowels, upholding IDENT-ADJ[VH] and IDENT[VH]. Optimal (48a) also adheres to IDENT-μ-IO because its coalesced vowel is monomoraic, whereas candidate (48b) fatally violates IDENT-μ-IO because it exhibits a bimoraic coalesced vowel. Note that tableau (48) shows an example of vowel alternations occurring alongside *h*-metathesis in the same form, a process to be addressed in section 6.6.

(48) Evaluation of /di-híma/ [dhíma] 'he hears'

/di$_{\mu}$-hima/	INDENT-μ-IO	IDENT-ADJ[VH]	INDENT[VH]
☞ a. dhi$_{\mu}$ma			
b. dhi:$_{\mu\mu}$ma	*!		

IDENT-μ-IO serves a dual purpose in Tariana prefix-root affixation. It not only prevents output candidates containing more moras than are found in the input, it also prevents output candidates that do not contain all input moras. Adherence to moraic faithfulness also results in the bimoraic vowels emergent in Group C, to be discussed in the next section.

In summary, section 6.4 shows that the quality of coalesced outputs produced in Group B results from adjacency to input vowels on the ternary vowel height scale. Additionally, because I propose that root-initial /i/ does not carry a mora in the input, the monomoraicity of coalesced outputs is ascribed to an adherence to moraic faithfulness.

6.5 Vowel elision

In this section I analyze generalization (20c): vowel elision occurs and long vowels emerge in the output when input sequences consist of /a/-/u/ or /a/-/e/. In section 6.5.1, I show that vowel elision in Tariana pronominal prefixation is constrained by faithfulness to the backness feature of the root vowel, and in section 6.5.2, I show that it is also dependent on a markedness constraint discouraging [+high] vowel outputs.

Group C, restated in (49) below, exemplifies generalization (20c). Each input vowel sequence in (49) results in a long vowel, but there does not appear to be a cohesive pattern

dictating which vowel, that of the prefix or the root, persists in the output. The input prefix vowel remains in the output in (49a), and the root vowel remains in (49b).

(49) Group C: $V_1+V_2 \rightarrow V_1V_1$, V_2V_2

	Input	Output	Gloss
a.	/na-**ú**ma/	[na**á**ma]	they seek
b.	/wa-**é**ku/	[we**é**ku]	we run

IDENT-μ-IO accounts for the bimoraic nature of the vowel outputs emerging from the bimoraic input sequences in Group C, because a monomoraic output from a bimoraic input would violate IDENT-μ-IO. The quality of the output vowels, however, remains unexplained. I propose that this data exhibits vowel elision, in which the features of either V_1 or V_2 in a sequence are lost upon affixation (Casali 1996). Vowel elision is often systematic in relation to hiatus resolution. For example, in Kinande, root vowels are always persistent and prefix vowels are lost (Clements 1991). Following this assumption, vowel elision appears to be unsystematic in Tariana, meaning persistence of the prefix versus root vowel varies, and must therefore be dependent on factors beyond vowel position. I discuss these factors in sections 6.5.1 and 6.5.2.

6.5.1 Root faithfulness

Shown in (49a), the low-high vowel combination of /a/-/u/ results in [aa], wherein the root vowel undergoes elision. Based on the ternary scale adjacency constraints explained in section 6.4.1, a mid-vowel coalescence would be predicted here, as illustrated in tableau (50). The errant winner (50b), upholds IDENT-ADJ[VH], where optimal (50c) fatally violates it. The optimality of (50c) suggests that there must be an additional constraint rendering the neutralization of /a/-/u/ to mid vowel [e] less tolerable than an adjacency violation.

(50) Incorrect evaluation of /na-úma/ [naáma] 'they seek'

/na_1-$u_2$ma/	*SONFALL	IDENT-ADJ[VH]	INDENT[VH]
a. na_1u_2ma	*!		
❽ b. ne:$_{1,2}$ma			**
☞ c. na_1a_2ma		*!	*

The constraint governing the optimal output persistence of the prefix vowel in (50) must also allow for the optimal persistence of the root vowel with respect to input /wa-éku/, shown in tableau (51). Candidate (51a) is eliminated based on its falling-sonority sequence [au], but candidates (51b) and (51c) remain tied, preserving root and prefix vowels, respectively. This points toward a constraint that accounts for the emergence of [ee] over [aa] in relation to the input sequence /a/-/e/.

(51) Incorrect evaluation of /wa-éku/ [weéku] 'we run'

/wa_1-$e_2$ku/	*SONFALL	IDENT-ADJ[VH]	INDENT[VH]
a. wa_1e_2ku	*!		
☞ b. we_1e_2ku			*
❽ c. wa_1a_2ku			*

I propose that the constraint militating against suboptimal (51b) and (51c) has to do with the preservation of root vowel backness. My basis for this proposal is evidenced by a pattern that emerges in example (49b), /wa-éku/, illustrated in (52) in order to isolate the segments at issue along with their backness features. The schema in (52) shows that output vowel segments maintain the backness feature of the input root vowel.

(52) Backness breakdown of /wa-éku/ [weéku] 'we run'

Input: /a/ /e/

[+bk] [-bk]

Output: [ee]

[-bk]

The faithfulness of root backness is perhaps obscured in this example by the fact that the output in (52) is faithful to all features of the input root vowel. Further evidence supporting faithfulness to the feature [αback], rather than total root identity, is presented later in this section.

Morphologically Dispersed Faithfulness asserts that there is a universal preference for maintaining faithfulness to the root over maintaining affix faithfulness (McCarthy & Prince 1995). Root faithfulness can be interpreted more specifically within a constraint. For example, Pater (1999) proposes ROOTLIN-IO in relation to Indonesian nasal substitution, emphasizing the importance of preserving the precedence structure of the root, over preserving the structure of the whole form in general. Also, ROOT-IDENT[ATR] is utilized in accounting for preservation of the [αATR] feature of the root vowel in Yorùbá vowel harmony (Bakovic 2000, Perkins 2005). The observed pattern among Tariana outputs in Group C leads to my proposal of a constraint that maintains input root-vowel identity in the output, specifically in relation to the feature [αback].

(53) ROOTIDENT[αbk]-OI: Output segments must maintain values of input segments of root with respect to the feature [back][6]

Tableau (54) shows an evaluation of /wa-éku/ by ROOTIDENT[αbk]-OI. Candidate (51c) is the winner, in spite of its violation of IDENT-ADJ[VH]. Candidate (51b) is eliminated because

[6] In relation to featural faithfulness constraints, the specification of 'OI' indicates consideration of faithfulness in a particular direction—from output to input.

it contains [+back] long vowel [aa], which does not maintain the [-back] feature of the root vowel /e/.

(54) Evaluation of /wa-éku/ [weéku] ‘we run’

	/wa$_1$-e$_2$ku/	*SONFALL	RTIDENT[αbk]-OI	IDENT-ADJ[VH]	INDENT[VH]
	a. wa$_1$e$_2$ku	*!			
	b. wa$_1$a$_2$ku		*!		*
☞	c. we$_1$e$_2$ku			*	*

It is crucial that ROOTIDENT[αbk]-OI rank above IDENT-ADJ[VH], ensuring that errant candidate (54b) will be eliminated before optimal (54c) violates IDENT-ADJ[VH]. No necessity exists for a strict ranking between ROOTIDENT[αbk]-OI and *SONFALL, as candidates violating ROOTIDENT[αbk]-OI will only emerge as alternatives to sequences of falling sonority.

It is not sufficient to say that long vowels in the output maintain complete featural identity with the root input vowel, as shown by example (49a), /na- úma/. In this example, re-illustrated in (55), the long vowel in the output is featurally identical to the input prefix vowel, but crucially, still maintains the backness feature of the root vowel.

(55) Backness breakdown of /na-úma/ [naáma] ‘they seek’

Input: /a/ /u/

[+bk] [+bk]

/

Output: [aa]

[+bk]

Tableau (56) shows the reevaluation of /na-úma/ with the addition of ROOTIDENT[αbk]-OI. Tableau (56) addresses the issue brought up in 6.4.1, why candidate (56b) is suboptimal in spite of upholding IDENT-ADJ[VH]. Candidate (56b) coalesces to [eː], which is [-back], from an

input sequence containing root vowel /u/, which is [+back]. In so doing, candidate (56b) violates ROOTIDENT[αbk]-OI, as does its uncoalesced counterpart (56d). Candidate (56c), exhibiting [+back] vowel [aa], is deemed optimal because it does not violate ROOTIDENT[αbk]-OI.

(56) Evaluation of /na-úma/ [naáma] 'they seek'

$/na_1$-$u_2ma/$	*SONFALL	RTIDENT[αbk]-OI	IDENT-ADJ[VH]	INDENT[VH]
a. na_1u_2ma	*!			
b. $ne{:}_{1,2}ma$		*!		**
☞ c. na_1a_2ma			*	*
d. ne_1e_2ma		*!		**

Tableau (56) demonstrates the dispreference for the occurrence of mid-vowel [e] with respect to the /a/-/u/ sequence. Note that the candidate [no_1o_2ma] exhibiting mid-vowel [o], which is [-back] in Tariana (/ɵ/ in IPA), would also be eliminated by ROOTIDENT[αbk]-OI in relation to the input sequence in (56).[7]

A question remains, however: given that both /a/ and /u/ are [+back], why is [naama] which maintains prefix /a/, optimal over [nuuma], which maintains root vowel /u/? In the next section, I propose that the answer to this question has to do with vocalic feature [+high].

6.5.2 Avoidance of [+high]

With respect to the evaluation of (49a) /na-úma/, consideration of incorrect candidate [nuuma], illustrates the necessity for the ranking of a further markedness constraint, shown in tableau (57). The input vowel sequence in (57) is comprised of prefix /a/ and root /u/, which are

[7] A candidate [nooma], wherein [o] is [+back] in accordance with IPA, could also be considered here. This vowel is not attested in Tariana's vowel inventory (Aikhenvald 2003), and I assume its emergence is prohibited based on markedness constraints, perhaps working in *Local Conjunction* to target the features [+back], [-high], [-low].

both [+back], and could therefore lead to outputs with either vowel emerging without violating ROOTIDENT[αbk]-OI. This issue is illustrated in tableau (57), wherein suboptimal candidate (57d) is tied with optimal candidate (57c). Neither violate *SONFALL or ROOTIDENT[αbk]-OI, and both are in equal violation of the ternary IDENTITY set.

(57) Incorrect evaluation of /na-úma/ [naáma] 'they seek'

	/na$_1$-u$_2$ma/	*SONFALL	RTIDENT[αbk]-OI	IDENT-ADJ[VH]	INDENT[VH]
	a. na$_1$u$_2$ma	*!			
	b. ne:$_{1,2}$ma		*!		**
☞	c. na$_1$a$_2$ma			*	*
❽	d. nu$_1$u$_2$ma			*	*

The feature that distinguishes between optimal candidate (57c) and suboptimal (57d) is vowel height. In this scenario, Tariana opts for [+back, -high] output [a], over [+back, +high] output [u]. I propose that this suggests a low-ranked dispreference for outputs containing the vocalic feature [+high]. The constraint *[+high] is presented by Kager (1999) as a means of discouraging the feature [+high] in relation to Lenakel vowel epenthesis. I adopt this constraint, as it is defined below.

(58) *[+high]: assign a penalty for each occurrence of a vowel with the feature [+high]

Tableau (59) isolates the competing [+back] candidates from tableau (57) above and shows the addition of the constraint *[+high]. Suboptimal (59b) is eliminated with its violation of *[+high], solidifying the optimality of (59a).

(59) Reevaluation of /na-úma/ [naáma] 'they seek'

	/na_1-$u_2$ma/	RTIDENT[αbk]-OI	IDENT-ADJ[VH]	INDENT[VH]	*[+high]
☞	a. na_1a_2ma		*	*	
	b. nu_1u_2ma		*	*	*!

The *[+high] constraint must be ranked low in Tariana because the occurrence of high vowels upon prefixation is not prohibited outright in the language, indicating that the constraint is dominated. Justification of the ranking of *[+high] below IDENT[VH] can be seen in the evaluation of /du-hépa/ in tableau (60). Optimal candidate (60a) maintains a high vowel in the output, violating *[+high]. This violation must not fatally eliminate (60a) before competing candidate (60b) violates IDENT[VH], which it would if *[+high] were ranked any higher. Note that *h*-metathesis (see section 6.4) occurs alongside vowel elision in tableau (60).

(60) Evaluation of /du-hépa/ [dhuépa] 'she answers'

	/du_1-he_2pa/	RTIDENT[αbk]-OI	IDENT-ADJ[VH]	INDENT[VH]	*[+high]
☞	a. dhu_1e_2pa				*
	b. dhe_1e_2pa			*!	

To summarize section 6.5, vowel elision occurs upon affixation in Group C, wherein features of either the prefix or root vowel are lost in the output. The long vowel output that emerges is determined based on its preservation of the [αback] feature of the input root vowel, and dispreference for the feature [+high].

6.6 *h*-metathesis

In this section I discuss *h*-metathesis as an alternation that often occurs in conjunction with Tariana vowel processes, as seen in tableaux (48) and (60). I argue that root-initial /h/ in the input inverts with the prefix vowel in the output in order to avoid sequences of [Vh]. Group D, shown again in (61), exemplifies *h*-metathesis, wherein the input prefix vowel and root-initial /h/ invert in the output.

(61) Group D: (C)V+*h*→(C)*h*V

	Input	Output	Gloss
a.	/na-hima/	[n**hé**ma]	they hear
b.	/wa-hépa/	[wheépa]	he hears
c.	/i-hemátha/	[hiemátha]	you shout

Glottal metathesis is widely attested cross-linguistically: Cherokee (Flemming 1996), Blackfoot (Frantz 1997), Cayuga (Blevins and Garret 1998), Nłeʔkepmxcin (Thompson River Salish) (Thompson et. al 1996), Estonian (Kiparsky 1967), and many others. Cases have been made in the literature for the phonetic motivation of metathesis (Blevins and Garrett 1998, Côté 1997, Flemming 1996, Hume 1998, 2001, 2004). Metathesis can occur based on the acoustic and auditory features of the segments involved, creating more optimal sequences with respect to the phonetic patterns existing in the language (Hume 2004). In OT, disfavored segment clusters can trigger metathesis, at the expense of violating the sequential structure-preserving constraint LINEAR-IO. Cluster constraints, proposed by Wheeler (2005) in relation to consonant cluster reduction in Catalan, militate against unfavorable combinations of segments based on their features.

Flemming (1996) proposes a cluster constraint governing glottal metathesis in Cherokee, *[s.g., son]. This constraint discourages breathy sonorants produced upon affixation by the featural sequence [+spread glottis, +sonorant]. Specification of the feature [+spread glottis] isolates the glottal fricative /h/ in Cherokee. Following Flemming, I propose that Tariana has a dispreference for the sequence [+syllabic, +spread glottis]. Such a sequence would produce aspirated vowels in Tariana, which are not attested (Aikhenvald 2003). My adaptation of *[s.g., son], narrows down the class of sonorants to vowels specifically, because Tariana does license aspirated nasals (61a) and approximants (61b) upon prefixation, which are both [+sonorant]. Also, because /h/ is the only glottal consonant in Tariana, I refer to it specifically in the cluster constraint proposed in (62).

(62) *V*h*: a segment with the feature [+spread glottis] must not follow a segment with the features [+sonorant, +continuant]

Tableau (63) shows an evaluation of /du-hépa/, pitting *V*h* against anti-metathesis constraint LINEAR-IO, as defined earlier in section 6.3. Candidate (63a) maintains input structure in the output, but fatally violates *V*h*. Optimal candidate (63b) incurs a LINEAR-IO violation, exhibiting metathesis of the input vowel and root-initial /h/, but avoids the unfavorable [Vh] sequence.

(63) Evaluation of /du-hépa/ [dhuépa] ‘she answers’

/du_1-$h_2$epa/	*V*h*	LINEAR-IO
a. du_1h_2epa	*!	
☞ b. dh_2u_1epa		*

The fact that metathesis is preferred to sequences of [Vh] indicates that LINEAR-IO must be ranked lower than *V*h*. It is not sufficient to merely rank *V*h* higher than LINEAR-IO in its

current position. This is illustrated by tableau (64), which shows that a violation of LINEAR-IO (64a) is more acceptable than a violation of MAX-IO (64c), necessitating a strict ranking between the two.

(64) Evaluation of /du-hépa/ [dhuépa] 'she answers'

/du$_1$-he$_2$pa/	*V*h*	MAX-IO	LINEAR-IO
☞ a. dhu$_1$e$_2$pa			*
b. du$_1$he$_2$pa	*!		
c. du$_1$e$_2$pa		*!	

LINEAR-IO must be ranked high enough to disallow vowel metathesis as a solution to *SONFALL, discussed in 6.3, in candidates that do not have /h/ as the root-initial input. An example of this scenario is shown the evaluation of /na-úma/ in tableau (65). Candidate (65c) exhibits metathesis of the errant, sonority-falling vowel sequence, resulting a LINEAR-IO violation. LINEAR-IO must be ranked higher than IDENT-ADJ[VH] because this violation must eliminate suboptimal (65c) before optimal (65a) violates IDENT-ADJ[VH].

(65) Evaluation of /na-úma/ [naáma] 'they seek'

	/na$_1$-u$_2$ma/	*SONFALL	LINEAR-IO	IDENT-ADJ[VH]	INDENT[VH]
☞	a. na$_1$a$_2$ma			*	*
	b. na$_1$u$_2$ma	*!			
	c. nu$_1$a$_2$ma		*!		

To summarize section 6.6, optimal output candidates exhibit *h*-metathesis when a prefix vowel aligns with root-initial /h/ in the input. This results from Tariana's prohibition of [Vh] sequences upon pronominal prefixation. Considering *h*-metathesis in conjunction with the vowel alternations in this analysis leads to the adapted ranking: *V*h*, *SONFALL, MAX-IO,

INDENT-μ-IO, ROOTIDENT[αbk]-OI >> LINEAR-IO >> IDENT-ADJ[VH] >> INDENT[VH] >> *[+high], UNIFORM-IO, IDENT-IO[F]. Full tableaux of the following examples are shown in appendix B: /wa-áru/ [waáru] 'we fly'; /na-ísa/ [nésa] 'they climb'; /di-híma/ [dhíma] 'he hears'; /na-úma/ [naáma] 'they seek'; /wa-éku/ [weéku] 'we run'; /du-hépa/ [dhuépa] 'she answers'.

7. Conclusion

7.1 Summary

This thesis has presented an account of the vowel alternations that occur between Tariana pronominal prefixes and verb roots. The data presented show that vowel sequences formed upon prefixation either undergo no change, surface as a coalesced monophthong, or are subject to vowel elision and produce long vowels. Additionally, metathesis occurs between a prefix vowel and root-initial /h/ when they are aligned by morpheme concatenation. My analysis reinterpreted Tariana pro-root vowel alternations using an OT framework. The previous analysis approaches the data from a linear perspective, describing the sound alternations as the results of two sets of ordered rules: *h*-metathesis feeding vowel fusion. OT analysis accounts for the vowel alternations described by these independently-motivated rules, while also showing that the alternations are functionally unified, each being prompted by Tariana's avoidance of hiatus.

Within this analysis, I have shown that vowel sequences occurring upon pronominal prefixation cannot fall in sonority. Output vowel sequences must be of equal or rising sonority from V_1 to V_2. Coalescence of the input sequence /a/-/i/ to output [e] transpires based on vowel height adjacency on a ternary scale. Coalesced outputs are monomoraic in preservation of the moracity of input /V/-/i/ sequences, under the assumption that /i/ carries no mora as the first

vowel in the root. Vowel elision occurs and long vowel outputs emerge from input sequences of falling sonority based on faithfulness to the backness feature of the root, as well as adherence to a dispreference for the feature [+high]. Together coalescence and vowel elision alternations work to resolve sequences of falling sonority deemed unfavorable by Tariana. The metathesis that happens in conjunction with these vowel processes results from Tariana's prohibition of [Vh] output sequences upon prefixation.

7.2 Theoretical support

My analysis of Tariana sound alternations offers corroboration for previous proposals in OT and in phonological theory more generally. In this section, I discuss four theoretical concepts that my analysis supports.

First, the high-ranking of ROOTIDENT[αbk]-OI shows a preference in Tariana for preservation of a root feature over that of the prefix in pro-root environments. In so doing, my analysis offers support for the concept of *Morphologically Dispersed Faithfulness* (McCarthy & Prince 1995). This notion, which proposes a universal inclination for the preservation of root properties (i.e. segments, features, prosodic elements) over those of an affix, holds true in Tariana with respect to the root feature [αback].

Second, the mid-vowel coalescence exhibited by Tariana and described by my analysis provides support for the sufficiency of the ternary scalar model presented by Gnanadesikan (1997) (section 6.4.1). Mid-vowel coalescence can also be described in OT analyses as resulting from preservation of the identity of features based on binary vowel height constraints: [-low] and [-high] ranked over [+low] and [+high] (Casali 1996, Tanner 2007). Gnanadesikan offers an

efficient alternative analysis of vowel height coalescence that does not rely on binary features. She argues that, based on weaknesses in the vowel height binary system (i.e. the absence of the fourth natural class [+high, +low]), binary features inaccurately represent vowel height, and that ternary scales delineate basic units of vowel height (see also Rivas 1977). The use of the ternary adjacency model accounts for the mid-vowel coalescence that occurs in Tariana, /a/-/i/ sequences resulting in [e], offering cross-linguistic support for its sufficiency.

Third, I proposed the constraint *V*h* as an adaptation of *[+spread glottis, +sonorant], defined by Flemming (1996) in relation to glottal metathesis in Cherokee (section 6.6). Cherokee metathesis, as identified by Flemming, is further classified by Blevins and Garrett (1998) as an instance of perceptual metathesis. Perceptual metathesis is one of the four main types of metathesis identified cross-linguistically (Blevins and Garrett 1998; 2004). It involves movement of segments that are characterized by acoustic features of long duration, based on the tendency of such features to spread to neighboring segments (Blevins and Garrett 1998; 2004). Cherokee and Tariana fall into this category because the glottal segments in these languages are not pronounced independently, but rather cause neighboring segments to become aspirated or breathy (Flemming 1996, Aikhenvald 2003). The high-ranking of *V*h* in Tariana supports the phonotactic grounding that underlies Flemming's proposal of *[+spread glottis, +sonorant], a cluster constraint militating against an unfavorable combination of segments in Cherokee, based on their features. Furthermore, my analysis couches Tariana *h*-metathesis in the cross-linguistic realm of perceptual metathesis. *h*-metathesis is also attested in Bare and Kurripako, Arawak languages closely related to Tariana (Aikhenvald 2003). Based on my analysis, I would predict that *V*h* would rank highly in those languages as well. Affirmation of this prediction would further support the phonotactic grounding of this constraint.

Finally, my analysis claims that in Tariana /i/ carries no mora when it is the root-initial vowel (section 6.4.2). Cross-linguistically, it has been proposed that /i/ can behave differently than other vowels in certain environments, in terms of its prosodic weight. For example, in Tohono O'odham it is argued that /i/ carries no mora in an unstressed diphthong, resulting in a monomoraic diphthong, but does carry mora in a stressed diphthong, resulting in a bimoraic dipthong (Miyashita 2002; 2011). My proposal that root-initial /i/ lacks mora in Tariana provides further evidence for the ability of /i/ to vary in weight cross-linguistically.

7.3 Theoretical implications and further questions

The proposals made in this thesis offer several implications, from which further veins of research may be derived. These implications and further questions are discussed below.

The sound alternations addressed in this thesis occur in environments of pronominal prefixation. A question to consider in light of my analysis, is how well it might account for vowel alternations that involve inflectional and derivational morphology elsewhere. The vowel alternations that occur in Tariana pronominal prefixation involve a limited set of vowels based on the phonotactic restrictions on segment distribution discussed in section 2.2: only /i/, /u/ and /a/ occur prefix-finally, and /i/, /u/, /e/ and /a/ occur root-initially. Other morphological environments may exhibit different alternations, given a larger inventory of vowels. If Tariana employs sound alternations as instruments of hiatus resolution in broader morphological environments, my analysis of pro-root alternations could serve to inform study of those alternations as well.

The claim that root-initial /i/ is monomoraic in Tariana, serves to differentiate /i/ from /u/. These vowels are both [+high] and of equally low sonority (20). High vowel /u/ behaves similarly to /i/ in the prefix-final position, in that both are allowed to remain in sequence in the output. It does not, however, pattern in accordance with /i/ in the root-initial position. Divergence between the behavior of /i/ and /u/ root-initially is evidenced by the bimoraic long vowel output that emerges when /u/ is found in the root-initial position of the input (/na-úma/, [naama]). This divergence is suggestive of more refined Tariana-specific sonority scale, such as those as proposed for Greek (Steriade 1982), Klamath (Levin 1985), English (Ladefoged 1993), wherein /u/ is more sonorous than /i/. Claiming that /i/ has a nonmoraic variant in Tariana points toward this implication, because vowels generally carry moras and are often associated with higher sonority following the sonority scale, here defined by Clements (1990): vowels > glides > liquids > nasals > obstruents. Consonants generally do not carry moras, although they can when found in the coda position of a syllable, in accordance with Weight by Position (Hayes 1989). If /i/ lacks a mora, exhibiting consonant-like behavior, it would follow that it ranks lower in sonority than mora-carrying /u/. Evidence for further specification between the sonority of /u/ and /i/ in Tariana, could be useful in the formation of a more specific universal vowel sonority scale.

As mentioned in section 3, the sequence /i/-/i/ has a bimoraic variant (e.g. /di-isa/ [diisa] ‘he climbs’), suggesting that /i/ can, at times, carry a mora in the root-initial position. I propose that this variation between a monomoraic [i] bimoraic [ii] output provides evidence for the presence of two types of /i/ in the root-initial position in Tariana—one that carries a mora, and one that does not. Root-initial, mora-less /i/ is present in the examples in Group C. Mora-carrying /i/ would be classified in Group A, among the vowel sequences exhibiting no apparent change.

A question remains in relation to this study, pertaining to the role of stress in Tariana vowel alternations. As mentioned in section 3, because stress did not appear to play a significant role in the pro-root vowel alternations I examined, it was not included in my OT analysis. Aikhenvald proposes a rule in which stress is specified, however: /u/-/ í/ → ú (9c). The monomoracity of [ú] substantiates my claim that root-initial /i/ does not carry a mora because it is monomoraic in spite of its emergence from an input sequence of two vowels. Because this sequence is made up of vowels of equal sonority on the scale in (20), my OT analysis would errantly predict that it persist in the output as [uí]. This is the only rule relating to pronominal prefixation in which stress is specified. When /u/ affixes to unstressed /i/, the segments remain in sequence ([ui]). It is apparent from this minimal pair, /u/-/i/ → [ui] versus /u/-/í/ → [ú], that stress affects vowel alternations, but the rest of the data in my analysis does not exhibit the same stress-related contrast. Stressed /í/ is not contrastive with any other prefix vowel (/a/-/i/ → [e], /a/-/í/ → [é]), nor does any other root vowel exhibit contrastive stress in pronominal prefixation environments (/i/-/e/→[ie], /i/-/é/ → [ié]). The minimal pair at issue, however, suggests the involvement of a further prosodic constraint which renders the sequence /u/-/í/ unfavorable. I leave the discovery of such a constraint, along with analysis of the role of stress in Tariana hiatus resolution, to further research.

In section 6.3, my analysis stated that sequences of rising sonority, specifically /i/-/V/ or /u/-/V/, do not trigger apparent alternation upon pro-root affixation in Tariana. As mentioned in 6.3, analyzing these sequences in terms of sonority implies that they constitute a single syllable, because sonority is normally used in phonology as a means of measuring a syllable's contour (Clements 1990, Blevins 1995). The prediction housed in this analysis is that /i/-/V/ and /u/-/V/ sequences undergo diphthong formation upon pro-root concatenation rather than remaining in

hiatus, and that resultant [iV] and [uV] sequences are tautosyllabic. Acoustic analysis of the data would be expected to corroborate the claim that vowel sequences exhibiting no change in pro-root environments are diphthongs rather than hiatus. This prediction unifies the persistent sequences with those that demonstrate overt alternation; both are instruments of hiatus resolution that occur upon pro-root concatenation. In other words, the pro-root vowel sequences exhibiting overt change in the output (Groups B and C), and those that appear to stay the same (Group A), are both working toward the same goal—hiatus resolution. Sonority sequencing governs the form that hiatus resolution takes. Sequences of falling sonority result in coalescence or vowel elision, and sequences of rising sonority result in diphthong formation.

Further questions emerge from this claim, regarding the weight of the hiatus-resolving diphthongs. Namely, are they bimoraic or monomoraic? It has been proposed in the literature that diphthongs of rising sonority are monomoraic based on their frequent occurrence in languages that do not have bimoraic syllable nuclei (Kaye 1985, Paradis 1989, Rosenthall 1994). In order to substantiate or refute this claim in Tariana, further descriptive data would be needed, determining moraicity, for example, by measuring the duration of the [iV] and [uV] within the prosodic words at issue. This type of acoustic phonetic research carries a degree of urgency in Tariana, because of the endangered status of the language (McDonough & Walen 2008).

Ultimately, seeking to understand features of less-studied endangered languages such as Tariana, in terms of cross-linguistically attested concepts, not only contributes to what is known about the languages, such an undertaking also tests and adds to what is known about the scope of concepts themselves (Hale, et al. 1992). Analysis of vowel alternations involved in pro-root hiatus resolution furthers phonological study of Tariana, while also contributing to theoretical study of hiatus resolution across the world's languages.

References

Aikhenvald, Alexandra Y., ed. 1999. *Tariana texts and cultural context* (Vol. 7). Lincom Europa.

Aikhenvald, Alexandra Y. 2003. *A grammar of Tariana.* Cambridge University Press.

Bakovic, Eric. 2000. *Harmony, dominance and control.* Doctoral dissertation, Rutgers University.

Blevins, Juliette. 1995. The syllable in phonological theory, in J. Goldsmith, ed., *The Handbook of Phonological Theory.* 206-244. Carnbridge, MS: Blackwell.

Blevins, Juliette & Andrew Garrett. 1998. The origins of consonant-vowel metathesis. *Language*, 508-556.

Blevins, Juliett & Andrew Garrett. 2004. The Evolution of Metathesis, in Bruce Hayes, Robert Kirchner & Donca Steriade, eds., *Phonetically Based Phonology.* 117-156. Cambridge: Cambridge University Press.

Casali, Roderic F. 1996. *Resolving Hiatus.* Doctoral dissertation, University of California, Los Angeles.

Clements, George N. 1986. Compensatory lengthening and consonant gemination in LuGanda, in Leo Wetzels and Enging Sezer, eds., *Studies in compensatory lengthening.* 37-77. Riverton: Foris Publications.

Clements, George N. 1990. The role of sonority in core syllabification, in John Kingston and Mary Beckman, eds., *Papers in Laboratory Phonology 1.* Cambridge, Mass.: Cambridge University Press. 283-333.

Clements, George N. 1991. Vowel height assimilation in Bantu languages. *Working Papers of the Cornell Phonetics Laboratory* 5. 37-76.

Côté, Marie-Hélène. 1997. Phonetic salience and consonant cluster simplification. *MIT Working Papers in Linguistics*, *30*. 229-262.

De Lacy, Paul. 2004. Markedness conflation in optimality theory. *Phonology*, *21*(2). 145-199.

Dixon, Robert M. & Alexandra Y. Aikhenvald, eds. 1999. *The Amazonian languages*. Cambridge: Cambridge University Press.

Flemming, Edward S. 1996. Laryngeal metathesis and vowel deletion in Cherokee. *UCLA Occasional Papers in Linguistics 16*. 23-44.

Frantz, Donald G. 1997. *Blackfoot grammar*. Second edition. Toronto: University of Toronto press.

Gnanadesikan, Amalia. 1997. *Phonology with ternary scales.* Doctoral dissertation, University of Massachusetts, Amherst.

Hale, Ken, Michael Krauss, Lucille J. Watahomigie, Akira Y. Yamamoto, Colette Craig, Jeanne, LaVerne Masayesva Jeanne, & Nora C. England. 1992. Endangered languages. *Language*. 1-42.

Hayes, Bruce. 1989. Compensatory lengthening in moraic phonology. *Linguistic inquiry*. 253-306.

Hayes, Bruce. 2011. *Introductory phonology*. (Vol. 36). John Wiley & Sons.

Hirayama, Midori. 2003. Contrast in Japanese vowels. *Toronto Working Papers in Linguistics*, *20*.

Hume, Elizabeth. 1998. Metathesis in phonological theory: The case of Leti. *Lingua*, *104*(3). 147-186.

Hume, Elizabeth. 2001. Metathesis: Formal and functional considerations. *Surface syllable structure and segment sequencing*. 1-25.

Hume, Elizabeth. 2004. The indeterminacy/attestation model of metathesis. *Language*. 203-237.

Itô, Junko & Armin Mester. 1999. The Phonological Lexicon1.

Kaye, Jonathan. 1985. On the syllable structure of certain West African languages. *African Linguistics: Essays in Memory of M. WK Semikenke*. 285-307.

Kager, René. 1999. *Optimality Theory*. Cambridge: Cambridge University Press.

Kenstowicz, Michael. 1997. Quality-sensitive stress. *Rivista di Linguistica 9*. 157–188. Reprinted in John J. McCarthy, ed., 2003. *Optimality Theory in phonology : a reader.* Oxford : Blackwell. 191–201.

Kiparsky, Paul 1967. Sonorant Clusters in Greek. *Language, 43*. 619-35.

Ladefoged, Peter. 1993. *A course in phonetics*. 3rd ed. New York: Harcourt Brace Jovanovich.

Lewis, M. Paul, Gary F. Simons & Charles D. Fennig (eds.). 2013. *Ethnologue: Languages of the World, Seventeenth edition.* Dallas, Texas: SIL International. Online version: http://www.ethnologue.com. Accessed February 23, 2014.

Levin, Juliette. 1985. *A metrical theory of syllabicity*. Doctoral dissertation, Massachusetts Institute of Technology.

McCarthy, J. 1995. "Faithfulness in Prosodic Morphology & Phonology: Rotuman Revisited", Ms., University of Massachusetts, Amherst.

McCarthy, John & Alan Prince. 1993. "Prosodic morphology I: constraint interaction and satisfaction", Ms., University of Massachusetts & Rutgers University.

McCarthy, John & Alan Prince. 1994. The Emergence of the Unmarked: Optimality in Prosodic Morphology, in Merc Gonzlez, ed., *Proceedings of the North East Linguistics Society 24*. 333–379.

McCarthy, John & Alan Prince. 1995. Faithfulness and reduplicative identity, in Jill Beckman, Laura Walsh Dickey, & Suzanne Urbanczyk, eds., *University of Massachusetts Occasional Papers in Linguistics 18*. 249-384.

McCarthy, John & Alan Prince. 2004. Generalized Alignment: The prosody-morphology interface, in John J. McCarthy, ed., *Optimality Theory in phonology*. 451-463.

McDonough, Joyce. & Whalen, D. H. 2008. The phonetics of native North American languages. *Journal of Phonetics*, *36*(3). 423-426.

Mester, Armin. 1986. *Studies in tier structure.* Doctoral dissertation, University of Massachusetts.

Miyashita, Mizuki. 2002. *Tohono O'odham syllable weight: Descriptive, theoretical and applied aspects.* Doctoral dissertation. University of Arizona.

Miyashita, Mizuki. 2011. Diphthongs in Tohono O'odham. *Anthropological Linguistics*, *53*(4). 323-342.

Morén, Bruce. 2001. *Distinctiveness, Coercion and Sonority: A Unified Theory of Weight.* Psychology Press.

Ngunga, Armindo. 2000. *Phonology and Morphology of the Ciyao verb*. Stanford: CSLI Publications.

Paradis, Carole & Jean-Francios Prunet. 1989. Vowel Fusion and Antigemination in Guere and Mau. *Toronto Working Papers in Linguistics*, *10*.

Pater, Joe. 1999. Austronesian nasal substitution and other NC effects, in René Kager, Harry van der Hulst, and Wim Zonneveld eds., *The Prosody Morphology Interface, 79*. 310-43.

Perkins, Jeremy. 2005. *The RTR harmonic domain in two dialects of Yoruba*. Doctoral dissertation, University of British Columbia.

Prince, Alan & Paul Smolensky. 1993. “Optimality Theory”, Ms., Rutgers University & University of Colorado.

Pulleyblank, Douglas. 2003. “Yoruba vowel patterns: asymmetries through phonological competition”’ Ms. UBC.

Rivas, Alberto. 1977. Hierarchical classes of features in binary-feature phonology. *Proceedings of NELS*, *8*. 185-189.

Rosenthall, Samuel. 1994. *Vowel/glide alternation in a theory of constraint interaction*. Doctoral dissertation, University of Massachusetts: Amherst.

Smolensky, Paul. 1993. Harmony, markedness, and phonological activity. Handout to talk presented at Rutgers Optimality Workshop 1. New Brunswick, NJ. ROA 87.

Steriade, Donca. 1982. *Greek prosodies and the nature of syllabification*. Doctoral dissertation, Massachusetts Institute of Technology.

Tanner, Darren Scott. 2007. Context insensitive vowel hiatus resolution in Ciyao. *on Rutgers Optimality Archive*. ROA 458.

Thompson, Lawrence. C., M. Terry Thompson, & Steven M. Egesdal. 1996. Sketch of Thompson, a Salishan Language, in Ives Goddard, ed., *Handbook of North American Indians, 17. Languages*. 609-643.

Trask, Robert Lawrence. 1996. *A dictionary of phonetics and phonology*. Routledge.

Wheeler, Max W. 2005. Cluster Reduction: Deletion or Coalescence? *Catalan Journal of Linguistics, 4*.

Zec, Draga. 1995. Sonority constraints on syllable structure. *Phonology*, *12*(1). 85-129.

Appendix A

The Arawak language family[8]

(Dixon and Aikhenvald 1999: 67-71)

NORTH ARAWAK
Upper Rio Negro – Brazil/Colombia/Venezuela
- *Tariana
- Baniwa of Icana/Kurripako
- *Guarequena

Orinoco – Brazil/Venezuela
- *Bare
- *Baniwa of Guainia

Middle Rio Negro – Brazil
- *Kaishana
- *Bahwana/Chiriana

Colombian – Peru/Columbia
- *Yucuna
- *Achagua
- Piapoco
- *Cabiyari

RIO BRANCO – Brazil/Guiana
- Wapishana
- *Mawayana

PALIKUR – Brazil/Guyana
- Palikur

CARIBBEAN – Dominica/Nicaragua/Belize/Guatemala/Honduras
- Garifuna

TA-ARAWAK SUBGROUP OF CARIBBEAN – Suirname/Guyana/French Guiana/Venezuela/Colombia/Bahamas/PR/ Cuba/Jamaica/Trinidad
- Lokono
- Guajiro
- Anun

SOUTH ARAWAK
South Arawak – Paraguay/Brazil/Argentina/Bolivia
- Terena
- Baure
- Moxo
- Saluma

Pareci-Xingu
- Warua
- Mehinaku
- *Yawalapiti

Pareci-Saraveca
- *Pareci

SOUTHWEST ARAWAK
Southwest Arawak – Brazil/Peru
- Piro
- Chontaquiro
- Apurina

Campa
- Ashaninca
- *Caquinte
- Machiguenga
- Nomatsiguenga
- Pajonal Campa

Amuesha
- Amuesha

[8] Only living languages are listed. Endangered languages are marked with (*).

Appendix B: Full tableaux

(1) Evaluation of /wa-aru/ [waaru] ‘we fly’ (Group A)

	/wa$_1$-a$_2$ra/	*SonFall	*V*h*	RtIdent[αbk]-OI	Max-IO	Ident-μ-IO	Linear-IO	Ident-Adj[VH]	Indent[VH]	*[+high]	Uniform-IO	Ident-IO[F]
☞	a. wa$_1$a$_{,2}$ru											
	b. wa$_1$e$_2$ru	*!										
	c. wa$_1$ru				*!	*						
	d. wa$_{12}$ru					*!					*	
	e. we$_1$ru			*!	*	*						
	f. we$_{12}$ru			*!		*			**		*	**
	g. wu$_1$ru				*!	*				*		
	h. wu$_1$u$_2$ru							*!*	**	**		
	i. wa:$_{1,2}$ru										*!	

(2) Evaluation of / du-hépa/ [dhuépa] ‘she answers’ (Group A & D)

	/du$_1$-he$_2$pa/	*SonFall	*V*h*	RtIdent[αbk]-OI	Max-IO	Ident-μ-IO	Linear-IO	Ident-Adj[VH]	Indent[VH]	*[+high]	Uniform-IO	Ident-IO[F]
☞	a. dhu$_1$e$_2$pa						*			*		
	b. du$_1$he$_2$pa		*!							*		
	c. du$_1$e$_2$pa				*!					*		
	d. dhu$_{12}$pa			*!		*	*		*	*	*	*
	e. dhu:$_{1,2}$pa			*!			*		*	**	*	
	f. dhu$_1$pa			*!	*	*	*			*		
	g. dhe$_{12}$pa					*!	*		*		*	*
	h. dhe:$_{1,2}$pa						*		*!		*	*
	i. dhe$_1$pa				*!	*	*					

(3) Evaluation of /na-ísa/ [nésa] ‘they climb’ (Group B)

	/na$_1$-i$_2$sa/	*SonFall	*V*h*	RtIdent[αbk]-OI	Max-IO	Ident-μ-IO	Linear-IO	Ident-Adj[VH]	Indent[VH]	*[+high]	Uniform-IO	Ident-IO[F]
☞	a. ne$_{12}$sa								**		*	**
	b. na$_1$i$_2$sa	*!								*		
	c. ne$_1$sa				*!							
	d. na$_1$sa			*!	*							
	e. na$_{12}$sa			*!		*		*	*		*	*
	f. ni$_2$sa				*!					*		
	h. ni$_{12}$sa							*!	*	*	*	*
	i. ni$_1$a$_2$sa						*!			*		
	j. ne:$_{1,2}$sa					*!				**	*	**

(4) Evaluation of /di-híma/ [dhíma] ‘he hears’ (Group B & D)

/di$_1$-hi$_2$ma/	*SonFall	*V*h*	RtIdent[αbk]-OI	Max-IO	Ident-μ-IO	Linear-IO	Ident-Adj[VH]	Indent[VH]	*[+high]	Uniform-IO	Ident-IO[F]
☞ a. dhi$_{12}$ma						*			*	*	
b. dhi$_1$ma				*!		*					
c. di$_1$hi$_2$ma		*!							**		
d. di$_1$i$_2$ma				*!	*				**!		
e. dhiː$_{1,2}$ma					*!	*			**!	*	
f. dhi$_1$e$_2$ma					*!	*			*		*

(4) Evaluation of /na-úma/ [naáma] ‘they seek’ (Group C)

/na$_1$-u$_2$ma/	*SonFall	*V*h*	RtIdent[αbk]-OI	Max-IO	Ident-μ-IO	Linear-IO	Ident-Adj[VH]	Indent[VH]	*[+high]	Uniform-IO	Ident-IO[F]
☞ a. na$_1$a$_2$ma							*	*			*
b. na$_1$u$_2$ma	*!								*		
c. nu$_1$a$_2$ma						*!			*		
d. na$_1$ma				*!							
e. na$_{12}$ma					*!		*	*		*	*
f. nu$_1$ma				*!					*		
g. nu$_{12}$ma					*!		*	*	*	*	*
h. ne$_{12}$ma			*!					**		*	
i. ne$_1$ma				*!							
j. naː$_{1,2}$ma							*	*		*!	*
k. nuː$_{1,2}$ma							*	*	*!*	*	*
l. neː$_{1,2}$ma			*!					**		*	**

(5) Evaluation of /wa-éku/ [weéku] ‘we run’ (Group C)

/wa$_1$-e$_2$ku/	*SonFall	*V*h*	RtIdent[αbk]-OI	Max-IO	Ident-μ-IO	Linear-IO	Ident-Adj[VH]	Indent[VH]	*[+high]	Uniform-IO	Ident-IO[F]
☞ a. we$_1$e$_2$ku								*			*
b. wa$_1$e$_2$ku	*!										
c. we$_1$a$_2$ku						*!				*	
d. wa$_1$ku			*!	*	*						
e. wa$_{12}$ku			*!		*			*		*	*
f. we$_1$ku				*!	*						
g. we$_{12}$ku					*!			*		*	*
h. weː$_{1,2}$ku								*		*!	*
i. waː$_{1,2}$ku			*!					*		*	*