Advanced Tongue Root Harmony in Anii-Gisida

by

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Abstract

This thesis provides an analysis of vowel harmony and positional neutralization in Anii-Gisida. Anii-Gisida is spoken in the northern part of Benin, eastern Togo, and the central-eastern part of Ghana. It has an eleven-vowel system, which is unique in that all the vowels are active in [ATR] harmony processes (Morton, 2012, 2014). Anii-Gisida has five [+ATR] vowels, /i, e, ə, o, u/ and six [-ATR] vowels, /ɪ, ɛ, ɨ, a, ɔ, ʊ/. All the vowels have a harmonic counterpart except the high central vowel /ɨ/. The high central vowel, however, occurs exclusively with [-ATR] vowels in a word. I argue that all the vowels, /i, ɪ, e, ɛ, ɨ, ə, a, o, ɔ, ʊ, u/ are contrastive for [ATR], including the high central vowel /ɨ/. I compare two approaches to contrastive feature specification, the Minimal Difference approach (e.g., Nevins, 2010) and the Successive Division Algorithm (e.g., Dresher, 2009), to determine which approach best accounts for vowel harmony patterning and positional neutralization in Anii-Gisida. The former approach does not result in contrastive specification of [ATR] for the Anii-Gisida high central vowel; and allows the non-contrastive vowel /ɨ/ to participate in [ATR] harmony. However, the latter allows all vowels to be contrastively specified for the harmonic feature; and allows only contrastive features to participate in [ATR] harmony. It is only the SDA version of contrastive specification that predicts that the high central vowel /ɨ/ can be phonologically active while also restricting phonological activity to contrastive features. The SDA also accounts for positional neutralization and markedness facts in Anii-Gisida. I propose that the features, [ATR], [low], [back], [high] and [round] are the features that divide the Anii-Gisida vowel inventory in a hierarchical tree. In the proposed hierarchical tree, the features ([±high] and [±round]) are ordered lower in the tree. These are the features that neutralize in affix position. Positional neutralization is

crucial to distinguishing between marked and unmarked values in Anii-Gisida. The [-high] and [-round] vowels do not occur in the affixes. I argue that these feature values are marked relative to [+high] and [+round] which do occur in affixes. The proposed feature tree accounts for both [ATR] harmony and positional neutralization in Anii-Gisida.

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Chapter 1: Introduction

This thesis provides an analysis of vowel harmony and positional neutralization in Anii-Gisida based on contrastive feature specification. Anii-Gisida is spoken in the northern part of Benin, eastern Togo, and the central-eastern part of Ghana. It exhibits an unusual vowel harmony system in which each of its eleven vowels are active in [ATR] harmony (Morton, 2012, 2014). This is unusual for two reasons: first, most languages with [ATR] vowel harmony have a smaller vowel inventory. While a number of African languages with [ATR] harmony have ten vowels (all participating in vowel harmony), it is more common to see languages with only seven or nine vowels, with seven being the most common (Casali, 2008). In most eleven vowel languages, only ten vowels are active in vowel harmony processes (Morton, 2012). Focusing on the asymmetric (or odd-numbered) vowel inventories, we find the second reason why vowel harmony in Anii-Gisida is unusual; all vowels participate in [ATR] harmony.

Typically in most languages with asymmetric (i.e., odd numbered) vowel inventories, at least one [ATR] vowel lacks a [+ATR] counterpart and does not participate in vowel harmony—it can co-occur with [+ATR] and [-ATR] vowels. In Anii-Gisida, however, the unpaired vowel [ɨ] *does* participate in [ATR] harmony, occurring exclusively with [-ATR] vowels in a word. This raises one of the central questions of my thesis: What accounts for the participation of the unpaired [-ATR] vowel in Anii-Gisida?

To address this question, I will consider two possible approaches to feature specification used in the literature to see which can better account for the vowel harmony patterning

in Anii-Gisida: the Minimal Difference Approach (MDA) (Nevins, 2005, 2010) and the Successive Division Algorithm (SDA) (Dresher, 2012, 2013, 2015). Both of these approaches appeal to contrastive feature specification to account for variable feature participation in harmony across languages. However, only in the SDA can the unpaired vowel be contrastively specified for the active harmonic feature. In the MDA, the unpaired [ɨ] is predicted to have a non-contrastive feature that participates in vowel harmony in Anii-Gisida. This yields my second research question: Are harmony triggers always contrastive in Anii-Gisida? Data for this study comes from Morton (2008, 2012, 2014). Most of Morton's earlier works are preliminary. Her (2014) work is the first to receive extensive study of Anii-Gisida.

Anii-Gisida has five [+ATR] vowels (/i, e, ə, o, u/) and six [-ATR] vowels /ɪ, ɛ, ɨ, a, ɔ, ʊ/. All these vowels have harmonic counterparts (i/ɪ, e/ɛ, ə/a, o/ɔ, ʊ/u) except the high central vowel /ɨ/. I will argue that all vowels are contrastive for [ATR], including the high central vowel, which consistently triggers [ATR] harmony. The patterning of the high central vowel supports the hypothesis that a segment need not have a minimally different counterpart to be contrastively specified for the harmonic feature.

Not only is the vowel harmony patterning in Anii-Gisida atypical, so too is its patterning of positional neutralization. In many African languages that have an [ATR] vowel contrast, [ATR] neutralization occurs as well as [ATR] vowel harmony. Two common patterns of [ATR] neutralization occur in less prominent positions (for example, affixes and grammatical morphemes), correlating with properties of the vowel inventory (specifically, the number of contrastive high vowels present) (see Casali, 2016). In Anii-

Gisida, while there is a restricted set of vowels that can appear in affixes, this restriction is not based solely on [ATR]. Rather, we find that all vowels except mid vowels and the high central vowel [ɨ] can appear in affixes. The high central vowel [ɨ] plays an important role in both vowel harmony and positional neutralization. Thus, the unpaired vowel /ɨ/ is active in vowel harmony processes and at the same time it neutralizes with the rounded vowels /ʊ/ and /ɔ/ in affix position. This brings us to the third question for my thesis: Why does the neutralization pattern seem to be associated with vowel height and rounding instead of [ATR]?

To address this question, I will again look to contrastive vowel specification using the same Successive Division Algorithm analysis that is used to account for the vowel harmony facts in Anii-Gisida. In my proposed SDA tree, the features ([±high] and the [±round]) are ordered lower in the proposed hierarchical tree. These are also the contrasts in Anii-Gisida that are neutralized in affix position.

I further discuss the implications of this pattern for markedness. Positional neutralization is crucial to distinguish between marked and unmarked values in Anii-Gisida. The [-high] and [-round] vowels are marked relative to the [+high] and [+round] vowels. The unmarked values show up in the affixes. Markedness is defined in terms of distributional pattern for features.

This thesis is organized as follows: Chapter 2 gives a general overview of Anii-Gisida phonology and morphology. Chapter 3 provides an analysis of the [ATR] harmony processes in Anii-Gisida. In chapters 4 and 5, I discuss the two approaches that have

been used to divide inventories into contrastive and non-contrastive features. Chapter 6 evaluates the fit of these two approaches with the Anii-Gisida vowel harmony system. I present an analysis of positional neutralization and markedness relation patterns in Anii-Gisida in chapter 7, and present conclusions in chapter 8.

Chapter 2: Background of Anii

2.1 Introduction

Anii is a severely under-documented Niger-Congo-Kwa language spoken by approximately 49,000 people (Morton, 2012) in Benin, eastern Togo, and the central-eastern part of Ghana. Benin has the largest population of Anii speakers (The name 'Anii' is an interjection which means 'do you hear' or 'do you understand' in Anii.). Anii is one of the fourteen Togo-remnant languages also known as Ghana-Togo Mountain Languages (GTM). Ghana-Togo Mountain Languages are spoken in Southeastern Ghana, Southwestern Togo and Northern Benin.

Anii is spoken in about fifteen villages in the northern part of Benin, and each village has a specific name for its dialect as shown in Figure 1[1]. There are about thirteen dialects of Anii, and some of them are not mutually intelligible. Thus, each dialect has a varied set of rules in terms of lexicon, phonology and syntax. This thesis focuses on the Gisida dialect, the one with the most speakers; it is

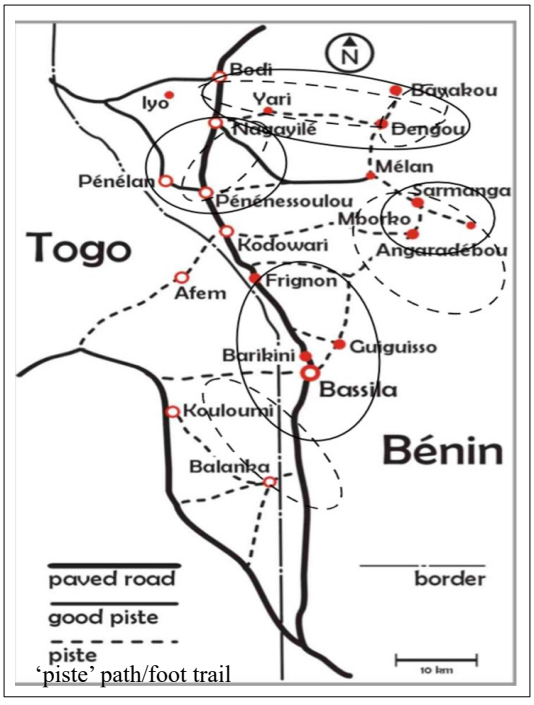


Figure 1: Map of Anii-dialects, Morton,2008, p.11

1 The circles show dialect clusters, thus dialect that share the same linguistics patterns.

spoken in Bassila village[2]. For the rest of this thesis, I will refer to this dialect as Anii-Gisida.

I will first discuss previous works on Anii (section 2.2) and then introduce some of the phonological and morphological aspects of Anii-Gisida that are needed to understand the vowel harmony system in Anii-Gisida (described later in chapter 3). This includes the phonemic inventory (section 2.3), three active phonological processes in Anii-Gisida (section 2.4) and a brief overview of some basic aspects of Anii-Gisida morphology (section 2.5).

2.2 Previous Work on Anii

Heine (1968) (as cited in Morton, 2014) was the first to do a brief sketch of the phonology and the morphology of Anii-Gisida. He provided the first consonant and vowel chart of Anii-Gisida, consisting of ten vowels. However, Morton (2010, 2012) later discovered an eleventh vowel, the high central vowel (/ɨ/). [ATR] vowel harmony in Anii-Gisida affects noun class markers, agreement, verb morphology, and some aspectual morphology (Heine, 1968). Its 5-level height/[ATR] system of [ATR]-based harmony is uncommon in African languages (Morton, 2014). The [ATR] vowel harmony system is fully analyzed in subsequent chapters.

2 Some speakers refer to the Gisida dialect as Bassila.

Morton (2014) is the first author to do extensive work on Anii-Gisida. Her work focuses on the temporal and aspectual semantics and verbal tonology of Anii-Gisida. Her first work was on a preliminary classification of the Anii-Gisida dialects and provided some evidence for dialect clusters among Anii villages. According to Morton (2008), there are four or five dialect clusters—villages that share the same pattern in terms of lexemes, phonology, semantics and other aspects of language structure (see Figure 1). For instance, Morton (2008) grouped the Anii territory into Northwest, Northeast, North, and Southern groups. The Northwest group includes the villages of Penelan, Penessoulu, and Nagayile. The salient feature that characterizes this group is the presence of word-final (/ɛ/ or /e/) where other dialects have /i/ instead. The dialects that make up the Northeast include the villages of Saramanga, Mboroko and Agaradebou. The villages in the North group include Bodi, Yari, Bayakou and Dengou. Finally, the villages of Bassila, Barikini, Frignon and Guiguisso are grouped together as dialects of Southern Anii. (see Morton, 2008 for more feature characteristics of these dialects).

2.3 Phonemic Inventory

Anii has 25 consonants, 22 of which are phonemes. The voiced fricatives, [v] and [z], only occur in borrowed words (French and Arabic); they are not phonemes of the Anii-Gisida dialect. The alveolar affricate [ts] is an allophone of /t͡ʃ/ occurring before mid-central and high central vowels (Morton, 2014). Glides are listed as phonemes in the chart below, though it is not clear whether these are separate phonemes or allophones of high

vowels (see Morton, 2014). The labiovelar /ŋm/ is rare in Anii-Gisida but occurs in other dialects[3].

Table 1. **Consonant Inventory** (Morton, 2014)

	Bilabial	Labio-dental	Alveolar	Alveo-palatal	Palatal	Velar	Glottal	Labio-velar
Plosives	p b		t d			k g		kp gb
Nasal	m		n		ɲ	ŋ		(ŋm)
Trill	r							
Fricatives		f (v)	s (z)	ʃ			h	
Affricate			(ts)	t͡ʃ d͡ʒ				
Glides[4]					j			w
Lateral			l					

Anii-Gisida has eleven (11) vowels, five [+ATR] /i, e, ə, o, u/ and six [-ATR] /ɪ, ɛ, ɨ, a, ɔ, ʊ/. All of the [-ATR] vowels have a [+ATR] counterpart with the exception of the high central vowel, /ɨ/ (see example (1)).

3 The other dialects of Anii are still under-documented.
4 Some scholars regard glides and vowels as allophones of the same phoneme, others consider them to be separate phonemes. Morton (2014) considers glides and high vowels to be separate phonemes in Anii.

Table 2. **Vowel Inventory** (Morton, 2014)

[+ATR]

	Front	Central	Back
High	i		u
Mid	e	ə	o

[-ATR]

	Front	Central	Back
High	ɪ	ɨ	ʊ
Mid	ɛ		ɔ
Low		a	

(1) [**ATR] Pair** (Morton, 2012, p. 72)

	[+ATR]	[-ATR]
High front	i	ɪ
Mid front	e	ɛ
Central	ə	a
High back	u	ʊ
Mid back	o	ɔ

All the vowels are phonemic and they occur in minimal or near minimal pairs, as in (2) (a-h).

(2) **Minimal Pairs** (Morton, 2012, pp. 72–76)

a.	[ri[5]]	'to trap'	[rɪ]	'to dance/grill'
	[pi]	'to break/crush'	[pɪ]	'to come'
b.	[ɲé]	'to detest/ hate strongly'	[ɲɛ́]	'to lend/pass'
	[ʧedé]	'to crumble'	[ʧɛdɛ]	'to divide kola nuts'
c.	[wə́]	'to cook meat'	[wá]	'to meet'
	[də]	'to jump over'	[da]	'to be there'
d.	[du]	'to sow'	[dʊ]	'to put/place'
	[fum]	'to bury'	[fʊŋ]	'to cultivate'
e.	[fodó]	'to doff (take off)'	[fɔrɔ]	'to mix/knead in'
	[to]	'to give'	[tɔ́]	'to last'
f.	[pɨl]	'to cook'	[pəl]	'to look along'
	[ŋkɨ́ŋ]	'behind'	[ŋkə́ŋ]	'there'
g.	[sɨlá]	'to approach'	[salá]	'to greet'
	[pɨra]	'to become'	[para]	'to glue/stick'
h.	[tɨ]	'future marker'	[tɪ]	'to put down'
	[ʧɨ̃]	'to build'	[ʧɪ]	'to wash'

2.4 Phonological Processes

This section focuses on three phonological processes found in Anii-Gisida: Nasal Place Assimilation, G-deletion and Palatalization to provide evidence for some active features.

Nasal Place Assimilation occurs when a nasal phoneme assimilates to the place features of another phoneme in the same environment (Morton, 2014). Nasal assimilation occurs

5 Anii-Gisida has two types of tone; high and low tone. The tones have lexical and morphological functions. I do not focus on tones in this paper and some of the segments might not bear tone. I will always omit these tones on [i, ɪ], because fonts style obscure the [ATR] difference between these two vowels. In any case, tone is not relevant in this thesis.

both within words (see (3) (a-b) and across a word boundary (see (3) (c-f)) and the assimilation is regressive.

(3) **Nasal Assimilation** (Morton, 2014, p. 21)

a.	**[ń**-tɨmà] CL.F-work	'work'
b.	**[m̀**-pá] CL.F.-village	'village'
c.	[à**ǹ̀**-gà-ʃɛ̌j] my-CL.sg-basket	'my basket'
d.	à**ḿ**-bɔ̀-ʃɛ̌j my-CL.pl-basket	'my baskets'
e.	[ń-fʊ**ǹ̀**-gà-wàrà] I-farm-CL.sg-field	'I farmed a field'
f.	[ń-fɔ̀**m̀**-bɔ̀-wàrà I-farm-CL.pl-field	'I farmed fields'

The second phonological process is G-deletion with associated vowel change. In Anii-Gisida, [g] is deleted when it follows a syllable with a voiceless velar stop, and the quality of the vowel before the [g] changes (Morton, 2014). The examples in (4) illustrate this process. In each of these cases, the possessive prefix -*àkì* 'your (sg)' is prefixed to a noun that begins with [g] -g*à-ʃɛ̀j*. In each case, the [g] is deleted (compare (4) (a-e) and (4) (f-i) where [g] is not deleted) as shown in the surface forms. As seen in example (4), a preceding [k] triggers the deletion of [g]. In addition to the G-deletion, the second vowel in the possessive pronoun (/àkì/) changes to have the same vowel quality as the first vowel in the noun form. Although total assimilation occurs in hiatus contexts created through G-deletion, assimilation in rounding occurs independently of G-deletion as

shown in (4) (h-i). G-deletion is also common in Cilungu (a Bantu language in the Northern Province of Zambia and Southern Tanzania) where /g/ is deleted to create a surface hiatus like seen in Anii-Gisida. (See Bickmore (2007) for more description of G-deletion in Cilungu).

(4) **G-Deletion** (Morton, 2014, pp. 25–26)

	Underlying form	Surface form	Glossing
a.	/àkɪ-gà-ʃɛ̀j/	[àkààʃɛ̀j]	‘your (sg) basket’
b.	/àkɪ-gà-nɔ̀/	[àkàànɔ̀]	‘your (sg) mouth’
c.	/àkɪ-gɪ-kò/	[àkììkò]	‘your (sg) belly button’
d.	/àkɪ-gɔ̀-dà /	[àkɔ̀ɔ̀dà]	‘your (sg) dream’
e.	/kà gɪ bɨ́lá!ná /	[kɪɪbɨ́lá!ná]	‘we did not refuse’

	Underlying	Surface form	Glossing
f.	/àtɪ-gà-ʃɛ́j/	[àtɨ̀-gà-ʃɛ́j]	‘our basket’
g.	/àtɪ-gà-nɔ́/	[àtɨ̀-gà-nɔ́]	‘our mouth’
h.	/àtɪ-gɔ̀-dà/	[àtɔ̀-gɔ̀-dà]	‘our dream’
i.	/àtì-gù-ɲɔ̀ɔ̀/	[àtɔ̀-gù-ɲɔ̀ɔ̀’]	‘our teeth’

The final phonological processes is palatalization. The front vowels, /i, ɪ, e, ɛ/ trigger palatalization of the voiceless alveolar fricative, /s/ [6]. As shown in example (5) (a), the [ʃ] allophone precedes only front vowels while the [s] allophone precedes non-front vowels in (5) (b).

6 However, /s/ occurs before a front vowel in one word *əsiiri* ‘secret’.

(5) **Palatalization** (Morton, 2014)

a.	[ùʃilè]	'sun'	b.	[sàrá]	'greet'
	[ʃɛ́ẁ]	'go-home'		[səŋkə́r̀]	'separate'
	[ʃém̀]	'spit'		[sɨra]	'be able'
	[baʃɪka]	'buyers'		[ə́sùl]	'at house'

2.5 Basic Morphology of Anii-Gisida

There are some aspects of Anii-Gisida morphology that are relevant for understanding the vowel harmony processes discussed in this thesis: the subject pronouns, clitics, the noun class system, suffixation, and nominalization are each discussed in turn.

2.5.1 The Subject Pronouns

There are two different sets of subject pronouns in Anii-Gisida, and these are used in different types of clauses (see Morton, 2014 for more detailed discussions on these type of clauses). The subject pronouns are illustrated in example (6).

(6) **Subject Pronouns** (Morton, 2014, p. 33)

Group 1	Group 2	Gloss
/ń/	/má/	'I'
/ó/	/á/	'you (sg)'
/à/	/à /	's/he'
/gí/	/gì /	'we'
/í/	/ì/	'you (pl)'
/bà/	/bà/	'they'

In the above examples, the third person pronouns have the same forms for group 1 and group 2 (/à/ 'she' and /bà/ 'they'), but the other type of pronouns are different in terms of segment and tone. The subject pronouns do not appear in isolation but always precede a verb. They function as syntactic words but are phonologically dependent on verbs, as shown in example (7) (a-e) (adapted from (Morton, 2014, pp. 278–279) and can be classified as clitics[7].

(7) Subject Pronouns in Anii-Gisida

a. [gi = rəŋə][8] 'we heard'
b. [ń =jidè] 'I stopped'
c. [ó = kɔ̀lɔ̀] 'you (sg) coughed'
d. [à = kàrà] 'she got dressed'
e. [bà = bɔ̀ŋà] 'they turned their heads'

In the above examples, the subject pronoun clitics participate in [ATR] harmony processes. The vowels in the verb roots trigger harmony and the subject pronouns are the targets. For instance, in (7) (a) the vowel in the third person pronoun *gi* has the same harmonic feature as the vowels in *rəŋə*, [+ATR]. In (7) (c) the second person pronoun *ó* shares the same harmonic feature,[-ATR], with the vowels in *kɔ̀lɔ̀.*

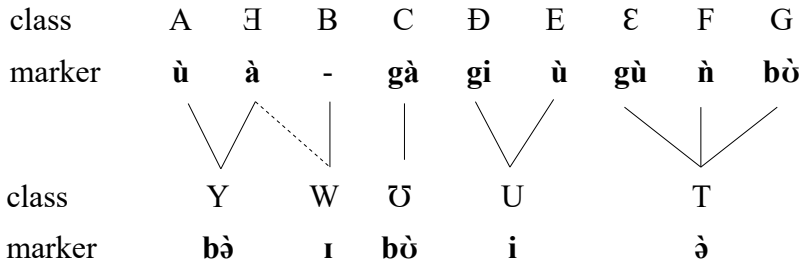
7 In morphology, a clitic is a non-lexical entity that is syntactically independent but phonologically dependent on a host (another word or phrase). Clitics are different from affixes, in that clitics can function as full words but affixes do not (see Zwicky & Pullum, 1983 for more discussion on criteria that distinguish clitics from affixes) Clitics normally function as pronominal markers, locatives, determiners among others. They can either precede nouns, adjectives or verbs (proclitics) or follow these lexical categories (enclitics).

8 The symbol "=" shows the status of clitics, and it will be used to represent clitic boundary from now on.

2.5.2 Noun Class Marker

According to Morton (2014), Anii has eight singular noun class markers as in (9) (a-h), one class marker for mass nouns as in (9) (i), and five plural noun class markers as in (9) (j-n). The same noun root has one class marker for singular and another form for plural. Most singular nouns of classes A and Ǝ take the plural class marker Y, but some class Ǝ nouns and class B nouns take the plural class marker W. The plural forms of class C nouns are in class Ʊ; also, singular nouns in classes Ð and E take the plural class marker U. The singular of the noun class markers Ɛ, F, and G take plural noun class T, which is the most productive plural noun class marker[9]. This is summarized in Figure 2, where the top row contains singular class markers and the bottom rows lists the plural markers. The lines indicate that a noun can belong to either class marker.

Figure 2*:* **Class Markers**



Noun class markers also trigger adjective and verb agreement. (Demonstratives, relative pronouns and object focus markers also agree with their noun class markers; see Morton,

9 See Morton (2014) for the semantic and the syntactic properties of the noun class system of Anii. Note that these still need further research for better classification. The letters used for the noun classes are conventional. For simplicity, I also used CL to stand for all the noun class markers.

2014 for further examples.) In example (8), the adjective *ʤàlà* 'small' agrees with the noun it modifies and the verb *-ɨ́dá* 'fall' agrees with the noun class its subjects.

(8) **Noun Class Agreement** (Morton, 2014, p. 30)

a. **à**-bɔ̀rɪ **à**-ʤàlà **à**-ɨ́dá
CL.∃-animal AGR.CL.∃-small AGR.CL.∃ -fall

'The small animal fell.'

b. **gà**-fɪlɪ **gà**-ʤàlà **gà**-ɨ́dá
CL.C-fish AGR.CL.C-small AGR.CL.C-fall
'The small fish (sg) fell.'

All the noun class markers participate in vowel harmony, with the exception of class F, which does not have a vowel. As shown in (9) (a), *ù-* agrees with the vowel in the noun root *-pì* in terms of the harmonic feature [+ATR]. Also, in the word ***à-ɨ́dá*** 'fall' the noun class marker **à-** harmonizes with the first vowel of the verb root in terms of the feature [-ATR]. (I will provide complete examples of vowel harmony in the subsequent chapter).

(9) **Anii Noun Class Markers** (Morton, 2014, pp. 30–31)

a. Class A **ù**-pi **à**-ʤàlà **à**-ɨ́dá
CL.A-child AGR.CL.A-small AGR.CL.A-fall
'The small child fell.'

b. Class ∃ **à**-bɔ̀rɪ **à**-ʤàlà **à**-ɨ́dá
CL.∃-animal AGR.CL.∃-small AGR.CL.∃ -fall
'The small animal fell.'

c. Class B kɛ́kɛ́ **à**-ʤàlà **à**-ɨ́dá
CL.B.bicycle AGR.CL.B-small AGR.CL.B-fall
'The small bicycle fell.'

d. Class C **gà**-fɪlɪ **gà**-ʤàlà **gà**-ɨ́dá
CL.C-fish AGR.CL.C-small AGR.CL.C-fall
'The small fish (sg) fell.'

e. Class Ð **gi**-ʤè **gɪ**-ʤàlà **gɪ**-fɨdá
CL.Ð-yam AGR.CL.Ð-small AGR.CL.Ð-fall
'The small yam fell.'

f. Class E **ù**-fò **ò**-ʤàlà **ò**-fɨdá
CL.E-partridge AGR.CL.E-small AGR.CL.E-fall
'The small partridge fell.'

g. Class Ɛ **gù**-jó **gò**-ʤàlà **gò**-fɨdá
CL.Ɛ-tree AGR.CL.Ɛ-small AGR.CL.Ɛ-fall
'The small tree fell.'

h. Class F **ǹ**-sɨlá **ǹ**-ʤàlà **ǹ**-fɨdá
CL.F-egg AGR.CL.F-small AGR CL.F- fall
'The small egg fell.'

i. Class G **bò**-tòŋà **bò**-ʤàlà **bò**-fɨdá
CL.G-salt AGR.CL.G-small AGR.CL.G-fall
'The small salt fell.'

j. Class Y **bə̀**-pi **bà**-ʤàlà **bà**-fɨdá
CL.Y-child AGR.CL.Y-small AGR.CL.Y-fall
'The small children fell.'

k. Class W **ɪ**-bɔ̀rɪ **bà**-ʤàlà **bà**-fɨdá
CL.W-animal AGR.CL.W-small AGR.CL.W-fall
'The small animals fell.'

l. Class Ʊ **ò**-fílɪ **bò**-ʤàlà **bò**-fɨdá
CL.Ʊ-fish AGR.CL.Ʊ-small AGR.CL.Ʊ-fall
'The small fish (pl) fell.'

m. Class U **i**-ʤè **ɪ**-ʤàlà **ɪ**-fɨda
CL.U-yam AGR.CL.U-small AGR.CL.U-fall
'The small yams fell.'

n. Class T **ə̀**-jó **à**-ʤàlà **à**-fɨdá
CL.T-tree AGR.CL.T-small AGR.CL.T-fall
'The small trees fell.'

2.5.3 Suffixes

Anii-Gisida has a relativizer suffix which attaches to nouns. Example (10) illustrates the relativizer suffix [i/ɪ][10]. This suffix undergoes [ATR] harmony based on the vowel feature in the preceding noun stems.

(10) **Suffixation in Anii-Gisida** (Morton, 2012, p. 74)

a.	[bu-tó]	'water'	[bu-tó-i]	'water which'
b.	[a-ɲɛ́]	'hand'	[a-ɲɛ́-ɪ]	'hand which'
c.	[gə-dú]	'place'	[gə-dú-i]	'place where'
d.	[a-rɛ]	'man'	[a-rɛ-ɪ]	'man who'

In Anii-Gisida, nouns can be derived from verbs, as shown in (11); (examples adapted from Morton 2012, p. 74). In example (11) (a)-b) the noun *ʊfaŋɔ́* 'the act of teaching' is derived from the verb *faŋá* 'to teach' by attaching both a prefix (a noun class marker) and a suffix.

(11) **Nominalization in Anii-Gisida**

a.	[faŋá]	'to teach'	[ʊfaŋɔ́]	'the act of teaching'
b.	[boŋɔ́]	'to finish'	[uboŋú]	'the end'

2.6 Summary

The sections of this chapter presented background that will facilitate our understanding of the vowel harmony system in Anii-Gisida. Anii-Gisida has eleven vowel phonemes and these vowels occur in minimal or near minimal pairs. In addition to vowel harmony, Anii-

10 The final tone is omitted in the relativized nouns in (10) in order to show the [ATR] value of the final relativizer suffix. The final surface tone is falling.

Gisida has processes of nasal place assimilation, G-deletion, and palatalization. In this language, all nouns have a noun class marker that triggers agreement on adjectives and verbs. There are fourteen noun class markers; nine of which are for singular nouns, and five are for plural nouns.

Chapter 3: Anii Vowel Harmony

3.1 Introduction

This chapter introduces the basic vowel harmony system of Anii-Gisida. The first publication containing an analysis of vowel harmony is Morton (2012). Most of the examples in this chapter come from Morton (2012, 2014). In this chapter, I will first give a general overview of vowel harmony (section 3.2) and go on to describe vowel harmony in Anii-Gisida (section 3.3). I will further discuss the high central vowel of the Anii-Gisida dialect which patterns differently from other high central vowels in eleven vowel languages (section 3.4). I will provide a brief overview of the domain of harmony in section(3.5). I discuss the domain of harmony in Anii-Gisida in section (3.5.1), and the directionality of harmonic spreading in section (3.5.2). The final section (3.6) will summarize the chapter.

3.2 Vowel Harmony

Vowel harmony is a phenomenon where vowels within a domain systematically agree with each other in terms of one or more features (Krämer, 2008). Thus, one set of vowels induces another set of vowels to change within the same domain. The domain can be a word or syllable, among others (see section (3.5.1) for more details). Vowel harmony has received considerable attention in the literature (see Archangeli & Pulleyblank, 1989; Atipoka & Nsoh, 2018; Clements, 1985; Kabak, 2011; O'Keefe, 2003; Van der Hulst, 2016; Van der Hulst & Jeroen van de Weijer, 1995). The harmonizing feature can be any vowel feature, including height, rounding, backness,

and Advanced Tongue Root ([ATR]). The feature [ATR] is most commonly involved in vowel harmony in Niger-Congo and Nilo-Saharan languages (Casali, 2003, 2008, 2016) (see also Rose, 2018). The following section will provide background on [ATR] processes in Anii-Gisida dialect.

3.3 [ATR] Harmony in Anii-Gisida

In [ATR] harmony languages, the harmonic feature is [ATR]. Phonetically, [+ATR] vowels are articulated with the root of the tongue in a more advanced position and the pharyngeal cavity widened; in contrast, [-ATR] vowels are produced with the tongue root in a less advanced position and more constriction in the pharynx Lindau, 1978); (the phonetic implementation of [ATR] varies based on the speakers and different languages) Some African languages with [ATR] harmony have a symmetric system of ten contrastive vowels with five [+ATR] /i, e, ə, o, u/ and five [-ATR] /ɪ, ɛ, a, ɔ, ʊ/ vowels (eg., Vata (Kaye, 1982), Diola-fogny (Sapir, 1965); etc). In contrast, nine-vowel harmony languages have five [-ATR] /ɪ, ɛ, a, ɔ, ʊ/ and four [+ATR] /i, e, o, u/; such languages include Akan (Clements, 1985; O'Keefe, 2003) and Maasai (Quinn-Wriedt, 2013). Seven-vowel inventory languages are the most common and such languages may have either /i, ɪ, ɛ, a, ɔ, ʊ, u/, like Kinande (Mutaka, 1995), or /i, e, ɛ, a, o, ɔ, u/, like Yoruba (Archangeli & Pulleyblank, 1989; Orie, 2001). In nine and seven-vowel languages, the low central vowel /a/ varies in status; in most cases, it is a non-participatory vowel; thus, it can co-occur with both [+ATR] and [-ATR] vowels, and in other cases it triggers harmony (Casali

2008). Eleven vowel languages have an asymmetric system of eleven contrastive vowels with five [+ATR] /i, e, ə, o, u/ and six [-ATR] /ɪ, ɛ, ɨ, a, ɔ, ʊ/; examples include Baka (Paker, 1985) and Boni (Heine, 1980) (see also Morton, 2012). In most cases the high central vowel /ɨ/ does not participate in harmony.

Anii-Gisida has an eleven vowel inventory, which is rare in African languages. All eleven vowels are active in [ATR] harmony. Anii-Gisida has five harmonizing pairs, [i,ɪ], [e,ɛ], [a,ə], [o,ɔ] and [u,ʊ]. The high central vowel, /ɨ/ does not have a harmonic counterpart, but it also occurs exclusively with [-ATR] vowels in a word and triggers [ATR] harmony. The target of [ATR] vowel harmony in Anii-Gisida is the affix vowel, and the root vowels act as the trigger (Morton, 2014). This is commonly seen in many other African vowel harmony systems in which affixes and roots can either be the trigger or the target of vowel harmony (see Casali, 2003, 2008). Finally, in Anii-Gisida the mid vowels /e, ɛ, o, ɔ/ and the high central vowel /ɨ/ only occur in stems and never in affixes (Morton, 2012).

[ATR] harmony affects noun class markers, adjectival and verbal prefixes as well as verb suffixes. Anii-Gisida class markers participate in [ATR] harmony. [ATR] harmony also occurs within roots (e.g., *òdʒɪò* ‘eat’), across morphemes (e.g., *gà-ʃɛjɪ* ‘basket’) and between clitics and verbs (e.g., *gi=jidè* ‘we stopped’). In the following examples, we see affixes agreeing in [ATR] with nominal, adjectival and verbal roots.

(12) **[ATR] in Noun-Class Markers** (Morton, 2012, p. 72-73)

	Class marker	[-ATR]		[+ATR]	
a.	Class A	Not attested[11]		[**u**-pi]	‘child’
b.	Class Ǝ	[**a**-bɔrɪ]	‘Sheep/animal’	[**ə**-kutú]	‘orange’
c.	Class C	[**ga**-fílɪ]	‘fish (sg)’	[**gə**-dú]	‘place’
d.	Class Ð	[**gɪ**-bɔ]	‘very short shorts’	[**gi**-ʤe]	‘yam’
e.	Class E	[**ʊ**-dɔ]	‘neck’	[**u**-ʧine]	‘heart/courage’
f.	Class Ɛ	[**gʊ**-tɔ]	‘ear’	[**gu**-jó]	‘tree’
g.	Class W	[ɪ-fɨtɨla]	‘lambs’	-	

The noun class markers are in bold in the data above. All the noun class markers participate in [ATR] harmony. Each noun class marker has two forms, except (12) (g), one that surfaces when attached to roots with [-ATR] vowels, and one that surfaces when attached to roots with [+ATR] vowels. The high central vowel in stems always triggers [-ATR] harmony, so there is no [+ATR] counterpart in (12) (g).

Noun class agreement prefixes on adjectives also participate in the [ATR] harmony process. The vowels in the adjective root determine the [ATR] specification of the vowel in the noun-class agreement prefix as shown in example (13). For instance, in (13) (a) the [+ATR] vowels in the adjectival root -*tolo* spreads their vowel quality to the agreement marker *gi*-. Thus, all the vowels in the adjectival word share the same harmonic feature. The noun class marker and its agreement marker on the adjectives are highlighted in the examples below.

11 The example for Class A is not known based on the available data.

(13) [**ATR] Harmony in Adjectives** (Morton, 2012, p. 73)

a.	**gi**-ʤe **gi**-tolo CL-yam CL-uncooked	‘uncooked yam’
b.	**gi**-ʤe **gɪ**-fɔlɪ CL-yam CL-new	‘new yam’
c.	**gɪ**-ʤaŋkáɪ **gi**-tolo CL-pepper CL-uncooked	‘uncooked pepper’
d.	**gɪ**-ʤaŋkáɪ **gɪ**-fɔlɪ CL-pepper CL-new	‘new pepper’

Similarly, [ATR] harmony exists within verbs (14). Both the subject agreement marker and the imperfective marker share the same [ATR] value as the vowels in the verb root. For example, in (14) (a) the vowels of the subject agreement marker *ba* and the imperfective marker *tɪ* are [-ATR], in agreement with vowels in the verb root *pɛmpɛŋɛ.* This contrasts with (14) (b) in which the subject agreement marker *bə* and the imperfective marker *ti* are both [+ATR] in agreement with the verb root *kide.*

(14) [**ATR] Harmony in Imperfective Marker and the Verb Root** (Morton, 2012, p. 74)

a. bə-pi ba-tɪ-pɛmpɛŋɛ ŋ-kú
CL.Y-child AGR.CL-A.IMPF-clean CL.Ɛ-room
'The children are cleaning the room'

b. bə-pi bə-ti-kidé ŋ́-kú
CL.Y.child AGR.CL.A-IMPF-look.at CL.Ɛ.room
'The children are looking at the room'

c. ù -pi à-ʤàlà à-tɪ-pɛ̀mpɛ̀ŋɛ̀ gù-jó
CL.A-child AGR,CL.A-small AGR.CL.A-IMP-clean CL.Ɛ-tree
gò-bòmbɔ̀nɔ̀
AGR.CL.Ɛ-big
'The small child is cleaning the big tree.'

d. ù -pi à-ʤàlà ə̀-ti-kide gù-jó
CL.A-child AGR.CL.A-small AGR.CL-A IMP look.at CL.Ɛ-tree
gò-bòmbɔ̀nɔ̀
AGR.CL.Ɛ-big
'The small child is looking at the big tree.'

Subject clitic pronouns in Anii-Gisida agree in [ATR] with the following verb. The verb determines the [ATR] properties of the vowels in the subject pronouns.

(15) [**ATR] Harmony in Verbs and the Subject Pronoun Clitics** (Morton, 2014, pp. 278–283)

a. [ń=tsikilà] 'I mixed'
b. [ń=kàrà] 'I got dressed'
c. [ń=tsəŋkèrè] 'I learned'
d. [à=tsɨkɨ̀là] 's/he mixed'
e. [ə̀=tsəŋkèrè] 's/he learned'
f. [gi=jidè][12] 'we stopped'
g. [ɪ=bɨ̀dà] 'you (pl) threw it away'

12 The low tone on gi and ɪ is omitted in the subject pronoun in (f-g) to show the [ATR] harmony difference in the vowels.

In example (15) (a-c), [ATR] harmony occurs only within the verbs since the subject pronouns are consonantal[13]. However, in example (15) (d-g) [ATR] harmony affects the clitics; the harmonic feature of the verb determines the [ATR] quality in the subject pronouns. This behaves like the noun-class marker and its noun head, as discussed above.

The relative pronoun enclitic [=i, =ɪ] also shows [ATR] harmony, and agrees with the [ATR] value of the vowels in the preceding noun root (adapted from Morton, 2012, p. 74).

(16) [**ATR] Harmony in Suffixes**

a.	[gə-dú]	'place'	[gə-dú=i]	'place where'
b.	[u-ʧĩne]	'courage'	[u-ʧĩnɛ=i]	'courage which'
c.	[a-rɛ]	'man'	[a-rɛ=ɪ]	'man who'
d.	[gʊ-tɔ]	'ear'	[gʊ-t=ɪ]	'ear which'

In example (16) (a) and (b), the root has a [+ATR] vowels and it determines the harmonic property of both the suffix and the prefix. In (16) (c) and (d), the [ATR] feature in the root is a [-ATR], causing both the affixes to be realized as [-ATR].

[ATR] harmony can also be seen with nouns derived from verbs. Both the vowels of the noun class markers and the nominalizing affix agree in [ATR] with the root, [-ATR] when the root is [-ATR] (see (17) (a-b) and [+ATR] when the root is [+ATR] (see ((17) (c-d)).

13 This high tone on the subject clitic in (15) (a-c) is grammatical. See Morton (2014) for more description of tones.

(17) [**ATR] Harmony in Nouns derived from Verbs** (Morton, 2012, p. 74)

a.	[faŋ-á]	‘to teach’	[ʊ-faŋ-ʊ́]	‘the act of teaching’
b.	[fʊb-a]	‘to change’	[ʊ-fʊb-ʊ]	‘the act of changing’
c.	[boŋ-ó]	‘to finish’	[u-boŋ-ú]	‘the end’
d.	[toŋ-o]	‘to transport’	[u-toŋ-u]	‘transportation’

3.4 The High Central Vowel

The high central vowel is an eleventh vowel phoneme in Anii-Gisida, discovered by Morton (2010, 2012). It is the only vowel that does not have a harmonic pair; however, it consistently triggers [ATR] harmony. This vowel occurs exclusively in the root and not the affix. This section presents some differences between the Anii-Gisida high central vowel in relation to other eleven-vowel systems in African languages. The high central vowel /ɨ/ in Anii-Gisida is a new phoneme due to a historic process known as phonemic split. According to Morton (2012), the high central vowel [ɨ] was an allophone of the high front vowel /ɪ/, occurring in the environment of liquids and nasals. However, in modern Anii-Gisida, these two vowels occur in minimal and near minimal pairs (eg., [ʧɨ] ‘to build’ vs [ʧɪ] ‘to wash’). Thus, they are now two different phonemes. (See Morton, 2012 for more discussion on the origin of the high central vowel).

The database in Casali (2003) shows several other languages that exhibit eleven vowel [ATR] harmony systems, including Baka (a central Sudanic language), Boni (Cushitic),

Lama (Gur) and Kanembu (Nilo Saharan). These languages all differ from Anii-Gisida in terms of the number of vowels that participate in harmony. In Baka and Boni, the high central vowel /ɨ/ does not participate in [ATR] harmony. The high central vowel /ɨ/ in Lama and Kenembu is part of a harmonic pair, however, unlike Anii-Gisida, the low vowel /a/ is neutral, and thus, does not participate in [ATR] harmony (see Morton, 2012 for more discussions on these languages, and Heine, 1980 for Boni dialect).

Baka has eleven vowel phonemes (/i, ɪ, e, ɛ, ə, a, ɨ, o, ɔ, u, ʊ/), of which ten vowels are active in [ATR] harmony processes. There are five [+ATR] vowels (/i, e, ə, o, u,/) and five [-ATR] vowels (/ɪ, ɛ, a, ɔ, ʊ/). The high central vowel (/ɨ/) is neutral and co-occurs with either [+ATR] vowels or [-ATR] vowels. The [ATR] harmony processes in Baka is shown in (18).

(18) **ATR Harmony in Baka** (Paker, 1985, pp. 73–75)

a.	mbɔ́lɪfɔ́		‘pigeon’
b.	gbègbéřì		‘throat’
c.	mɨmbɛ́dɛ̀		‘liver’
d.	lɔ́ndɔ̀ +-yi brother+2sg	lúndùyi	‘your brother
e.	lémì +-ma[14] sister+1sg	lémìmə	‘my sister’
f.	bɨlɔ́ndɔ̀ +-yi grandfather+2sg	bɨlunduyi	‘your grandfather’
g.	tàrà +-yi mouth+2sg	tərəyi	‘your mouth’

14 Paker (1985) highlights some exceptions to stem harmony for low vowel /a/, and provides an example: aka+yi =akayi ‘your co-wife’.

As shown in the examples above, all vowels in a word is either [+ATR] or [-ATR], like other [ATR] harmony languages.

The Baka high central vowel /ɨ/ patterns as a neutral vowel; as mentioned above. Thus, it does not participate in harmony. Paker (1985) posits that the Baka high central vowel is a lax vowel since it is not active in [ATR] harmony processes. This vowel occurs in proclitics as in (20) (a-b), and is found in unstressed antepenultimate syllables in (21) (a-b); several other vowels can also occur in unstressed antepenultimate position (see Paker, 1985, p. 70).

(19) **Baka Neutral Vowel** (Paker, 1985, p. 71)

a. [nɨ-ógù] ‘he (future) come’
b. [mɨ-ógù] ‘coming’

(20) **Baka Proclitic** (Paker, 1985, p. 70)

a.	/**mɨ**=tɔ́nɔ́/		[**mɨ**tɔ́nɔ́]	‘beginning’
	nominalizer	‘begin’		
b.	/**kɨ**=di/		[**kɨ**di]	‘speech introducer’
	‘with’	‘said’		

(21) **Baka Unstressed Syllable** (Paker, 1985, p. 70)

a.	/bʲlúndɔ̀/	[bɨ̀lɔ́ndɔ́]	‘grandfather’
b.	/màŋgʲrɔ̀kɔ/	[màŋgɨ̀rɔ̀kɔ]	‘woman's hoe’

Unlike Baka, the high central vowel (the eleventh vowel) in Anii-Gisida is always [-ATR] and occurs exclusively with [-ATR] vowels (see example (22) (a-d). It also occurs only in stems, and it does not appear in clitics or affixes syllables as shown in (22) (e-f).

(22) **High Central Vowel** in **Anii-Gisida** (Morton, 2012, pp. 73–75)

a.	[gɪ=pɨl]	‘we cooked’
b.	[gɪ=tsíŋ]	‘we are good’
c.	[bʊ-kɨma]	‘black’
d.	[gɪ-dɔmpɨlá]	‘slavery/captivity’
e.	[fɨl]	‘to pass/leave’
f.	[kɨ]	‘to hit’

In the above examples, all the vowels in (22) (a-d) are [-ATR] and the high central vowel triggers [-ATR][15]. Examples (22) (e) and (f) provide evidence that this vowel can occur alone in words.

3.5 Domain and Directionality of Anii-Gisida [ATR] Harmony

This section provides an overview of the domain and the directionality of harmony spreading in Anii-Gisida. I will present the domain in which harmony occurs in section (3.5.1), then describe the directionality of Anii-Gisida harmony in section (3.5.2).

15 An alternative possibility, not pursued here, is that [ɨ] could be underlyingly a [-ATR] since it only occurs with [-ATR] words in a stem (see example (23).

3.5.1 The Domain of Harmony in Anii-Gisida

The domain of harmony in [ATR] vowel harmony languages in Africa is language-specific. [ATR] can spread across a word boundary (e.g., Alur; Kutsch Lojenga, 1991); between root morphemes in lexical compounds (e.g., Nawuri; Casali, 2002), (Gurene; Atipoka & Nsoh, 2018b); or be restricted within a word and root/stem (Nata; Gambarage, 2013).

In Anii-Gisida, the domain of harmony is within the clitic group[16]. This is evidenced by [ATR] harmony spread between subject pronouns (clitics) and verbs (see example (23)) and between noun class markers and the head nouns (see example (24)) but not words in compounds (example (25)).

(23) **The Domain of Harmony between Clitics and Verbs** (Morton, 2014, pp. 278–283)

a.	à = t͡sɨkɨlà	‘s/he mixed’
b.	ə = tsəŋkèrè	‘s/he learned’
c.	gi = jidè	‘we stopped’
d.	ɪ = bɨdà	‘you(pl) threw it away’
e.	ó = bɨdà	‘you(sg) threw it away’
f.	à = d͡ʒàŋkpàtà	‘s/he is annoyed’
g.	ə = dòŋò	‘she made a field by burning’
h.	à = kɔ̀kɨr̀	‘s/he scooped or emptied it’

16 In prosodic phonology, the domain of constituents can be the syllable, foot, phonological word, clitic group, phonological phrase, intonational phrase and utterance. The syllable is the lowest while the utterance is the highest (Nespor & Vogel, 2012) (see also Kabak & Vogel, 2001; Rose & Walker, 2011).

In the above examples, the domain of harmony is between the clitics and the verbs; for instance, in example (23) (a) the verb *t͡sɨ̀kɨ̀là* ‘mixed’ and the clitic subject pronoun *à* ‘she’ share the same feature value: [-ATR]; likewise, in (23) (b). the subject pronoun is *ə̀* ‘she’ due to [+ATR] harmony.

(24) **Domain of Harmony between Noun Class Markers** (Morton, 2012, p. 72, 2014, p. 269)

a.	gə-dú CL.C-place	‘place’	ga-fılı Cl.C-fish	‘fish(sg)’
b.	ù-fò Cl.E-partridge	‘partridge’	ʊ-dɔ Cl.E-neck	‘neck’
c.	ə-kutú Cl.Ǝ-orange	‘orange’	a-bɔrı Cl.Ǝ sheep/animal	‘sheep/animal’
d.	gi-ʤè Cl.Đ-yam	‘yam’	gı-ʧá CL.Đ-bean	‘bean’

In example (24), [ATR] harmony is across morpheme boundaries (class marker and stem). For instance in (24) (a), the word *bò-* ‘plural class marker’ is a morpheme which takes its [-ATR] feature value from the stem *-fılı* ‘fish’.

In compound words, as in (25), the adjacent stems do not agree for [ATR], illustrating that harmony does not occur across compound words. The noun class marker agrees with the closest stem in compounds, but each root retains its original [ATR] feature specification.

(25) **The Domain of Harmony in Compound Nouns** (Morton, 2012, p. 74)

a. [ò-fàl-ŋóno]
CL-house-old/important person
'head of the house'

b. [gə̀-tú-nɔ́]
CL.stream-mouth
'bank of a river'

c. [ʊ-pa-pí]
CL.village-child
'a native'

The domains in (23) - (25) all correspond to the clitic group, which consists of a stem plus any clitics dependant on it, but does not include the domain of a compound.

3.5.2 The Directionality of Anii-Gisida Harmony

In recent studies of the directionality of vowel harmony (Aoki, 1968; Bakovic, 2000, 2003; Casali, 2008; Harvey & Baker, 2005; Linebaugh, 2015), we find different patterns in terms of whether directionality is dependant on morphological or phonological factors. In some cases, directionality is determined by morphological factors. Thus, languages with only prefixes may have only regressive harmony (harmony affects only vowels to the left), where languages with only suffixes will have progressive harmony (harmony affects only vowels to right), and languages with both prefixes and suffixes will have bidirectional harmony. Aoki (1968) argues that harmony is bidirectional in dominant-recessive[17] harmony systems, while morphological factors account for directionality in

17 Dominant recessive harmony is where the trigger is always of the dominant feature value either in the root or the affix.

root controlled systems[18]. Bakovic (2000) posits that agreement constraints, as well as faithfulness and markedness constraints, are responsible for determining directionality within an Optimality Theory framework.

The directionality and the type of vowel harmony are not predictable from morphological factors. Casali (2008) highlights (based on his language survey) that directionality in vowel harmony must be stipulated in the phonology of a language. Linebaugh (2015) provides evidence in support of Casali's claim. Linebaugh highlights that some languages like Dilo, Mayogo and Karajá, Kalabri, which have both prefixes and suffixes, are strictly regressive, thus, harmony affects only the vowels to the left (regressive) and not to the right (progressive). Also, Kalabri has both prefixes and suffixes, but the direction of harmony is exclusively regressive. Linebaugh concludes that the direction of harmony does not follow from morphological factors (see also Otero, 2015).

In Anii-Gisida, harmony is bidirectional, but regressive harmony is more common, because prefixes are more common than suffixes. Bidirectionality is illustrated in (26), and regressive harmony, in (27).

18 Root-controlled harmony is where vowel in the root of affixation determines the value of the harmonic feature in the entire word (Bakovic, 2000).

(26) **Bidirectional Harmony** (Morton, 2012, p. 74)

← →

a. [gə-dú-i] ‘place where’
b. [u-ʧĩne-i] ‘courage which’
c. [a-rɛ-ɪ] ‘man who’
d. [ʊfaŋó] ‘the act of teaching’
e. [utoŋu] ‘transportation’

(27) **Regressive Harmony** (Morton, 2012, p. 73)

←

a. [bʊ-tʊŋa] ‘salt’
b. [a-ɲɛ́] ‘hand’
c. [gí=tsəŋ] ‘we stung’
d. [bu-tó] ‘water’
e. [i-bú] ‘snakes’

In the above examples, the arrows show the direction of harmonic spread. [ATR] harmony is root-controlled: the root is the trigger and the affix is the target. In (26) (a-e), the direction of the harmonic spread is both progressive and regressive (bidirectional). The root spreads its [ATR] quality to the vowels in both the suffix and the prefix or proclitic. For instance in (26) (a) the root /-dú-/ which is a [+ATR] stem determines the feature value of the prefix /gə-/ and the suffix /-i/. The direction is from the vowels in the root to both the prefix; (right-left) and to the suffix (left-right). In contrast, in example (27) (a-e), the direction of spreading is only from the right to the left (these words lack suffixes). The vowels in the root spreads its [ATR] feature to the vowels in the prefix.

3.6 Summary

The previous sections of this chapter have provided background on the Anii-Gisida [ATR] harmony system. Anii-Gisida has eleven vowel phonemes and all the vowels participate in [ATR] harmony. The domain of harmony is within clitic group (which includes a word plus any proclitics and enclitics). The direction of harmony is bidirectional in words with both prefixes and suffixes, and regressive in words with only prefixes. Words with only suffixes have not been attested in Anii-Gisida, and this needs future research. The rest of this thesis will focus on the theories used in the literature to account for vowels that participate in vowel harmony processes, positional neutralization and markedness relations. These theories will be considered in relation to vowel harmony patterns in Anii-Gisida.

Chapter 4: Minimal Difference Approach to Vowel Harmony

4.1 Introduction

Features serve to distinguish segments that undergo and do not undergo phonological process and also distinguish each segment in a language's inventory. In some approaches (Dresher, 1998, 2003b, 2009; Hall, 2007, 2017) to feature specification, only contrastive features are expected to play a role in phonological processes and to be specified in underlying representations. Different approaches have been adopted to decide whether a feature is contrastive or not. What then is a contrastive feature? This chapter provides an overview of contrastive features in section (4.2). The second section (4.3) will introduce the minimal pair definition of contrast, and an analysis using one of the approaches (Minimal Difference Approach (MDA)) to determining contrastive features. Section (4.4) will focus on the relationship between the MDA and vowel harmony processes. The final section (4.5) will summarize the chapter.

4.2 Contrastive Features

Contrastive features are features that distinguish one segment from another. Trubetzkoy (1936) refers to contrastive features as *oppositions*. Dresher (2016) posits that this notion of opposition is a relation between a pair of phonemes, and that every phoneme enters into opposition with every other phoneme in a language. For instance, in English, [voice] is contrastive in obstruents. The feature [voice] distinguishes between [p]/[b], [f]/[v], [t]/[d], [s]/[z], [ʃ]/[ʒ], [k]/[g] as shown in (28).

(28) Contrastive [±voice] in English Obstruents

	Bilabial	Labiodental	Apical	Alveolar	Prepalatal	Velar
[-voice]	p	f	t	s	ʃ	k
[+voice]	b	v	d	z	ʒ	g

4.3 Minimal Pair Difference Approach to Contrast

The Minimal Difference Approach (MDA) has been used to determine contrastive features. The MDA designates features as contrastive if they distinguish pairs of phonemes. This approach is implemented by pairing segments. In dividing features within the MDA, Archangeli (1988) (cited in Dresher, 2009) proposes the *pairwise algorithm* in (29).

(29) **MD Algorithm** (Archangeli, 1988, p. 192)

> a. Fully specify all segments
> b. Isolate all pairs of segments
> c. Determine which segment pairs differ by a single feature specification
> d. Designate such feature specification as 'contrastive' on the member of that pair.
> e. Once all pairs have been examined and appropriate feature specifications have been marked 'contrastive' delete all unmarked feature specifications on each segment.

Martinet's (1960) description of Standard French consonants illustrates the MDA. Focusing on the contrastive specifications of bilabial stops /p, b, m/, Martinet stipulates that /p/ is contrastively [-voice], /b/ is contrastively [+voice] and [-nasal], while /m/ is

contrastively [+nasal] but not contrastively [+voice]. By applying the above algorithm, we will arrive at the contrastive specifications in (30).

(30) **French Bilabial Stops** (Martinet, 1960) (cited in Dresher, 2009, p. 13)

a.

	p	b	m
[voice]	-	+	+
[nasal]	-	-	+

b.

	p	b	m
[voice]	-	+	
[nasal]		-	+

Example (30) (a) shows the full specifications of the French bilabial stops while (30) (b) provides the contrastive specifications, where the phonemes are minimally different in terms of their feature specification. For instance, the feature [voice] is the only feature which distinguishes /p/ from /b/ and the feature [nasal] is the only feature which distinguishes /b/ from /m/. To put it differently, the feature [voice] is contrastive in /p/ and /b/ and [nasal] is also contrastive in /b/ and /m/. According to Martinet (1960) (cited in Dresher, 2009), /m/ is not contrastively voiced because:

> The segments /m, n, ñ/ are not only nasal but also voiced. However, here voice cannot be dissociated from nasality since in this position there are no voiceless nasals. This is why /m, n, ñ/ do not figure in the class of the 'voiced' elements, which are defined as such solely in virtue of their opposition to 'voiceless' partners (Martinet, 1960, cited in Dresher, 2009, p. 14).

Similarly, Dresher (2009) points out that the phoneme /p/ is not contrastively [-nasal] in French because there is no voiceless nasal /m̥/ phoneme in the language. As illustrated in

(30) the feature [nasal] and [voice] are unspecified for /p/ and /m/ respectively. The phoneme /m/ is inherently voiced, so [+voice] is redundant.

4.4 Minimal Difference Approach to Vowel Harmony Processes

One issue in the analysis of vowel harmony processes has been whether only contrastive features participate in harmony or whether both contrastive and non-contrastive features participate in harmony. Nevins (2010) asserts that there are harmony processes that employ both contrastive and non-contrastive features. Nevins (2010) proposes a *Minimal Difference* algorithm in classifying features that are contrastive, similar to the pairwise algorithm shown above. According to Nevins "a segment S with specification αF in position P is contrastive for F if there is another segment S in the inventory that can occur in P and is featurally identical to S, except that it is -αF" (Nevins, 2010, p. 80). This means that assuming there are two segments, A and B in a language's inventory, A and B must share the same feature set, (e.g., [round]), except one and only one feature of the set should have opposite feature values, (e.g., [+back] and [-back]). To better understand Nevins' definition of contrast, let's look at an example in Finnish shown in (31).

(31) **Finnish Vowel Inventory** (Nevins, 2010, p. 80)

[-back,-round]	[-back,+round]	[+back,+round]	[+back,-round]	
i	ü	u		[+high,-low]
e	ö	o		[-high,-low]
ä			a	[high,+low]

In the Finnish vowel inventory, the [-back] vowels (/ü, ö, ä/) have harmonic counterparts of [+back] (/u, o, a/) respectively. These vowels only differ in [±back]. Since these vowels have harmonic counterparts, they are contrastive for the harmonic feature and, participate in the vowel harmony processes in Finnish as shown in (31). On the other hand, /i/ and /e/ have no harmonic counterpart; thus they are non-contrastive for the feature [±back], so they do not participate in vowel harmony but are instead transparent. The Finnish vowel harmony process is illustrated in (32) below.

(32) **Finnish Vowel Harmony** (Nevins, 2010, p. 80)

a. pöütä-nä ‘table-essive’
b. pouta-na ‘fine.weather-essive’
c. koti-na ‘home-essive’
d. pappi-na ‘priest-essive’

In the above example, the essive suffix /-na, -nä/ alternates based on the feature specification in the root. In (32) (a) the vowels in the root *pöütä*- are [-back] so they trigger a [-back] feature in the essive suffix -*nä.* In (32) (b) the [+back] vowels in the root *pouta*- triggers a [+back] feature in the essive suffix -*na.* However, in (32) (c-d), the [high, -back] vowel, /i/ does not trigger harmony. The [+back] vowels in the root rather

skip it to trigger [+back] harmony in the suffix *-na.* As Nevins (2010) posits, segments are only contrastive for a given feature if there are two segments that differ in only that feature value. In Finnish, only segments that contrast in a particular feature participate in vowel harmony.

Nevins' hypothesis, however, still maintains that harmony processes can refer to both contrastive and non-contrastive features in a language. For example, non-contrastive segments that do not have a harmonic pair can participate in harmony processes in Standard Yoruba, but not in Ife Yoruba.

(33) **Yoruba Vowel Inventory** (Nevins, 2005, p. 11)

i	u	[+high, +ATR, -low]
e	o	[- high, +ATR, -low]
ɛ	ɔ	[-high, -ATR, -low]
a		[-high, -ATR, +low]

As seen in (33), the feature [ATR] is contrastive in the [-high, -low] vowels (/e/o, ɛ/ɔ/) and not in [+high] or [+low] vowels /i, u, a/.

Ife Yoruba and Standard Yoruba are two dialects of the same language with identical vowel inventories but different patterns of [ATR] harmony. In Ife Yoruba, only contrastive vowels participate in vowel harmony as in examples (34) while in Standard Yoruba, all vowels participate, both those with a contrastive [ATR] specification and those with a non-contrastive [ATR] specification as in (35). Nevins (2005) explains the

difference as microvariation, thus, non-contrastive features can participate in harmony in some dialects and in others, they do not participate in harmony.

(34) **Ife Vowel Harmony** (Nevins, 2005, pp. 17–20)

a. ole ‘thief’
b. ɔsɛ ‘soap’
c. ɛúrɛ́ ‘goat’
d. ɔdídɛ ‘parrot’
e. ɔrukɔ ‘name’

As shown in the examples above, all mid vowels are active in [ATR] harmony in Ife Yoruba. The [ATR] harmony affects only contrastive vowels (mid vowels) in both disyllabic and trisyllabic words. The non-contrastive vowels, /i/ and /u/ are transparent and do not participate in [ATR] harmony. This process is similar to the Finnish vowel harmony system described above.

In Standard Yoruba, the mid vowels are also active in [ATR] harmony processes. In disyllabic[19] words as in (35) (a-b), [ATR] harmony affects all mid vowels. In trisyllabic words as in (35) (c-e), all mid vowels that precede medial high vowels are [+ATR]. According to (Dresher, 2012, 2013), the high vowels, /i/ and /u/, which are non-contrastively [+ATR] in Standard Yoruba determine the [ATR] specification of the preceding mid vowel. Based on Nevins’ definition as seen in section (4.4), features that do not have harmonic pairs are non-contrastive. However, in Standard Yoruba, all

19 There are some disharmonic features in disyllabic words in Yoruba. The high vowel, which lacks a [-ATR] counterpart follows [-ATR] vowels (e.g., ɛ̀bi ‘guilt’, ɛtu ‘deer’). See Nevins (2005) for more examples.

features, both contrastive and non-contrastive, are active in harmony processes due to microvariation (Dresher, 2013). Conversely, Archangeli and Pulleyblank (1989) describe why the high vowels in Standard Yoruba neither trigger nor undergo [ATR] harmony. According to them there are no [-ATR, +high] vowels in the language's inventory, therefore a constraint prevents [-ATR] spreading on [+high] vowels. In other words, the [high] vowels in Standard Yoruba are opaque, blocking harmony processes.

(35) **Standard Yoruba Vowel Harmony** (Nevins, 2005, pp. 12–17)

a.	ole	thief
b.	ɔsɛ	'soap'
c.	orukɔ	'name'
d.	èlùbɔ́	'yam flour'
e.	òkígb͡ɛ	'magical drug'

The non-contrastive low vowel /a/, which does not have a harmonic [ATR] counterpart, participates in [ATR] harmony in both Ife and Standard Yoruba (Nevins, 2005) as shown in (36). According to Archangeli & Pulleyblank (1989), [-ATR] specification on low vowels in Standard Yoruba is not a property of underlying representations; [-ATR] is predictable in vowels that are [+low]. In other words, all [+low] vowels are [-ATR]. (see Archangeli & Pulleyblank, 1989) for more discussions on Standard Yoruba vowels. I assume that the behaviour of the low vowel /a/ in Standard Yoruba is the same as that of Ife Yoruba.

(36) **The [+low] Vowel in Ife and Standard Yoruba** (Nevins, 2005, p. 17)

	Ife Yoruba	Standard Yoruba	
a.	ɔba	ɔba	'king'
b.	ɛpa	ɛpa	'peanut'

4.5 Summary

This chapter provided background on contrastive features, the MDA, how the MDA helps to determine features that participate in vowel harmony processes. It is noted that Nevins' hypothesis of vowel harmony processes is based on the concept of minimal difference and he posits that only contrastive features participate in some languages, whereas other languages also allow non-contrastive features to participate in harmony. Is the MDA the best approach to decide whether a segment is contrastive or not? Is harmony limited to only contrastive features? Can segments that do not have a harmonic pair participate in harmony processes? The subsequent chapters will provide answers to these questions, based on Anii-Gisida vowel harmony.

Chapter 5: Vowel Harmony via the SDA Approach

5.1 Introduction

In the preceding chapter, I identified one of the approaches that determines the contrastive specification of segments. The Minimal Difference Algorithm has been adopted by many scholars. However, Dresher (1998, 2003b, 2009) argues against the pairwise approach advocated by the MDA. According to Dresher (2009), the minimal difference (or pairwise) approach does not accurately yield contrastive features in all languages. In particular, it fails to distinguish some members of an inventory when the features are reduced to the minimal set. (Minimal set is a group of distinct words in a language which differ in only one phonological elements). Due to such issues, Dresher (2009) proposes feature ordering as an approach to determine the contrastive feature specifications of an inventory. The first section (5.2) of this chapter provides an overview of the Successive Division Algorithm (SDA). The next section (5.3) will illustrate how the features that participate in harmony processes are determined through feature ranking, using Dresher's (2012) analysis of Yoruba as an example. The final section (5.4) will summarize the chapter.

5.2 Contrastive Feature Specification via the Successive Division Algorithm (SDA)

The Successive Division Algorithm works by successively splitting an inventory until each segment has been assigned a unique set of features. The SDA provides a mechanism for designating contrastive features in a language, and these features are

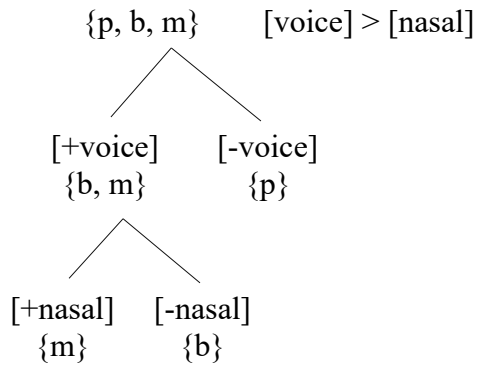
ordered in the form of a hierarchical tree. According to Dresher (2018), the contrastive feature hierarchy is universal to languages. However, the features and the feature ordering is language-specific. Dresher (1998, 2003b, 2009, 2018) posits that the SDA provides a limit to the number of features that can be associated with any given phonological inventory. According to him, learners of a language always arrive at a set of hierarchically ordered features that distinguish between all the phonemes of their language. To fully understand how the SDA works, let us first of all look at some tenets of this theory, from Dresher (2018). The first tenet is that contrasts are computed in the form of a branching tree, and this branching tree is guided by the Successive Division Algorithm. The SDA assigns contrastive features by successively dividing the inventory until every phoneme has been distinguished. The next tenet is the hypothesis that the phonological components of a language L operate only on those features which are necessary to distinguish the phonemes of that language from each other (Hall, 2007). The following example illustrates how SDA determines contrastive feature specification.

(37) **Successive Division Algorithm** (Dresher, 2009, p. 16)

> a. Begin with no feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
> b. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.
> c. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.

According to Hall (2007), the SDA is an acquisition algorithm that defines how language learners build phonological representations. The learners build these representations by discovering phonemic distinctions (features) and then use the features to mark phonemes. He further adds that all the features assigned by the SDA are contrastive. Let us see how the SDA divides an inventory by using the example of French bilabial stops (/p, b, m/). The features are [voice] and [nasal]. By ranking [voice] before [nasal], we will get the hierarchy shown in (38).

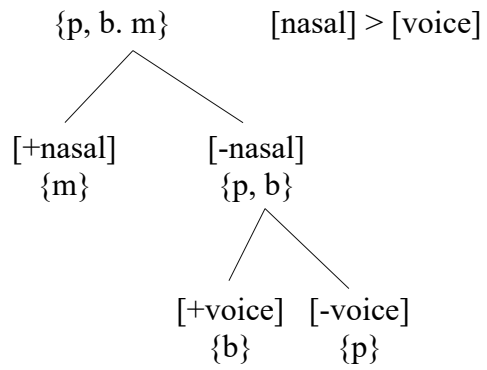
(38) **French Bilabial Stops**



As Dresher (2003a) posits, all members of the inventory are contrastive for a feature F receive specification for F and members for which F is redundant do not receive any specification. As shown in example (38), if [voice] is ordered above [nasal], /p, b, m/ receive contrastive specifications for [voice]. Thus, the feature [voice] is contrastive in the domain of /p, b, m/. /b, m/ further receive contrastive specifications for [nasal]. Thus, [nasal] is contrastive for /b, m/ but not for /p/.

The ordering of features under this approach is important to the analysis of contrastive features in a language's inventory. Different ordering of the features yield different contrastive feature specifications. For example, reversing the order in (38) from [voice] > [nasal] to [nasal] > [voice] will produce the contrastive features in (39).

(39) **Reverse Ranking of French Bilabial Stops**



In example (39), the phonemes /p, b, m/ receive contrastive specification for [nasal], thus [nasal] distinguishes nasal sounds from non-nasal sounds. The non-nasal sounds /p, b/ are further divided into [-voice] and [+voice] respectively. The feature [voice] is redundant in the domain of *nasal,* therefore [voice] is unspecified for /m/. The feature [voice] uniquely distinguishes /p/ from /b/. Language variation or micro-variation is due to the ranking of features in the SDA.

5.3 Contrastive Features in Vowel Harmony via SDA

Phoneme inventories are best understood in terms of contrastive feature specifications assigned in a language-specific hierarchy by the Successive Division Algorithm (SDA)

(Dresher, 2012). Only contrastive features can be phonologically active. Thus, segments that participate in phonological processes in a particular language are active, and therefore must be contrastively specified for the relevant feature. In this approach, the SDA is used in conjunction with the Contrastivist Hypothesis (Hall, 2007) in order to determine feature specifications.

Phonological activity is one of the most compelling motivations that governs the feature hierarchy (Dresher, 2015). Dresher (2012) proposes that harmony is limited to contrastive features and argues that allowing non-contrastive features to participate in harmony processes weakens the predictive power. Dresher (2012, 2013) gives an account with the SDA to show that features that are phonologically active in a language must be contrastive. This account is shown in the analysis of Ife and Standard Yoruba, which is discussed below.

The two dialects of Yoruba have seven vowels /i, e, ɛ, a, o, ɔ, u/, and all the mid vowels participate in [ATR] harmony as shown in (40). The low vowel also triggers [ATR] harmony as in (41), but it does not have a harmonic pair for [ATR] as seen in (33) and discussed in the previous chapter.

(40) [**ATR] Harmony in Yoruba** (Dresher, 2012, p. 11)

	Ife Yoruba		**Standard Yoruba**		
a.	olè	b.	olè	‘thief’	*ɔlè
c.	ɔsɛ	d.	ɔsɛ	‘soap’	*osɛ
e.	ɔrúkɔ́	f.	orúkɔ	‘name’	
g.	ɛ̀lùbɔ́	h.	èlùbɔ́	‘yam flour’	

In Ife and Standard Yoruba, [ATR] harmony affects only the contrastive mid vowels (/ɛ, ɔ/) (/e, o/). However, Ife and Standard Yoruba treat high vowels differently. In Ife Yoruba, the high vowels (/i, u/) are not specified for [ATR]; they are transparent and are not active in the harmony processes (cf. e and g). In Standard Yoruba, the high vowels are specified for [ATR], and act as blockers of harmony (cf. f and h) in (40). The high vowels, /i, u/ in Standard Yoruba are not only opaque, but they are also involved in the [ATR] harmony process. The preceding mid vowels take on the [+ATR] feature from the high vowels in trisyllabic words (Dresher, 2012, 2013). The low vowel /a/ in both Ife and Standard Yoruba also participates in harmony as shown in example (41).

(41) **The Low Vowel in Ife and Standard Yoruba** (Dresher, 2012, p. 13)

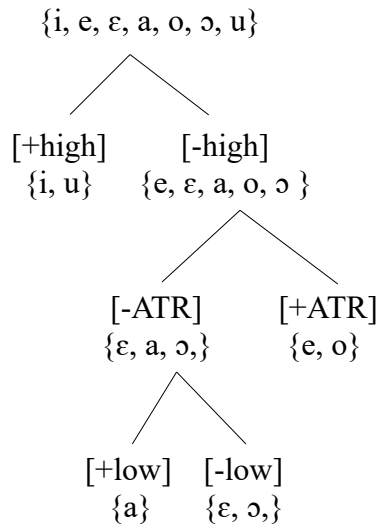
	Ife Yoruba	**Standard Yoruba**		
a.	ɔba	ɔba	‘king’	*oba
b.	ɛpa	ɛpa	‘peanut’	*epa

The SDA can limit contrastive [ATR] specification to the mid vowels in Ife Yoruba. As shown in (42) (a), [ATR] is contrastive only on mid vowels and the low vowel, while

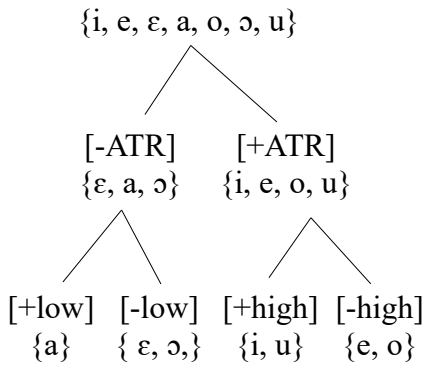
[ATR] is contrastive for all vowels including the high vowels in Standard Yoruba (42) (b). Feature ordering is best able to account for why /a/ is contrastive for [ATR] and also participates in the [ATR] harmony process in both dialects. Note that the ranking of features are [high] > [ATR] > [low] for Ife Yoruba and the ranking for Standard Yoruba is [ATR] > [high] > [low]. The difference between Ife and Standard Yoruba is a consequence of feature ordering in the two dialects (Dresher, 2013). [ATR] harmony computes only contrastive features in both dialects.

(42) **Contrastive Features in Yoruba via SDA** (Dresher, 2013, p. 148)

a. **Ife Yoruba [high] > [ATR] > [low]**



b. **Standard Yoruba [ATR] > [high] > [low]**



According to Dresher's approach, [ATR] harmony affects only contrastive mid-vowels and the low vowel in Ife Yoruba but in Standard Yoruba all vowels are contrastively specified for [ATR]. In this analysis, only contrastive features participate in harmony. On

the other hand, both contrastive and non-contrastive features participate in [ATR] harmony in Ife Yoruba and Standard Yoruba in Nevin's MDA approach to contrast.

5.4 Summary

The sections in this chapter provided an overview illustrating how the SDA assigns contrastive features to phonemes. All segments that contrast for a particular feature receive a specification. Redundant features are not specified. The ordering of contrastive feature specification can account for which features participate in vowel harmony and, in this approach, only contrastive features are active in harmony processes.

Chapter 6: Contrastive Features in Anii-Gisida

6.1 Introduction

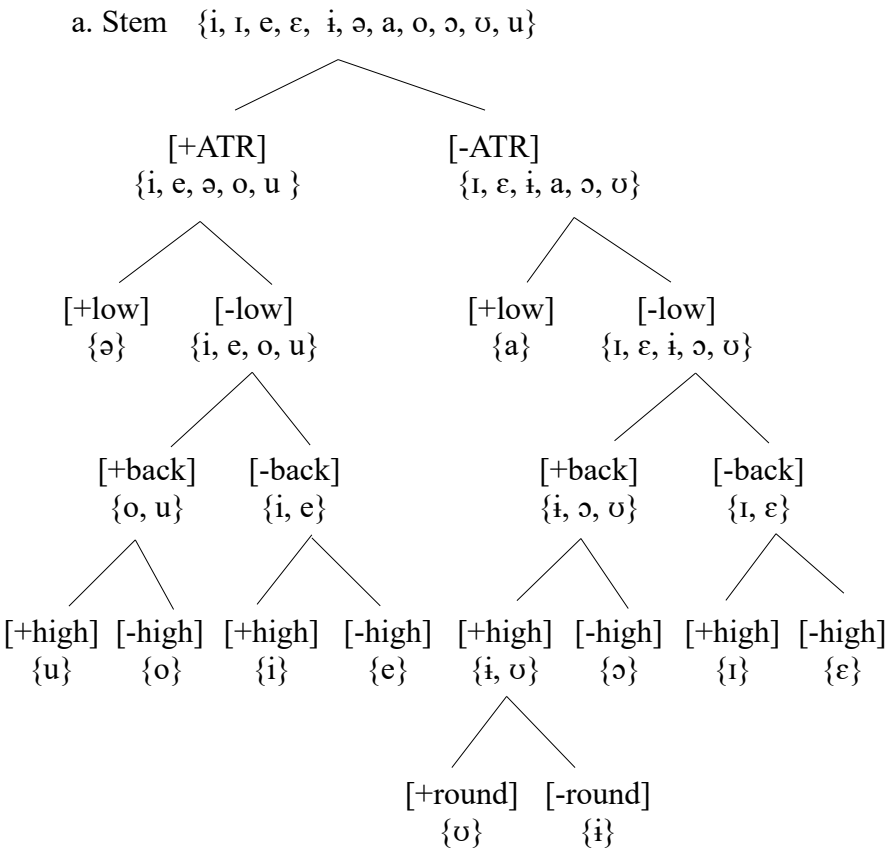
The main goal of this chapter is to classify the Anii-Gisida vowel inventory. To compare the predictive power of each approach, I will use both the Successive Division Algorithm (SDA) (Dresher et al., 1994; Dresher, 2003b) and the Minimal Difference Approach (MDA) (Nevins, 2010). The first section (6.2) of this chapter will show how the SDA assigns Anii-Gisida features. The next section (6.3) will look at how the MDA determines contrastive features in the Anii-Gisida vowel inventory. The chapter will also discuss how the SDA assigns only contrastive features whereas the MDA requires both contrastive and non-contrastive features in order to account for Anii-Gisida vowel harmony. The final section (6.4) will conclude the chapter in favour of the SDA approach.

6.2 Contrastive Features in Anii-Gisida

The SDA limits the number of contrastive features that can be associated with a given phonological inventory and assigns contrastive features by successively dividing the inventory until every phoneme has been distinguished. The steps to determine how the SDA assigns contrastive features was given in example (37). To divide an inventory, a number of features is required to divide an inventory of *n* elements. The minimum number of features is equal to the smallest integer that is greater or equal to $\log_2 n$, and the maximum number of features is equal to n-1 (Dresher, 2018).

The first principle that will guide us with the feature ordering is to identify the number of features required in the language. Anii-Gisida has eleven vowels; hence, *n* is 11. In this case the minimum number of features is 4 ($\log_2 11 = 3.46 \sim 4$) and the maximum number of features is 10 (11-1 = 10). The next is to determine features that are active. Active features are relevant in phonological patterning and, according to the Contrastivist Hypothesis, only contrastive features are active (Dresher, 2016). All the vowels in Anii-Gisida are active in [ATR] harmony processes, so the first feature to divide the inventory in the proposed hierarchy is [ATR]. The second feature is [low]. This feature is used commonly in vowel systems (Dresher, 2012), and [low] will distinguish the [+low] vowels from [-low] vowels. The next feature is [back], chosen because all [-back] vowels trigger fronting or palatalization in Anii-Gisida. The feature [high] is also active in the hierarchy, because all the high vowels (/i, ɪ, i̱, ʊ, u/) contrast with the non-high mid vowels (/e, ɛ, ə, a, o, ɔ/). The final feature for the hierarchy is [round], which is necessary to distinguish round vowels from non-round vowels. Putting together these features, I proposed the hierarchy [ATR] > [low] > [back] > [high] > [round] as shown in (43). As mentioned above, the ordering of the features is crucial to yield the contrastive features in the language's inventory. Changing the ordering will provide a different set of contrastive features that are not relevant for Anii-Gisida. In particular, a different order cannot account for vowel harmony or for the positional neutralization facts discussed in the following chapter.

(43) **Contrastive Features via the SDA**



As shown in the above hierarchy, all vowels in Anii-Gisida are contrastive for [ATR]. This satisfies the requirement that all vowels active in [ATR] harmony processes are contrastively specified for the harmonic feature. The feature [round] is unspecified for /o, ɔ, u/ because the algorithm has already successfully distinguished them from other vowels before the feature [round] is assigned. In this ordering, the feature [round] is only assigned to distinguish round vowel /ʊ/ from the non-round vowel /ɨ/[20].

20 The pairing of /ʊ/ and /ɨ/ does not mirror the historical development of /ɨ/ from *ɪ, but this does not matter, since children learn from synchronic evidence only.

6.3 Minimal Difference Approach in Anii-Gisida

In this section, I will show how the MDA divides the Anii-Gisida vowel inventory into contrastive and non-contrastive features. The MDA allows both contrastive and non-contrastive features to participate in harmony processes (Nevins 2010). According to the definition in Nevins (2010), “A segment S with specification αF in position P is contrastive for F if there is another segment S’ in the inventory that can occur in P and is featurally identical to S, except that it is -αF” (Nevins, 2010, p. 80). Nevins (2010) assumes that some harmony processes compute only contrastive features, and segments that do not have harmonic counterparts are non-contrastive for the feature in question. However, he allows non-contrastive features (based on MDA) to participate in vowel harmony in some languages, like the Yoruba low vowel /a/ and the high vowels /i, u/ which are non-contrastive for [ATR] but participate in [ATR] harmony in Nevins' analysis. Even within a single language, Nevins (2010) allows some processes to be restricted to contrastive features and others to refer to all feature values.

The high central vowel (/ɨ/) in Anii-Gisida behaves like the unpaired vowels (/i, a, u/) in Yoruba. The high central vowel does not have an [ATR] harmonic pair but triggers harmony in Anii-Gisida. If we follow the MDA, the non-contrastive features must participate in [ATR] harmony in Anii-Gisida. Below is the contrastive specification according to Nevins’ model of contrast for the Anii-Gisida vowel inventory.

(44) **Contrastive Features via MDA in Anii-Gisida**

a. Full Specification

	i	ɪ	e	ɛ	ɨ	ə	a	ɔ	o	ʊ	u
[low]	-	-	-	-	-	+	+	-	-	-	-
[high]	+	+	-	-	+	-	-	-	-	+	+
[back]	-	-	-	-	-	-	-	+	+	+	+
[ATR]	+	-	+	-	-	+	-	-	+	-	+

b. MD Contrastive Features

	i	ɪ	e	ɛ	ɨ	ə	a	ɔ	o	ʊ	u
[low]			-	-		+	+				
[high]	+	+	-	-				-	-	+	+
[back]	-	-	-	-				+	+	+	+
[ATR]	+	-	+	-		+	-	-	+	-	+

In the above example, (44) (a) shows the full set of feature specifications and (44) (b) shows the contrastive specifications according to the MDA of contrastive features. In (44) (b) the high central vowel is unspecified for [ATR]. Thus [ATR] is redundant for [ɨ] in Nevins' approach, which is the main difference from the SDA approach.

According to Nevins (2010), a language like Anii-Gisida provides evidence that non-contrastive features can participate in harmony processes. The MDA approach argues against the Contrastivist Hypothesis, since it requires the non-contrastive [ATR] feature of the high central vowel to be phonologically active. But for Dresher (2018), the vowel /ɨ/ can be contrastively specified for [ATR] given the appropriate feature hierarchy. An

appropriate hierarchy is shown in example (43). With the ordering in (43) all the vowels in Anii-Gisida are contrastive for [ATR], including the high central vowel /ɨ/, even though it does not have a harmonic pair.

6.4 Summary

The Successive Division Algorithm and the Minimal Difference Approach divide the vowel inventory of Anii-Gisida into contrastive and non-contrastive features. The SDA, in combination with the Contrastivist Hypothesis, allows only contrastive features to participate in vowel harmony in Anii-Gisida and the high central vowel /ɨ/ is contrastively specified for [ATR]. The Contrastivist Hypothesis states that all phonologically active features are contrastive, thus harmony triggers must be contrastive features. However, the MDA allows non-contrastive features to participate in vowel harmony in Anii-Gisida, like the unpaired high vowels /i, u/ in Standard Yoruba and the low vowel /a/ in both Ife and Standard Yoruba. In a MDA analysis of Anii-Gisida, the high central vowel cannot be contrastively specified for the harmonic feature, but it can nonetheless participate in harmony, counter to the Contrastivist Hypothesis. The following chapter will focus on positional neutralization facts in Anii-Gisida. I will argue that the SDA has more explanatory power than the MDA because the SDA can also account for the positional neutralization.

Chapter 7: Positional Neutralization and Markedness

7.1 Introduction

In this chapter, I show that the SDA hierarchy in (43) is the best way to explain not only the vowel harmony patterning in Anii-Gisida, but also facts about Anii-Gisida positional neutralization and markedness.

The notion of markedness is central to phonological theory. Marked phonological features and structures are considered more complex and less common than unmarked ones. One of the diagnostics of markedness is neutralization. Marked values are typically subject to neutralization and unmarked values are the output of neutralization (Rice, 2014). This chapter focuses on the notion of positional markedness in Anii-Gisida by looking at vowel contrasts that neutralize in specific positions. In order to understand positional neutralization in Anii-Gisida, we will first provide a general overview of positional neutralization in section (7.2). The next section (7.3) will provide an analysis of positional neutralization in Anii-Gisida. Section (7.4) will explain marked and unmarked vowels in Anii-Gisida making reference to the SDA analysis proposed in the preceding chapter. The final section (7.6) will summarize the chapter.

7.2 Overview of Positional Neutralization

Positional neutralization is “a categorical inability to realize a given contrast within some phonologically defined environment” (Spahr, 2014, p. 552). According to Spahr (2014), a neutralized phoneme is derived from or equivalent to a phonetically non-

neutralized pair. Positional neutralization involves a reduction of the number of phonemes in a specific environment, especially unstressed position (Bisol & Veloso, 2016; Spahr, 2014; Steriade, 1994). For example, vowels do not contrast for nasality in stressless syllables in Guaraní (Kiparsky, 1985 cited in; Steriade, 1994). According to Steriade (1994), neutralization involves contrasts and not features. Thus, in Guaraní, "it is not 'nasality' that is disallowed in stressless syllables, but 'distinctive nasality' (the contrast between nasal and oral)" (Steriade, 1994, p. 3).

The Bulgarian contrast in which six vowels neutralize to three vowels in unstressed positions is shown in (45) (adapted from Spahr, 2014).

(45) **Bulgarian Vowel Inventory** (Spahr, 2014, p. 563)

a.

front	central	back
non-round		round
i	â[21]	u
e	a	o

b. /â, a/ → [ə]
/o, u/ → [ʊ]
/i, e/ → [ɪ]

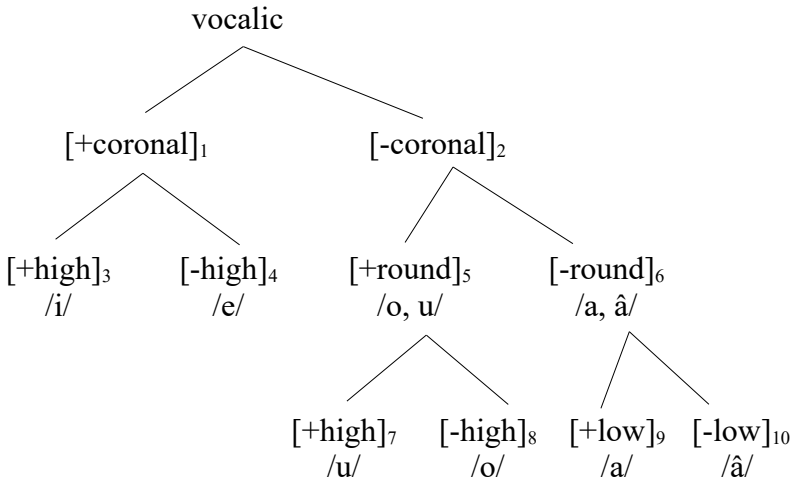
As shown in the above examples, the vowels in (45) (a) are reduced to those in (45) (b) in unstressed environments. Thus, /â/ and /a/ correspond to unstressed [ə], /o/ and /u/

21 The vowel /â/ in Bulgarian represents a non-low central unrounded vowel (/ʌ/).

correspond to unstressed [ʊ], and /i/ and /e/ correspond to unstressed [ɪ]. The low/non-low or high/non-high height contrast is neutralized for every vowel place of articulation.

In Spahr's analysis of Bulgarian, the Contrastive Hierarchy is central to the way neutralization functions and this is shown in (46) (Spahr, 2014).

(46) **Bulgarian Contrastive Specification** (Spahr, 2014, p. 564)



Spahr (2014) proposes that vowels in the reduced position are 'archiphonemic', which is equivalent to the non-terminal nodes of the contrastive hierarchy. (46) shows a contrastive hierarchy of the stressed inventory. The reduction process changes both node 10 (/â/) and node 9 (/a/) into a segment specified for the features assigned in node 6, [-coronal, -round] which is then realized as [ə]. At the same time node 7 (/u/) and node 8 (/o/) neutralize to a segment consistent with features of node 5, namely [ʊ]. The neutralization of /i/ (node 3) and /e/ (node 4) also results in [ɪ] which has the features specified at node 1

7.3 Positional Neutralization in Anii-Gisida

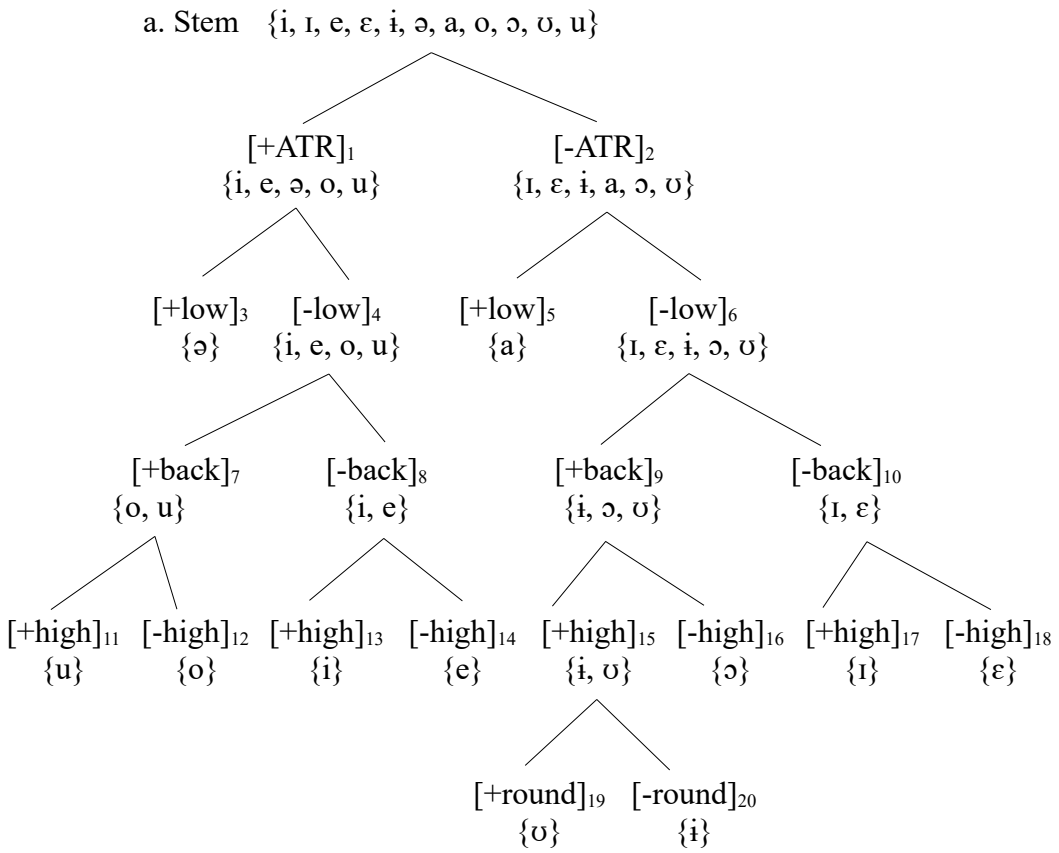
As seen above, positional neutralization is the absence of segmental contrast in a certain position. Positional neutralization is relevant for Anii-Gisida because the height distinction and the contrast between round and non-rounded vowels in Anii-Gisida are neutralized in the affix position (see (47)). The mid vowels (/e, ɛ, o, ɔ/) and the high central vowel (/ɨ/) never occur in affixes. The vowels in the affix inventory neutralize to fewer contrasts than those found in the stem inventory as shown in (47).

(47) **Neutralized Vowels in Anii-Gisida**

/u, o/→ [u] /ʊ, ɔ, ɨ/ → [ʊ]
/i, e/ → [i] /ɪ, ɛ/→ [ɪ]

I propose that the contrast between [±high] vowels and [±round] vowels (shown in example (43)) neutralizes in the affixes as shown in (48) and (49). The analysis relies on the same feature hierarchy that is needed for [ATR] harmony in Anii-Gisida.

(48) **Anii-Gisida Contrastive Specifications in Positional Neutralization**

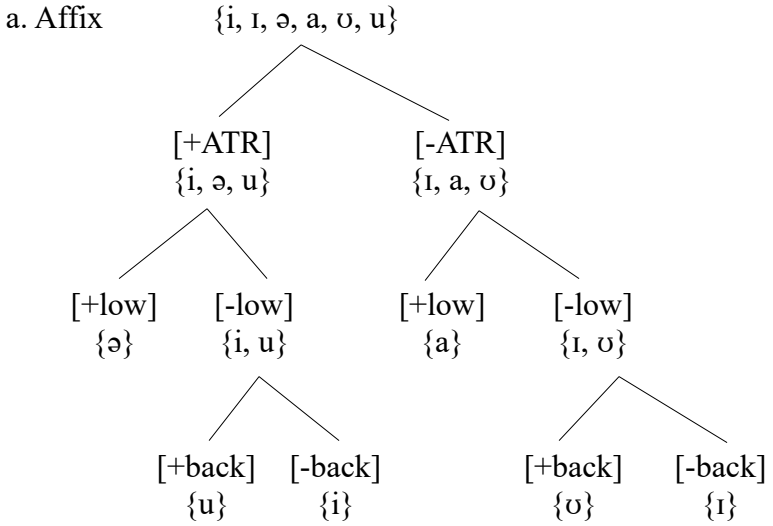


As with Spahr's (2014) analysis of Bulgarian vowel neutralization, in Anii-Gisida, node 11 (/u/) and node 12 (/o/) neutralize into the features specified at node 7 and are realized as /u/. Node 13 (/i/) and node 14 (/e/) neutralize to the features specified at node 8 and are realized as /i/. Node 15 (/ʊ, ɨ/) and node 16 (/ɔ/) neutralize to the features specified at node 9 and are realized as /ʊ/ and finally node 17 (/ɪ/) and node 18 (/ɛ/) neutralize to the features specified at node 10 with /ɪ/ being the output of neutralization. All the terminal contrasts ([±high] and [±round]) neutralize to non-terminal nodes in affixes.

In Anii-Gisida the output of neutralization is equivalent to the realization of one of the segments present in the full inventory. For example, the neutralization of /u/, node 11, and /o/, node 12, results in /u/. This differs from the neutralization process illustrated in Spahr's (2014) analysis of Bulgarian in which the output of neutralization is a segment not found in the stressed inventory. Instead, the unstressed vowels of Bulgarian can be interpreted as phonetically intermediate between those that contrast in the stressed inventory. This difference between Anii-Gisida and Bulgarian is an example of language-particular variation in how "archiphonemic" contrasts are realized.

The neutralization process results in fewer vowel contrasts in the affix vowel inventory in Anii-Gisida as shown in the hierarchy in (49).

(49) **Contrastive Features in the Affix Vowels**



The relationship between the stem (48) and the affix inventories (49) is neutralization. The stem inventory supports more contrastive features (twenty) in the hierarchy while affixes support fewer contrastive features (ten) in the hierarchy.

7.4 Markedness

This section discusses the implications of positional neutralization in Anii-Gisida for markedness relations within the language. I will discuss the relationship between the neutralization facts described above, and Casali's (2016) markedness-based typology of vowel harmony systems in Niger-Congo-Kwa languages.

Marked and unmarked values have received different definitions in the literature. Marked structures are seen as less natural, less common, more unexpected, more complex, and more likely to be subject to neutralization. Unmarked values are defined as more natural, more common, expected, simpler, more likely to be targets of neutralization, and have a wider distribution (Rice, 2014).

Casali (2016) describes differences in markedness patterning between languages with different inventories. The key distinction in Casali's (2016) analysis is between /1IU/ and /2IU/ vowel systems. /1IU/ systems have an [ATR] contrast in the mid vowels (/e, o/, /ɛ, ɔ/) but not the high vowels while /2IU/ systems have two sets of contrastive high vowels [+ATR] (/i, u/) and [-ATR] (/ɪ, ʊ/) (e.g., /1IU/ systems have one 'I' and 'U' while /

2IU/ systems have two ‘I’s and ‘U’s.). The following sections give a brief description of the distribution of vowels of these two systems.

7.4.1 Markedness in /1IU/ Systems

/1IU/ systems have a single set of high vowels (/i, u/). In terms of markedness-related patterns involving tongue root features, in /1IU/ languages, high [-ATR] vowels are marked relative to high [+ATR] vowels (Casali, 2016). According to Casali (2016), [-ATR] high vowels are avoided in /1IU/ languages, and the languages that have these vowels treat them as allophones, so it is clear evidence that high [-ATR] vowels are marked in /1IU/ systems. Rose (2018) also examines the presences of [ATR] vowel harmony in Nilo-Saharan and Niger-Congo languages. Her study investigates the correlation between the vowel inventory and the type of harmonic system that occurs in these languages. According to Rose (2018), ATR harmony is limited or does not occur in 1IU languages and it is rare to have allophonic [-ATR] high vowels in 1IU languages. /1IU/ systems also treat [-ATR] as marked for mid vowels. The evidence is that mid [+ATR] vowels have a wider distribution relative to their [-ATR] counterparts (Casali, 2016). When there is neutralization in the affixes, then what is realized in the affixes is the unmarked feature value, which is [+ATR]. For instance, in Bantu C languages like Bolia, mid vowels in both nominal and verbal prefixes fail to undergo harmony and are always realized as [+ATR], as shown in the examples below.

(50) **Bolia** (Casali, 2016, p. 120) (English translation from the French by the author)

a.	kŏ-kel-a	‘do it then’ (exhortive imperative)
b.	kŏ-kɛnd-ɛ	‘walk then’ (exhortive imperative)
c.	lo-yo-kɔh-e	‘come and take’ (motional imperative)
d.	bá-pó-bɔng-é	‘they are not suitable’ (negative present indicative)

Casali (2016) posits that the underlying exhortative suffix is /-a/ in (a) and (b). The suffix vowel assimilates to the preceding vowel /ɛ/ in (b). The [+ATR] mid vowel /e/ in the stem fails to trigger harmony in (50) (a), but the [-ATR] mid vowel /ɛ/ in the stem triggers harmony in (50) (b). According to Casali (2016), the motional imperative and the negative present indicative in (c) and (d) display the underlying [+ATR] suffix vowel /e/, but this vowel does not participate in harmony. Thus, the [+ATR] mid vowels in Bolia pattern as unmarked, both having a wider distribution than their [-ATR] counterparts and in failing to trigger harmony.

7.4.2 Markedness in /2IU/ System

In /2IU/ systems, Casali (2016) observes a different markedness pattern. [-ATR] vowels in /2IU/ systems have a wider distribution as compared to their [+ATR] counterparts, and /2IU/ systems treat both mid and high [-ATR] vowels as unmarked relative to mid and high [+ATR] vowels (Casali, 2016). For instance, in Chumburung (a Guang language spoken in the north side of Volta Lake in Ghana) the high [-ATR] vowels /ɪ, ʊ/ and the low [-ATR] /a/ are the only vowels that can occur in independent pronouns (as illustrated

in (51)) and other environments (see Casali 2016 for more examples of 2IU languages with this type of distribution).

(51) **Chumburung Pronouns** (Casali, 2016, p. 115)

mɔ́	'I'
fɔ́	'you (sg)'
mɔ̀	'she/he'
àní	'we'
mɔ̀ní	'you (pl)'
bàmɔ́	'they'

The Chumburung vowel pattern in the above example provides evidence that the [+ATR] high vowels /i, u/ and the mid vowels /e, ɛ, o, ɔ/ are absent in independent pronouns. The tongue root contrast in high vowels /i, u/ and /ʊ, ɪ/, is positionally neutralized to [-ATR] vowels (/ɪ, ʊ/) in independent pronouns in Chumburung.

In summary, positional neutralization shows different markedness relations among high vowels between /2IU/ and /1IU/ languages. /2IU/ systems neutralize tongue root contrasts in both high and mid vowels to [-ATR] (Casali, 2016), and the result of neutralization is the wider distribution of the unmarked feature values that show up in both stems and affixes.

Neutralization patterning can also be used to characterize marked and unmarked values in Anii-Gisida. Although Anii-Gisida is a /2IU/ language, unlike other /2IU/ languages

described above, I claim that the neutralization pattern eliminates contrasts in height and rounding, rather than [ATR]. Using Casali's markedness-related patterning criterion, I argue that the [-high] and [-round] vowels in Anii-Gisida are marked relative to the [+high] and [+round] vowels. As mentioned above, the contrast between [±high] and [±round] vowels neutralizes in the affixes. In other words, the mid vowels /e, ɛ, o, ɔ/ and the central high vowel /ɨ/ do not appear in the affixes. The mid vowels /e, ɛ, o, ɔ/ thus neutralize with the high vowels /i, u/ in affixes, as in the Chumburung vowel system seen above. The high central vowel /ɨ/ also fails to occur in affixes and neutralizes with its [+round] vowels, (/ʊ, ɔ/). The unmarked values [+high] and [+round][22] show up in both Anii-Gisida stems and affixes just as other /2IU/ languages show unmarked [-ATR] occurring in stems, affixes and independent pronouns.

In the hierarchical tree in (48), the features [±high] and [±round] are lower in the tree. These features neutralize in the affix position, as shown in (49). For instance, /u/ and /o/ neutralize to /u/, /i/ and /e/ neutralize to /i/, /ʊ/, /ɔ/ and /ɨ / neutralize to /ʊ/, and /ɪ/ and /ɛ/ neutralize to /ɪ/. According to Casali's distribution criterion, this means the [+high] and [+round] vowels /i, ɪ, ʊ, u/ represent the unmarked feature values in Anii-Gisida. Anii-Gisida may thus differ from other /2IU/ languages with [ATR] harmony in that vowel height and rounding, rather than [ATR], plays a key role in the distribution of vowels, which is a diagnostic of markedness.

22 I acknowledge that, crosslinguistically, [+round] often patterns as marked, rather than unmarked.

In an SDA analysis, [+ATR] vowels would neutralize in the affixes in other /2IU/ languages because the feature [ATR] would be ordered lower in the hierarchy, since neutralization processes eliminate contrasts encoded by features that are ordered low within the contrastive hierarchy. However, in Anii-Gisida, the feature [ATR] must be ordered high in the hierarchy in order to account for the participation of the high central vowel in the [ATR] harmony process. This suggests a reason why [±high] and [±round] vowels neutralize in affixes in Anii-Gisida, while [±ATR] contrasts neutralize in the cases discussed in Casali (2016).

7.5 Positional Neutralization in Anii-Gisida and the MDA

Unlike the SDA analysis of vowel harmony, which can be extended to account for neutralization patterns, the MDA fails to explain the positional neutralization facts in Anii-Gisida. The contrastive features assigned to Anii-Gisida vowels according to the MDA, as illustrated in example (44), are able to account for the neutralization of [±high] vowels in affix position. /e/ and /ɛ/ neutralize to /i/ and /o/ and /ɔ/ also neutralize to /u/. This can be achieved by eliminating the [-high] feature in affix vowels, consistent with the specifications according to the MDA. However, the MDA cannot explain why /ɨ/, /ɔ/ and /ʊ/ neutralize to /ʊ/ in affix position. According to the features designated as contrastive by the MDA, /ɨ/, /ɔ/ and /ʊ/ do not share any common features. /ɨ/, in fact, is not contrastively specified for any features in the MDA analysis. Given this, it is unclear how a neutralization process would eliminate underspecified /ɨ/, together with /ɔ/ in

favour of /ʊ/, which is specified for [high], [back], and [ATR]. In the SDA analysis, /ɨ/, /ɔ/, and /ʊ/ share all features except for round with /ɨ/ being specified as [-round] and /ʊ/ and /ɔ/, as [+round]. The contrast between round and non-rounded vowels in Anii-Gisida is neutralized in affix position, resulting in /ʊ/ surfacing as the [-low], [+back], [-ATR] vowel. Thus the feature [-round] is lost in affixes when we adopt the SDA. But based on the MDA approach, /ɨ/, /ɔ/ and /ʊ/ do not share any features. No loss of features will result in the neutralization of /ɨ/, /ɔ/ and /ʊ/ to /ʊ/, as found in affixes. No loss of features would result in the neutralization of /ɨ/ since it is not specified for any features.

7.6 Summary

The previous sections of this chapter have provided a brief introduction to the analysis of positional neutralization and markedness related patterns in Anii-Gisida. The mid vowels /e, ɛ, o, ɔ/ and the high central vowel /ɨ/ never occur in the affix position while all the vowels, including the mid vowels and the high central vowel, occur in the stem. Positional neutralization is crucial to differentiate marked and unmarked values in Anii-Gisida. The [-high] and [-round] vowels are marked relative to the [+high] and [+round] vowels, and the unmarked values show up in both stems and affixes. In other /2IU/ languages, the feature that typically undergoes neutralization is [ATR] while in Anii-Gisida, neutralization affects height and rounding features. The SDA analysis proposed in the analysis of vowel harmony can be extended to account for the observed pattern of neutralization. The feature specifications found in affixes are consistent with a reduced

version of the feature hierarchy proposed for Anii-Gisida, with contrasts encoded by the lowest ordered features, [high] and [round], absent from the affix inventory. The specifications determined by the MDA, on the other hand, cannot account for the neutralization patterns, particularly with respect to the neutralization of /ɨ/.

Chapter 8: Conclusion

This thesis has provided an analysis of vowel harmony and positional neutralization in Anii-Gisida based on contrastive feature specification. Anii-Gisida has an eleven vowel inventory in which all the vowels are active in the [ATR] harmony process. [ATR] harmony affects noun class markers, agreement, verbs, clitics and some aspectual morphology. The domain of harmony is within clitic group. I argue that in Anii-Gisida, all vowels (/i, ɪ, e, ɛ, ɨ, ə, a, o, ɔ, ʊ, u/) are contrastive for [ATR], including the high central vowel /ɨ/ that does not have a harmonic counterpart.

I showed how the Successive Division Algorithm and the Minimal Difference Approach make different predictions about the Anii-Gisida vowel inventory's contrastive and non-contrastive features. The SDA divides features based on feature ordering in the form of a hierarchical tree and assigns features in a language-specific order until each phoneme is uniquely specified. This approach also assumes the Contrastivist Hypothesis, and thus allows only contrastive features to participate in harmony. The analysis of vowel harmony in Anii-Gisida based on the SDA supports the Contrastivist Hypothesis. The MDA, however, designates only features that minimally distinguish one phoneme from another as contrastive. In Nevins' (2010) MDA, the unpaired vowel in Anii-Gisida is not contrastively specified for [ATR], yet it participates in [ATR] vowel harmony.

The high central vowel in Anii-Gisida thus poses a challenge for the MDA, if we adopt the Contrastivist Hypothesis. However, according to Nevins (2010), non-contrastive features participate in harmony as a result of microvariation (non-contrastive features

participate in harmony in some dialects, and do not in others). Does the high central vowel in Anii-Gisida participate in [ATR] harmony as a result of microvariation? What accounts for the unpaired high central vowel's participation in vowel harmony in Anii-Gisida, in the MDA? These questions are left for future research.

The analysis proposed here demonstrates that the SDA can account for both the vowel harmony and the positional neutralization facts in Anii-Gisida. In the proposed hierarchical tree, the features ([±high] and [±round]), which are ordered lower in the tree, are precisely the features that neutralize in the affix position, with the result that the mid vowels, /e, ɛ, o, ɔ/ and the high central vowel /ɨ/ never occur in the affix position. Based on positional neutralization facts, I showed that the [-high] and [-round] vowels are marked relative to the [+high] and [+round] vowels, and that the unmarked values are the vowels that show up in affixes.

This research has contributed to the study of understudied and endangered languages in Africa. To date, only a brief descriptive analysis of vowel harmony in Anii-Gisida exists. The thesis has presented an in-depth analysis of the phonology of Anii-Gisida and provided evidence for the SDA. This approach best explains the vowel harmony pattern and positional neutralization in Anii-Gisida. This thesis has contributed to the Contrastivist Hypothesis claim that only contrastive features are phonologically active, and supported the claim that harmony triggers are always contrastive. The study provides background for future research on [ATR] vowels in other dialects in Anii. These dialects

need both descriptive and theoretical analysis in order to have a broader understanding of the vowel system in the language.

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