Ewe vowel harmony: Implications for theories of underspecification

by

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Abstract

This thesis examines vowel harmony in Ewe, with a focus on the northern dialect. I show that harmony patterns seen in the northern dialect differ from what has been proposed as a general analysis for the language by Clements (1974). The patterns seen in the northern dialect highlight asymmetries in the behaviour of the vowels /a/ and /ɛ/. These vowels are triggers of harmony in some contexts (i.e., Low harmony), whereas in others, they are targets of harmony (i.e., Height harmony for /ɛ/ and Place harmony for /a/). I argue that this asymmetry can be explained by considering the phonological representation of these vowels as well as relying on the mechanisms of lexical phonology and morphology. I then situate my analysis within Stratal Optimality Theory.

Regarding the phonological representation of vowels, I follow Reiss (2017) and propose that contrast is not relevant in the representation of vowels in Ewe; these vowels must be specified for features based on phonological activity. Given this, their specifications reflect what phonological processes each vowel triggers in the language. I provide further evidence supporting this analysis by highlighting the failures of theories of representation that rely on contrast in the face of Ewe data. As part of this discussion, I explore both Radical and Contrastive (under-)specification as well as the Contrastive Hierarchy.

I propose that Height and Place harmony are lexical processes, and that Low harmony is a post-lexical process. This proposal is based on the characteristics displayed by these processes, which I also consider in light of cross-linguistic evidence.

Within Stratal OT, I assume a strong version of Richness of the Base and argue that underlying representations cannot be restricted by the grammar. Thus, any combination of features is allowed in the underlying representation. Through the interactions of violable constraints, I derive vowel feature specifications based on activity at the stem level of derivation. I observe that constraints that are antagonistic to phonetic richness are ranked higher at this level of derivation, while those favouring it are ranked lowly. The output of the stem level then feeds the word level of derivation, where the lexical processes take place. At this level, the grammar preserves features through a high ranking of faithfulness constraints. Thus, segments are not further impoverished at this level of derivation. At the phrasal level, where Low harmony applies, different constraint rankings capture the observation that /a/ and /ɛ/ are not targets of harmony, and that /ɛ/ is a trigger of harmony.

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"In every things give thanks: for that is the will of God in Christ Jesus concerning you"

1Thessalonians 5:18 KJV

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Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

1 Introduction

This dissertation focuses on vowel harmony in the northern dialect of Ewe spoken in the south-eastern part of Ghana. In Ewe, vowels harmonize when an enclitic is affixed to a verb or noun. Harmony largely affects the enclitic vowels, causing them to assimilate to the height or place feature of the root vowel. In this dissertation, I highlight differences between the harmony processes attested in the northern dialect of Ewe and earlier analyses which have focused on developing a more general analysis. I show that earlier analyses failed to account for variation across different dialects of the language. In doing this, I propose that segments are not specified for features based on contrast; rather, they are specified for features that are necessary to account for the various processes seen in the language. This argument is partly based on the proposal by Reiss (2017) that contrast is not relevant in phonological computation, and supported by the fact that different theories of underspecification fail to produce the specifications needed to account for the harmony processes observed in the northern dialect of Ewe.

The remainder of this thesis is organized as follows. I begin by introducing the Ewe language, focusing on the inventory as well as the morpho-phonological processes as attested in the language. I then discuss the objectives of the study, followed by an overview of the theoretical frameworks adopted for data analysis. In Chapter 2, I provide a detailed discussion of earlier approaches to vowel harmony in Ewe. I highlight the inadequacies inherent to these approaches. I then introduce new data, in order to shed more light on the harmony processes attested in Ewe. Specifically, I show how the processes attested in the northern dialect of Ewe differ from the general proposals previously made by scholars of Ewe as well as the challenges that these proposals face in light of the new data. Chapter 3 discusses how the vowel inventory of the northern dialect can be parsed into distinct units in order to account for the harmony processes and related asymmetries. I argue that contrast cannot be relied on in the specification of vowels in the northern dialect of Ewe, given that vowels need to be specified for features that are necessary to account for phonological activity. I proceed and specify vowels based on phonological activity. I conclude the chapter by proposing that the asymmetries observed in the northern dialect of Ewe can be explained by relying on the principles of lexical phonology. Specifically, I argue that the asymmetries in the harmony processes can be captured when we make a distinction between lexical and post-lexical processes.

To situate my discussions in a current theoretical framework, I propose a Stratal OT analysis for vowel specification, in Chapter 4, and for the harmony processes, in Chapter 5. I rely on Stratal OT to show how the harmony processes of Ewe can be explained within a uniform grammar in spite of the asymmetries found in the data. I argue that vowel feature specification applies at the stem level of derivation, while the Place and Height harmony processes apply at the word level of derivation, fed by the output of the stem level. Low harmony, on the other hand, applies at the phrasal level of derivation. In Chapter 6, I look at alternative methods of specifying vowels in the northern dialect of Ewe. I show that theories of specification fail to predict the feature specifications necessary to account for the asymmetries seen in Ewe. This supports the general argument of this thesis that contrast is not relevant to the representation of vowels in the northern dialect of Ewe. I summarize my arguments and conclude in Chapter 7.

2 The Ewe language

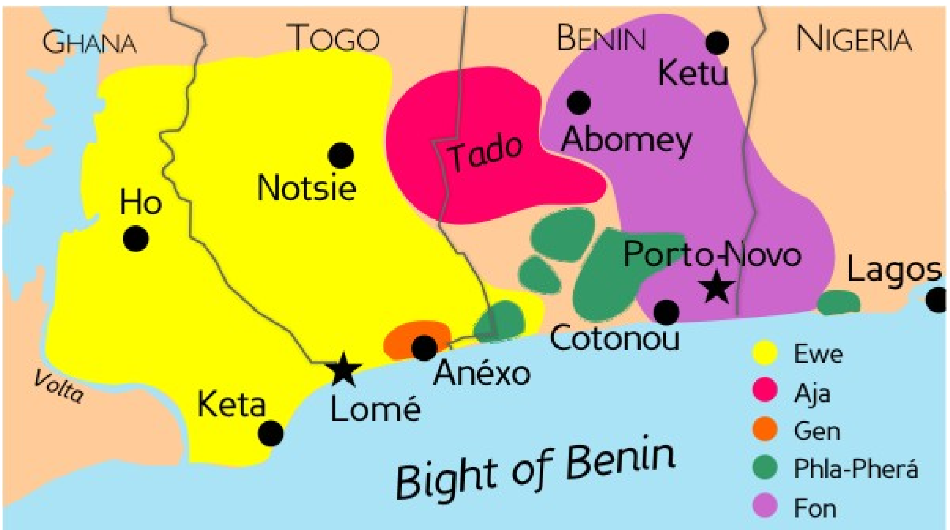
According to the classification of African languages proposed by Greenberg (1963), Ewe belongs to the Kwa language family of the Niger-Congo branch spoken in West Africa. Within the Kwa family, Ewe is a member of the GBE cluster of languages which is spoken around the southeastern part of Ghana, Togo, Benin and also parts of the Ogun and Lagos states of Nigeria (Capo 1991; Ameka 2001). Other languages in the cluster include Fon, Aja, and Gen.

The dialects of Ewe have been categorized geographically into inland dialects (also known as northern dialects, or Eʋedome),[1] southern (or coastal) dialects and western dialects (Stahlke 1971; Clements 1974; Kpodo 2017). The inland and southern dialects are spoken in Ghana, while the western dialect is spoken in Togo. As can be seen in Figure 1 below, the northern dialect is spoken in the northern half of the Volta region of Ghana, with major dialect clusters around Ho. Even though there are minor variations across the various sub-groups of the northern dialect, the Ho sub-group (on which this study is based) is representative of the northern dialect. The coastal/southern dialects are spoken in the southern part of the Volta region of Ghana

1 Ameka (1991; 2001) divides the inland dialects into central and northern dialects. However, I do not refer to this distinction in the current study.

and the Aŋlɔ sub-group (spoken in and around Keta) is considered representative of this group of dialects. The final major dialect block consists of the western dialects which are spoken in Togo. Just as in the Ghanaian dialects, there is variation among the various sub-groupings found in Togo as well. However, the Adangbe dialect has been considered as representative of these groupings (Stahlke 1971; Clements 1974).

Figure 1 A map of Gbe languages (en.wikipedia.org/wiki/Ewe_language 11/24/2020)



The syntax of Ewe has been widely studied (see Collins 1993, 1997; Ameka 2006; Aboh 2009). However, to my knowledge, relatively little work can be found in the literature on the phonology of the language, and most of the existing works are based on theories that have since evolved or been abandoned (for instance, Stahlke 1971; Clements 1974; Capo 1985, 1986). In addition, while the existing studies have focused on describing the language as a whole, no study has focused on a particular dialect of Ewe.[2] In this

2 Despite this, each study cited earlier has considered the major dialect block in its attempt to provide an analysis that describes the language as a whole.

section, I provide a broad description of the phonology of Ewe, focusing on consonants, and vowels as well as syllable structure, building on previous descriptions of the language, which I supplement with some of my own native speaker intuitions. In line with other sections of this study, my descriptions focus on the northern dialect of Ewe, with references to other dialects where needed. All data except where stated are based on my native speaker intuitions.

2.1 Consonants

Ewe has 27 consonants phonemically, and 28 phonetically, as listed in Table 1 below. According to Ansre (1961), the sounds [l] and [r] are allophones of the same phoneme /l/. However, there are varying accounts of allophonic distributions in the language. I discuss this next.

Table 1: Phonetic inventory of Ewe consonants (adapted and modified from Stahlke 1971:5)

	Stops	Affricates	Fricatives	Sonorants
Bilabial	p b		ɸ β	m
Labio-dental			f v	
Dental	t̪ d̪	ts dz		
Alveolar			s z	n l [l̃]
Retroflex	ɖ			r
Alveo-palatal				ɲ j
Velar	k g			ŋ ɰ
Labio-velar	k͜p g͜b			w
Pharyngeal			ħ ʕ	

Scholars (Ansre 1961; Westermann 1965; Smith 1968) have previously argued for an allophonic relationship between /l/ and /r/. Key to this hypothesis is that /r/ only occurs after coronal sounds whereas /l/ occurs elsewhere. This is seen in the following examples.

(1) Allophonic relationship between /l/ and /r/

a.	trɔ́	'turn/change'
b.	jrí	'bloat'
c.	ɲrã̀	'yell'
d.	lɔ̃̀	'to love'
e.	lí	'to stick'
f.	àlɔ́	'cheek'
g.	àlɛ̀lɛ̀	'fibroid'
h.	flɛ́	'rip'
i.	glà	'jaw'

Examples (1a-c) show the distribution of /r/ after coronal consonants whereas /l/ occurs word initially in (1d-e), intervocalically in (1f-g) and after non-coronal consonants in (1h-i). Also, /l/ and /r/ do not occur after one another due to a phonotactic restriction which prevents sequences of liquids in the language. Further, neither /r/ nor /l/ occurs word-finally due to restrictions on syllable structure.[3]

Stahlke (1971), on the other hand, argues that the allophonic relationship between /l/ and /r/ is a partial one. Rather, the true allophonic relationship is between /r/ and /ɖ/ (see Stahlke 1971 for full analysis). Stahlke (1971) observes that /ɖ/ is the only obstruent in Ewe without a voiceless counterpart and it is never followed by a liquid (see example (2a-c) below). This characteristic is consistent with the phonotactic rule which prevents liquids from following each other in Ewe, as stated earlier. In addition,

3 I discuss the syllable structure of Ewe in section 2.3.

Stahlke observes that /r – ɖ/ alternations are attested in some lexical items, as seen in (2d-e).

(2) Allophonic relationship between [ɖ] and [r]

a.	*ɖlà	but	ɖà	'to cook'
b.	*ɖrɛ̀	but	ɖɛ̀	'to marry'
c.	*àɖrɛ̀	but	àɖɛ̀	'tongue'
d.	**ɖ**ɛ̀ká ~ **r**ɛ̀ká		'one'	
e.	àdɛ̀**ɖ**ɛ́ ~ àdɛ́**r**ɛ́		'seven'	

Following this analysis, /ɖ/ is a liquid as opposed to an obstruent. Its distribution relative to /r/ is as follows: /ɖ/ occurs word-initially (3a-b) and intervocalically (3c-d), while /r/ occurs after coronals (1a-c). Thus, the /l-r/ alternation remains a partial allophonic distribution.

(3) Distribution of /ɖ/ in Ewe

a.	ɖì	'burry'
b.	ɖù	'eat'
c.	àɖàŋù	'advice'
d.	àɖì	'poison'

Following the argument of Stahlke (1971) that /ɖ/ is an allophone of /r/, Ewe has symmetrical obstruents: every voiced obstruent has a voiceless counterpart. Stahlke (1971) and Ameka (1991) also account for a nasalized alveolar lateral /l̃/ which occurs in words such as / l̃ɔ̃́/ 'remove from fire'. It is in complementary distribution with its oral counterpart: [l̃] only occurs before nasal vowels while /l/ occurs elsewhere. However, Stahlke (1971:19) argues that "[…] it is impossible to decide uniquely whether the distribution is to be treated as a condition on morpheme structure, implying both /l/ and [l̃] are systematic phonemes, or whether it is to be stated as a phonological rule, claiming that only one presumable /l/ is a systematic phoneme.”

2.2 Vowels

As a general language, Ewe has eight phonemic vowels, from which dialects tend to select a subset.[4] The dialects spoken in Ghana select seven vowels from the inventory, each with a nasalized allophone (Stahlke 1971; Clements 1974; Ameka 1991).

Table 2: Surface inventory of Ewe vowels

i		u
e	ə	o
ɛ	a	ɔ

The high and back vowels in the Ghanaian dialects of Ewe are phonemic, while the phonemic status of the mid, unrounded vowels is subject to some debate. Both Duthie (1988) and Ameka (1991) posit that /e/, /ɛ/ and /ə/ can be used interchangeably by speakers, with /ə/ and /ɛ/ used more frequently than /e/. Duthie (1988) argues that speakers use /ə/ instead of /e/ in regular and/or careful speech, as in (4a-b), but /e/ is realized when it occurs immediately after another vowel or stylistically when native speakers sing the words that contain it. This is seen in (4c-d) below.

4 Adangbe (spoken in Togo) is the only dialect that incorporates all eight phonemic vowels.

(4) Distribution of /ə, ɛ/ and /e/ in Ewe.

a.	bə̀		'hide'
b.	hə̌		'knife'
c.	tó	-é	'it's a mountain'
	mountain	-FOC	
d.	tú	-é	'it's a gun'
	gun	-FOC	

In addition, Duthie (1988) proposes that /ɛ/ and /e/ have "merged" for most speakers of Ewe. However, Ameka (1991) argues for an allophonic relationship between /ə/ and /e/. As I will show in section 1 of Chapter 2, /ɛ/ and /e/ are phonemic in the northern dialect of Ewe. In the next section, I describe the syllable structure of Ewe.

2.3 Syllable structure

The syllable structure of Ewe can be represented in CV terms as $(C_1)(C_2)V^T(C_3)$. All consonants except /r/ can occur in C_1. I show this in example (5a-b). C_2 on the other hand can only be filled by a liquid or a glide. However, as described already, /r/ can only occur after coronals whereas /l/ occurs elsewhere, as in (5c) and (5d), respectively.[5]

(5) Syllables of Ewe

a.	bɛ̀	'thatch'
b.	à.tí	'stick'
c.	drɔ̃́	'to judge'
d.	βlɛ̃̀	'snatch'
e.	swě	'small'
f.	bjá	'to ask'

5 Throughout this document, I mark syllable boundary with a period (.) where it is relevant.

The V^T position can be filled by any vowel or by the bilabial and velar nasals. I discuss syllabic nasals in more detail in the next section. The C_3 position can be filled only by nasals. Each syllable in Ewe must be marked for tone, which is carried by the segment that fills the nucleus of the syllable. I discuss the various syllable types found in Ewe in the next subsection.

2.4 Syllable types in Ewe

The smallest syllable type in Ewe consists of only a vowel, or a bilabial or velar nasal, marked by a tone, as stated above. This is illustrated in example (6). For the sake of convenience, I refer to these syllables as “V-only”.

(6) V–only syllable type
  a. à.zì ‘egg’
  b. ŋ̀.kú ‘eye’
  c. ɸō.ḿ ‘beat (progressive)’[6]
  d. flé.ḿ ‘pluck (progressive)’

The CV syllable type illustrated in (7), is the most common syllable type in Ewe (Ansre 1991), and all consonants except /r/ can occur in this syllable type.

(7) CV syllables
  a. kɛ́ ‘sand’
  b. tɔ́ ‘to stop’
  c. ɖì ‘be clean’

6 The nasal /m/ is considered as syllabic based on its ability to bear tone, a characteristic unique to elements that occupy the nucleus of a syllable. In other instances such as in (8), the final nasals do not bear tones and are thus treated as syllable codas.

Ewe also allows for syllables with complex onsets (CCV(C)). The first consonant of the complex onset can be any consonant in the language except the coronals /r, l, ɖ/. The second consonant can be the liquids /l/ and /r/, depending on the place of articulation of the first consonant, or a glide, as in (5c-f) above. Finally, closed syllables in Ewe always display a single nasal in the coda position. The onset of a closed syllable can be simple, as in (8a-c), or complex, as in (8d-e).

(8) Ewe closed syllables

a.	kán.tsì	'iron sheet'
b.	à.tám	'oath'
c.	sɔ́ŋ	'several'
d.	à.prím	'canon'
e.	krān.té	'machete'

2.5 Tones

Phonemically, there are two primary and secondary tones in Ewe. The primary tones are the high and non-high tone. The non-high tone has the mid and low tones as its allotones. The secondary tones are rising and falling tones. Given the allotony among the non-high tones, the rising tone can be realized as low-high and mid-high, and the falling tone as high-low and high-mid.

2.5.1 Tone in nominals

In monosyllabic nouns, the class of the stem consonant is important in determining which tone occurs (Ansre 1961). Ewe consonants can be classified into three groups. Class A consonants consist of voiced obstruents and they occur with only low tones;

class B consonants, which are voiceless obstruents, are realized with either high or mid tones, and class C consonants, sonorants, are also realized with high or mid tones.

(9) Consonant interactions with tones

a. Class A consonants with low tone
   - i. gə̀ 'beard'
   - ii. gà 'money'
   - iii. d̪à 'hair'

b. Class B consonants with mid tone
   - i. fɛ̄ 'debt'
   - ii. tə̄ 'yam'

c. Class B consonants with high tone
   - i. sə́ 'law'
   - ii. kə́ 'sand'
   - iii. tó 'ear'

d. Class C consonants with mid tone
   - i. ɲī 'cattle'
   - ii. mō 'face'

e. Class C consonant with high tone
   - i. mɔ́ 'road'
   - ii. yí 'machete'
   - iii. nə́ 'nut'

Polysyllabic nominals do not follow the same distribution pattern as their monosyllabic counterparts. Ansre (1961) argues that only the first syllable in polysyllabic nominals follows the distribution in (9). Ansre however did not provide further detail regarding how tones are distributed in polysyllabic nominals. Because this topic transcends the scope of the current thesis, I leave it open for further research.

2.5.2 Tone in verbs

The distribution of tones in verbs functions differently from that of nominals. Tones in verbs are not distributed based on the class of the stem consonant. The high tone is underlying, and its distribution is not based on its environment. The variants of the non-high tone (mid and low) are distributed based on the environment in which they occur. Smith (1968) proposes the mid variant of the non-high tone as underlying: "By convention, the unmarked tone is [-H, -L]. Any vowel, whether in the lexicon or introduced by rule, which is not marked otherwise is presumed to have these features" Smith (1968:292). Smith did not provide any other motivation for his analysis. I believe he posited it due to the fact that across many tone languages, the mid tone is treated as the unmarked one. For instance, Woo (1969), as cited in Stahlke (1971), argues that the analysis of Mandarin Chinese and Tepehuan is simplified when the mid tone is posited as default. Similarly, in languages that have a two-tone system such as Akan, Efik and Igbo, where contrast is between a high and a non-high tone, the mid tone comes as the default non-high tone (Stahlke 1971).

According to Smith (1968), a verb with a mid tone (in bold) is realized as low when the following item begins with an obstruent, as we can see in (10a-c). However, it remains mid when the following item begins with a sonorant consonant or a vowel, as in (10d-f).

(10) Non-high tone in Ewe verbs

a.	mə̀ **gbə̀** kútsə̀tsə̀ á wó	'I plucked the fruits'
b.	wó **wɔ̀** kúnú	'they performed a funeral'
c.	mə̀ **fì** kpō lá	'I stole the stick'
d.	mə̀ **gbə̄** āŋūtí á wó	'I plucked the oranges'
e.	má ā **ɖū** nú	'I shall eat'
f.	mə̀ **fī** yí lá	'I stole the machete'
g.	ə́ **tsī** kábá	'he grew fast'
h.	mə̀ **zɔ̄** hlɔ̀yìhlɔ̀yì	'I walked clumsily'

Smith (1968) further observes that when the word after a verb is an adverb, the tone of the verb remains mid irrespective of whether it begins with an obstruent, a sonorant or a vowel. This is seen in examples (10g-h). In the next section, I discuss a group of prefixes that are crucial to some of the morpho-phonological processes I discuss in the present study. They have been classified by Stalkhe (1971) as vocalic prefixes.

2.6 Vocalic prefixes in Ewe

To my knowledge, nouns are the only words that begin with vowels in Ewe. Stahlke (1971), in his analysis of Ewe tones, argues that nouns in Ewe obligatorily occur with a vocalic prefix. This prefix can either be realized as 'ɛ-' or 'a-' (with a non-high tone). Thus, only /ɛ/ and /a/ can be found in vowel initial words in Ewe; surface nouns can be classified as either vowel initial or consonant initial. Nouns that are monosyllabic underlyingly can occur with either an /ɛ/ or an /a/ vocalic prefix, as we can see in (11).

(11) Distribution of vocalic prefix in monosyllabic words

a. monosyllabic nouns with /a/

i.	ālɔ́	'cheek'
ii.	āmē	'person'
iii.	āɖɛ̌	'tongue'

b. monosyllabic nouns with /ɛ/

i.	ɛ̀lȁ	'meat'
ii.	ɛ̀tsī	'water'
iii.	ɛ̀gbɔ̌	'goat'

However, multisyllabic nouns are either consonant initial, as in (12a), or they occur with the prefix /a/, as in (12b).

(12) Distribution of vocalic prefix in multisyllabic words

a. Consonant initial multisyllabic nouns

i.	gàkpō	'metal'
ii.	vēhlǒ	'throat'
iii.	bɔ̀lú	'shrimp'

b. Multisyllabic nouns with /a/

i.	àdàtsì	'tears'
ii.	àbólǒ	'bread'
iii.	àtádí	'pepper'

This distribution, as I stated earlier, implies that only nouns can be vowel initial, and that the initial vowel can only be an /a/ or an /ɛ/.

Ewe, just like many of the world's languages, exhibits phonological alternations. In the next section, I discuss some of the phonological processes found in the language which result from morphological operations.

2.7 Morpho-phonological processes in Ewe

My discussion of alternations found in Ewe in this section draws from previous work on the phonology of the language. I supplement these descriptions with my own observations. The first process I discuss is vowel deletion.

2.7.1 Vowel deletion

There are two contexts where vowel deletion applies in Ewe. The first takes place in the context of morphological compounding and the second in the context of hiatus involving /ɛ/ in phrases and sentences. In (13) below, I show instances of deletion arising from compounding.

(13) Compounding contexts in Ewe

a. Compounding with /a/ deletion

i.	ɛ̀blí	+	àgblɛ̀			=	ɛ̀blí-gblɛ̌
	corn		farm				'corn farm'
ii.	āmɛ̄	+	ɸò	+	àtí	=	āmɛ̄-ɸò-tí
	person		beat		stick		'cane'
iii.	nú	+	ɖù	+	àsí	=	nú-ɖù-sí
	thing		eat		hand		'righthand'
iv.	gbɔ̀	+	àtsú			=	gbɔ̀-tsú
	goat		male				'he-goat'
v.	gbɛ̌	+	àvú			=	gbɛ̄-vú
	bush		dog				'ruffian'

b. Compounding with /ɛ/ deletion

i.	ɛ̀blí	+	ɛ̀xɔ̀			=	ɛ̀blí-xɔ̌
	corn		house				'cornbarn'
ii.	àgblɛ̀	+	ɛ̀mɔ́			=	àgblɛ̀-mɔ́
	farm		road				'the path to a farm'
iii.	Àtsú	+	ɛ̀nɔ̀			=	Àtsú-nɔ̀
	A		mother				'Atsu's mother'
iv.	àsŏ	+	ɛ̀ɲà			=	àsŏ-ɲǎ
	stupid		issue				'stupid issue'
v.	ɛ̀sɔ́	+	ɛ̀lã			=	ɛ̀sɔ́-lã
	horse		meat				'horse meat'
vi.	nú	+	yà	+	ɛ̀yí	=	nú-yà-yí
	thing		weed		cutlass		'a cutlass for weeding'

In (13) above, the hiatus is resolved by the deletion of the second vowel of the sequence. This process only affects /a/ and /ɛ/ because they are the only vowels found at the beginning of nouns in Ewe, as I showed in (11) and (12) above. It is worth noting that it is only in the compounding process that the second vowel is deleted to resolve a hiatus. In other instances, there is no clear evidence of positional deletion. I discuss this next.

Apart from the compounding process where /a/ and /ɛ/ are deleted to resolve a hiatus, /ɛ/ is also deleted when it occurs in a verb and is followed by a noun beginning with a vowel. I show this in (14).

(14) Clauses with verbs ending in /ɛ/

a. mɛ̀ ɸl**ɛ̀** **à**bólǒ = mɛ̀ ɸl-**à**bólǒ
1SG buy bread
'I bought bread'

b. Kòfí gb**ɛ̀** **à**kūtú lá = Kòfí gb-**à**kūtú lá
K pluck orange DET
'Kofi plucked the orange'

c. Ámá xl**ɛ̃̀** **à**gbàlɛ̃ lá = Ámá xl-**à**gbàlɛ̃ lá
A read book DET
'Ama read the book'

Importantly, deletion only occurs when the hiatus involves /ɛ/. In verbs that end in other vowels, both vowels of the sequence are realized, as can be seen in (15).

(15) Clauses with verbs ending in other vowels other than /ɛ/

a. mɛ̀ w**ù** **à**fì lá = mɛ̀ w**ù** **à**fì lá
1SG kill mouse DET
'I killed the mouse'

b. Kòfí ts**ò** **à**tí lá = Kòfí ts**ò** **à**tí lá
K fell tree DET
'Kofi fell the tree'

c. ɖèví -á ts**ɔ́** **à**wù lá = ɖèvíá ts**ɔ́** **à**wù lá
child -DET take cloth DET
'the child took the cloth'

d. ɛ́- y**í** **à**ɸɛ́ -mɛ̄ = ɛ́-y**í** **à**ɸɛ́mɛ̄
3SG go house -POSTP
'he/she went home'

In another context, /ɛ/ is deleted to resolve a hiatus when it occupies the V_2 position in the hiatus, as in (16).

(16) Clauses with objects that have the vocalic prefix /ɛ/

a.

Kòfí	ɸl**ɛ̀**	**ɛ̀**sɔ́	=	Kòfí ɸl**ɛ̀** sɔ́
K	buy	horse		

‘Kofi bought a horse’

b.

ɖèví	-á	y**ì**	**ɛ̀**xɔ̀	-mɛ̀	=	ɖèví-á y**ì** xɔ̀mɛ̀
child	-DET	go	house	-POSTP		

‘the child is gone into the house’

c.

Ámā	ts**ɔ́**	**ɛ̀**xá	lá	=	Ámā ts**ɔ́** xá lá
A	take	broom	DET		

‘Ama took the broom’

d.

ɛ́-	d**à**	**ɛ̀**kɔ́	ŋútsù	lá	=	ɛ́-d**à** kɔ́ ŋútsù lá
3SG-	throw	blow	man	DET		

‘he/she threw a blow at the man’

e.

būtsà	lá	ts**ò**	**ɛ̀**gbɔ̌	=	būtsà lá ts**ò** gbɔ̌
butcher	DET	break	goat		

‘the butcher slaughtered a goat’

f.

Kɔ̀mlā	t**ú**	**ɛ̀**tsì	lá	=	Kɔ̀mlā t**ú** tsì lá
K	close	water	DET		

‘Komla closed the tap’

In summary, any hiatus involving /ɛ/ is resolved by deleting this vowel. This happens regardless of the position it occupies within the string.

I showed above that the behaviour of /ɛ/ is symmetric with that of /a/ in the compounding process described in (13) while, in the verbal contexts in (14) and (16), /ɛ/ undergoes deletion even when it occurs as the second vowel in a hiatus. This asymmetric behaviour of /ɛ/ is seen in other phonological processes such as vowel harmony, to which we turn next.

2.7.2 Vowel harmony

Harmony is generally described as an assimilatory process in which sounds in a word (consonants or vowels) agree with each other in terms of some specific phonological feature or set of features. In a prototypical harmony system, the harmonizing sounds are non-adjacent and agreement extends to all vowels and/or consonants within domains such as the word (van der Hulst 2016). The harmonizing features can refer to voicing, nasality and minor places of articulation such as anterior (among consonants) or height, backness, tenseness and rounding for vowels. In this section, I highlight various aspects of vowel harmony systems attested across different languages. I then introduce the vowel harmony system of Ewe.

Vowel harmony systems across languages differ not only in terms of the features that are shared between vowels but also based on the particular classes of vowels that participate in the processes. In some languages, all vowels participate in harmony. Take, for example, Akan, a Kwa language spoken in Ghana (Clements 1981; Stewart 1983; Kügler 2015). In Akan, vowels are divided into two groups: those produced with advanced tongue root (/u, i, o, e/) and those produced with retracted tongue root (/ʊ, ɪ, ɛ, ɔ/). Words can only choose vowels from one of these groups.[7] By implication, all vowels in the language participate in harmony. This is illustrated in (17).

7 Akan has a neutral vowel /a/ that co-occurs with both + and – [ATR] vowels. Also, Amoako (2020) reports that there are certain lexical items that do not obey ATR harmony in Akan (e.g. [mɛko] 'pepper', [abɛti] 'shoulder'). They have both + and – [ATR] vowels co-occurring.

(17) Akan [ATR] harmony (Amoako 2020)

a.	kotodze	'knee'
b.	efie	'home'
c.	osetie	'obedience'
d.	ɛwʊɔ	'honey'
e.	ɛbʊɔ	'stone'

In contrast, not all vowels participate in harmony in other languages. In some of these languages, harmony can be triggered by specific vowels and targets other specific vowels, for example in Turkish rounding harmony which targets high vowels (Kabak 2011, Rose & Walker 2011) while, in others, certain vowels are impervious to harmony. These vowels can either be opaque to harmony or transparent to it. Opaque vowels block harmony from spreading to other vowels in the word. On the other hand, transparent vowels do not harmonize but allow harmony to apply across them to other vowels.

Harmony systems can be classified based on the morphological or phonological unit which triggers the harmony process. In root dominance or stem controlled systems, vowels in affixes harmonize to some feature of the root vowel (Bakovic 2000), whereas in feature dominance (also known as dominant-recessive) systems, vowels harmonize to a dominant feature irrespective of whether this feature originates from the root or from the affix. Feature dominance harmony is mostly found in languages that have [ATR] harmony (Casali 2008). According to Casali (2008), languages that exhibit feature dominance are distinguished by the presence of some 'dominant affix' which does not vary its [ATR] value but causes other vowels to harmonize to it. The following examples from Maasai show [ATR] dominance. Maasai has an instrumental suffix '-íé' which does not alternate in its [ATR] value. If this suffix is attached to a root with [-ATR] vowels, the root vowels harmonize to the [ATR] value of the suffix, as in (18).

(18) [ATR] dominance harmony system in Maasai (Casali 2008:514)

a.	ɛ́	-sʊj		'he will follow'
	3s	-follow		
b.	e	-suj	-íé	'he will follow using it (e.g., a car)'
	3s	-follow	-INSTR	
c.	ɛ́	-bɛ́l		'he will break (it)'
	3s	-break		
d.	e	-bel	-íé	'he will break (it) using it'
	3s	-break	-INSTR	

In the above examples, the [-ATR] vowels in (18a) and (18c) are realized as [+ATR] when the instrumental suffix '-íé' is attached to it, in (18b) and (18d). Thus, the dominant [+ATR] feature of the suffix is passed on to the underlyingly [-ATR] vowels of the stem.

So far, I have discussed harmony as it applies within a 'word' (i.e., morphological word). However, this is not the only domain within which harmony can apply. Harmony can operate within phonological domains such as syllables or feet. For instance, in Ndonga, a Bantu language, nasal harmony only applies when the target and trigger are in adjacent syllables (Viljoen 1973, as cited by Rose & Walker 2011). Other domains of harmony may also span domains larger than the morphological word (e.g., phonological phrases). Given these systems, harmony can be either unbounded or bounded. In unbounded systems, "harmony has the potential to operate to the full extent in some domain" (Walker 2012: 575) whereas, in bounded systems, harmony operates, reaches a certain point and halts.

Finally, let us look at directionality in vowel harmony. Harmony can be progressive (i.e., operate from left to right) or regressive (right-to-left). Some scholars argue that directionality is determined by morphological restrictions on stems (Bakovic 2000, 2003). In contrast, others suggest a default left-to-right directionality (Hansson 2001, Hyman 2002). Yet still, others, such as Clements (1981), have avoided directionality in analyzing harmony. Clements argues that underspecified segments trigger the spreading of features from specified segments. Thus, the effect of feature spreading surfaces as directionality. As Rose & Walker (2011: 279) put it, "unspecified segments trigger feature spreading from a specified segment due to well-formedness requirements." There is therefore no directionality restriction on harmony systems.

Now that we have summarized the characteristics of harmony systems across languages, let us look at the vowel harmony processes in Ewe. Clements (1974) observes that harmony in Ewe occurs when the enclitic '-e' harmonizes to the [ATR] and height features of the root vowel, as can be seen in (19) below. This clitic functions as the third person singular pronoun and is homophonous with the focus marker across all dialects of Ewe.

(19) Vowel harmony in Ewe Clements (1974:290)

a.	əsì	-é	=	əsì-í
	water	-FOC		'it's water'
b.	àvǔ	-é	=	àvǔ-í
	dog	-FOC		'it's a dog'
c.	əyè	-é	=	əyè -é
	spider	-FOC		'it's a spider'
d.	əwò	-é	=	əwò -é
	2SG	-FOC		'it's you'
e.	əʋlɛ	-é	=	əʋlɛ-ɛ́
	weaver bird	-FOC		'it's a weaver bird'
f.	əsɔ́	-é	=	əsɔ́-ɛ́
	horse	-FOC		'it's a horse'
g.	àgbà	-é	=	àgbɛ̀-ɛ́
	load	-FOC		'it's a load'
h.	əɲə̀	-é	=	əɲè-é
	1SG	-FOC		'it's me'

Even though Clements (1974) characterizes /ɛ/, /a/ and /ɔ/ as [-ATR], I follow Capo (1985) and specify them as [+low]. I show Capo's specification in (20).

(20) Capo's (1985) specification of vowels in Ewe

	[+front]	[-front, -back]	[+back]
[+high]	i		u
[-high, -low]	e	ə	o
[+low]	ɛ	a	ɔ

As I will show later, this specification makes the description of the harmony process clearer and more straightforward. As we can see in (19a-b), the enclitic agrees in height with the root vowel. It is thus realized as [i] in both instances. (19c-d) show instances where the enclitic has the same height specification as the root vowel, in which case it remains the same. In roots with a [+low] vowel, the enclitic is realized as [+low].

This is seen in (19e-f). (19g-h) present instances where two processes take place. First, there is Front harmony which causes central vowels to agree in the feature [+front] with adjacent vowels over morpheme boundaries. These vowels in turn keep their height feature which they pass to the enclitic vowel through the Height harmony process. Hence the root vowels in these examples must harmonize in terms of frontness while triggering Height harmony in the affix.

Another process that is similar to harmony is metaphony. According to Dillon (2014:4), "metaphony is a phonological change in the height of a stem vowel triggered by a suffix vowel". Thus, vowels must agree in height and this vowel agreement must be triggered by the suffix vowel to be described as metaphony. Metaphonic processes are well attested in Romance languages (Dillon 2014). How different is metaphony from vowel harmony? According to Bakovic (2000), in a stem controlled harmony, it is the stem vowel that induces change in the suffix vowel. However, the suffix vowel is the trigger in metaphony. In dominant recessive harmony, "a dominant-feature-valued vowel triggers a change in the 'recessive' vowels in the morpheme (and sometimes across morphemes)" (Dillon 2004: 6). On the other hand, in most cases of metaphony, the change occurs across morphemes and only one vowel in the stem is targeted.

3 Objectives of the current study

As described earlier, Ewe vowel harmony manifests itself when an enclitic vowel is cliticized to a verb. Only two studies of Ewe vowel harmony can be found in the published literature, by Clements (1974) and Kpodo (2017), respectively. These two studies available on the subject oppose each other on the nature of the Ewe harmony system. Further, both studies overlook data that are crucial to understanding the dialectal variations that exist within the larger harmony system of Ewe. My objective in the current study is to describe the vowel harmony system of the northern dialect of Ewe, highlighting the inadequacies of previous analyses. I show that the analyses proposed by Clements (1974) fail to make the right prediction when specific dialects are considered. Building on this, I offer an alternative analysis of the vowel harmony system of the northern dialect of Ewe, also with the aim of improving our general understanding of this harmony system.

This study attempts to answer the following research questions:

- What factors shape the harmony system found in Ewe?
- What does the asymmetric behaviour of /ɛ/ tell us about the feature specification of vowels in Ewe? How can this asymmetric behaviour be accounted for?

In the next section, I discuss my methodology for the study.

4 Methods

I now discuss the methods I employed for the current study. I begin by describing the source of my data.

4.1 The data

The data for this study is based on previous accounts as well as on my native speaker intuitions about the phenomenon. In order to ensure accuracy, I contacted other native speakers of the northern dialect of Ewe to seek their judgement on certain words and sentences.

In the next section, I provide a quick overview of data showing the harmony processes of the northern dialect of Ewe. I start with Height harmony, after which I discuss Low harmony and Place harmony.

4.1.1 Height harmony in the northern dialect

Height harmony is attested when the 3SG pronoun '-e' is cliticized to a verb. The clitic harmonizes to the height feature of the root vowel as in (21a). In cases where the root vowel is /a/, the clitic harmonizes to the [low] feature of /a/, while /a/ harmonizes to the front feature of the enclitic. I illustrate this in (21b). Finally, when /ɛ/ is the root vowel, /ɛ/ harmonizes to the [low] feature of the enclitic as in (21c). I discuss these further in section 3 of the next chapter.

(21) Height harmony in the northern dialect

a. Height harmony with /u, i, o, ɔ/ as root vowels

i.	ɖù	è	=	ɖù-ì
	eat	3SG		'eat it'
ii.	zì	è	=	zì-ì
	smash	3SG		'smash it'
iii.	dzró	è	=	dzró-è
	crave	3SG		'crave it'
iv.	trɔ́	è	=	trɔ́-ɛ̀
	change	3SG		'change it'

b. Height harmony with /a/ as root vowel

i.	dzrá	è	=	dzrɛ́-ɛ̀
	sell	3SG		'sell it'
ii.	blá	è	=	blɛ́-ɛ̀
	tie	3SG		'tie it'
iii.	sà	è	=	sɛ̀-ɛ̀
	lock	3SG		'lock it'

c. Height harmony with /ɛ/ as root vowel

i.	blɛ̀	è	=	blè-è
	deceive	3SG		'deceive him/her'
ii.	gbɛ́	è	=	gbé-è
	refuse	3SG		'refuse it'
iii.	fɛ́	è	=	fé-è
	split	3SG		'split it'

4.1.2 Low harmony in the northern dialect of Ewe

In Low harmony, the enclitic /e/ which is functioning as the focus marker only harmonizes to the [+low] feature of root vowels, as illustrated in (22d-f). In forms with non-low root vowels, the underlying form of the enclitic is attested, as in (22a-c).

(22) Low harmony

a.	ɛ̀ɖù	é	=	ɛ̀ɖù-é
	bullet	FOC		'it's a bullet'
b.	àmì	é	=	àmì-é
	oil	FOC		'it's an oil'
c.	ɛ̀tō	é	=	ɛ̀tō-é
	buffalo	FOC		'it's a buffalo'
d.	àká	é	=	àká-ɛ́
	charcoal	FOC		'it's a charcoal'
e.	àlɔ́	é	=	àlɔ́-ɛ́
	cheek	FOC		'it's a cheek'
f.	àyɛ̀	é	=	àyɛ̀-ɛ́
	trick	FOC		'it's a trick'

4.1.3 Place harmony in the northern dialect of Ewe

Place harmony targets /a/ irrespective of whether it occurs in the root vowel, as in (21b) above, or as an enclitic. As an enclitic, /a/ functions as a determiner, as in (23a), or as the habitual marker, as in (23b). /a/ harmonizes to the place feature of adjacent vowels. It is realized as a front, low vowel when it is adjacent to front vowels and as a back, low vowel when it is adjacent to back vowels.

(23) Place harmony in the northern dialect

a. Place harmony with determiner

i.	àsí	á	=	àsí-ɛ́
	hand	DET		'the hand'
ii.	àtɛ́	á	=	àtɛ́-ɛ́
	ant	DET		'the ant'
iii.	ɛ̀tɛ̃́	á	=	ɛ̀tɛ̃́-ɛ́
	egg plant	DET		'the egg plant'
iv.	àwù	á	=	àwù-ɔ́
	cloth	DET		'the cloth'
v.	ɛ̀wɔ́	á	=	ɛ̀wɔ́-ɔ́
	flour	DET		'the flour'
vi.	ɛ̀tó	á	=	ɛ̀tó-ɔ́
	mountain	DET		'the mountain'
vii.	ɛ̀tà	á	=	ɛ̀tà-á
	head	DET		'the head'

b. Place harmony with the habitual marker

i.	tsí	à	=	tsí-ɛ́
	turn off	HAB		'turn off_HAB'
ii.	tɛ́	à	=	tɛ́-ɛ́
	compress	HAB		'compress-HAB'
iii.	mū	à	=	mū-ɔ̄
	fall	HAB		'fall-HAB'
iv.	kò	à	=	kò-ɔ̀
	laugh	HAB		'laugh-HAB'
v.	tsɔ́	à	=	tsɔ́-ɔ́
	take	HAB		'take-HAB'
vi.	ɖā	ā	=	ɖā-ā
	cook	HAB		'cook-HAB'

4.2 Theoretical assumptions

In this section, I discuss the theories that underpin the current analyses and discussions. I highlight the main ideas proposed by these theories. I begin with theories of underspecification.

4.2.1 Theories of underspecification

Theories of underspecification stem from the hypothesis that not all features are specified on segments in the underlying representations of morphemes and words. However, there are varying accounts of what is specified and what is not. On one hand, scholars such as Steriade (1987, 1995) have argued that only features that make a distinction between a pair of segments should be included in underlying representation (Contrastive specification). On the other hand, Pulleyblank (1986, 1988) and Archangeli (1988) propose that redundant (i.e., predictable) feature values are absent in underlying representation (Radical underspecification). Thus, only one value of a binary feature (the unpredictable one) is present in underlying representation, while the other value is inserted by a context free rule. I discuss both Contrastive and Radical underspecification further in Chapter 6. These theories differ from the Contrastive Hierarchy, which I discuss next.

4.2.2 Contrastive Hierarchy

The Contrastive Hierarchy (Mackenzie & Dresher 2003; Hall 2007; Dresher 2009, 2018; Mackenzie 2016) differs from the other theories of underspecification discussed. The Contrastive Hierarchy holds that features are hierarchically ordered. This results in some features being limited to a sub-group of a superordinate feature. Languages with similar inventories may thus differ by the ranking of features in each individual language. For instance, a feature such as [low] may be ranked highly in language A but lowly in language B with the same inventory of phonemes. The Contrastive Hierarchy also shows the relationship between phonological activity and contrast in languages. As Hall (2007:20) puts it, "the phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of L from one another." Therefore, a phonologically active feature is a contrasting feature. I discuss the theories of underspecification and the Contrastive Hierarchy further in Chapter 6.

4.2.3 Optimality Theory

Optimality Theory holds that phonological grammars are made up of two components: GEN, which takes care of operations, and EVAL, which is made of hierarchically ordered, violable constraints (Prince & Smolensky 1993). Surface representations are chosen by

EVAL, which screens candidates (generated by GEN) based on the hierarchy of constraints it contains. The output representation is the candidate with the fewest violations of highly ranked constraints. The most notable assumption about the nature of the input in Optimality Theory is that the input can take any linguistically possible form. This is known as the Richness of the Base (Prince & Smolensky 1993). There are various versions of Optimality Theory. I discuss these later in Chapter 4 and also show how this theory applies to the processes attested in the northern dialect of Ewe.

Before that, let us discuss the background to the Ewe language.

Chapter 2 Background

1 Introduction

As stated in the previous chapter, the phonology of Ewe has not received a lot of attention within the literature. Scholars such as Ford (1973), Clements (1974), and Capo (1985, 1986) have attempted to provide a unified description of the phonology of the language meant to be compatible with all dialects of Ewe. Even though their analyses capture many of the facts, they fail to account for aspects of phonological patterning in some dialects and over-generalize in others. In this chapter, I discuss previous works on the morpho-phonological alternations attested in Ewe, focusing primarily on the vowel harmony system. For each of these previous analyses, I highlight whether they apply to the language as a whole or to specific dialects. I then focus on the northern dialect of Ewe more specifically. I show the areas of departure as well as convergence between studies, in light of differences between the various dialects of the language. I conclude this chapter by showing the challenges associated with the previous studies and suggest some of the ways forward. All examples except where stated are based on my native speaker intuitions.

Before I discuss vowel harmony in Ewe, I offer a brief recapitulation of the phonemic vowel system of Ewe. I begin with the general vowel inventory of the language, repeated in Table 3 for convenience.

Table 3: Surface inventory of Ewe vowels (repeated from Table 2)

i		u
e	ə	o
ɛ	a	ɔ

The general Ewe language displays up to eight vowels, each of which comes with a nasalized allophone. As stated earlier, all dialects select from this general set of vowels. Adangbe, which is spoken in Togo, is the only dialect with all eight phonemic vowels, while the dialects spoken in Ghana variably select seven vowels from the general set. The inventory of the northern dialect spoken in Ghana is provided in Table 4.

Table 4: Surface inventory of vowels in the northern dialect of Ewe

i		u
e		o
ɛ	a	ɔ

The high and back vowels /i, u, o, ɔ, a/ are phonemic in the northern dialect. However, as already mentioned, the phonemic status of the non-high, unrounded vowels /e, ɛ/ is subject to some debate. As mentioned in Chapter 1, Duthie (1988) argues that speakers use /ə/ instead of /e/ in regular and/or careful speech but /e/ is realized when it occurs immediately after another vowel. This, however, does not match my observations: /e/ and /ɛ/ do not appear to be in an allophonic distribution. The mid unrounded vowel /e/ has the most restricted distribution in Ewe; even though it occurs in underived environments, words with /e/ are rare in the language. Based on a search of an Ewe-English dictionary by Westermann (1973), I observe that /e/ only occurs after coronals, as exemplified in (24a, c and e).[8] However, this environment is not exclusive to /e/; its lax counterpart, /ɛ/, also occurs in this environment, as in (24b, d and f). These two phones thus cannot be in an allophonic distribution. Given the data in (24), we must consider all of the vowels in Table 4 to be phonemic in the northern dialect of Ewe.

(24) Distribution of /e/ and /ɛ/ in the northern dialect of Ewe

a.	ɖé	Topicalizer
b.	ɖɛ̀	'to remove/marry
c.	kɔ́té	'exactly/ without doubt'
d.	tɛ́	'to press'
e.	fúɖě	'funnel'
f.	ādɛ́	'six'

Concerning the phonological feature specification of the vowels, there have been varying accounts of what features are active in the language. Clements (1974) proposes the features [high], [ATR], [back] and [round] to characterize the vowels of Ewe. He argues that these features are sufficient to parse the vowel inventory into contrastive units. However, Smith (1968) and Ford (1973) suggest that Ewe vowels can be contrastively parsed with the features [high], [low], [back] and [round]. According to Smith (1968), /a, ɛ, ɔ/ can be characterized as [+low] vowels, while Ford (1973) argues for /a/ as a [+low] vowel and /ɛ, ɔ/ as mid ([-low]) vowels. Capo (1985) deviates from all the others; he proposes that the vowel inventory of Ewe can be divided into contrastive phonemes using the features [low], [high], [back] and [front].

8 This is not an exhaustive search for the distribution of /e/, since the dictionary has not been updated (to my knowledge) since it was originally published. It is thus possible that /e/ occurs in other environments that have not been reported by the dictionary.

He also argues for /a, ɛ, ɔ/ to be characterized as [+low] and that the place features [back] and [front] are justified since there are three frontness/backness places of articulation in the vowel inventory. Given this, central vowels bear the negative values for both place features. Capo (1985) likens his proposal to the analysis of the tongue height features [high] and [low] where mid vowels are considered to be [-high] and [-low].

Given Capo's (1985) proposal, we can specify the general eight vowel system as in (25) below. Note that all eight vowels are attested in Adangbe, which can thus be used as representative of the general set.

(25) Adangbe vowel specifications (adapted from Capo 1985:27)

	[+front]	[-front, -back]	[+back]
[+high]	i		u
[-high, -low]	e	ə	o
[+low]	ɛ	a	ɔ

The choice of features in (25) can be modified to involve [round] instead of [back], without consequences for the specifications and behaviours of the vowels in the language. Also, Capo (1985) notes that all [+back] vowels in the language are [+round] as well. Thus, any process that makes reference to the feature [+back] redundantly refers to [+round]. For the remainder of this study, I use the specifications proposed by Capo (1985) to refer to vowel specifications. I do this to provide a consistent argument for what features are active in the language. I also show in Chapter

3 that Capo's (1985) specifications offer a simpler explanation for the alternations seen in the northern dialect of Ewe than any other specifications discussed above.

2 Previous studies on Ewe alternations

In this section, I summarize previous descriptions and analyses of the Ewe vowel harmony system. I consider two dialects in this review (Adangbe and the northern dialect). The literature on Ewe vowel harmony cannot be considered to be as rich as that of other Kwa languages such as Akan. To my knowledge, as mentioned already, there have been only two works published on Ewe vowel harmony: Clements (1974) and Kpodo (2017).[9] Clements (1974) sought to provide an analysis that accounts for the harmony process found across all dialects of Ewe. However, as I show later in this chapter, his analysis can only account for the alternations found in the Adangbe dialect. Kpodo (2017), on the other hand, provides an analysis that takes into account the dialectal variations seen in Ewe. However, as we will see, he makes questionable assumptions about the context of harmony; consequently, his analysis falls short in light of the larger, more representative set of observations.

2.1 Clements' (1974) analysis of Ewe vowel harmony

Recall that vowel harmony in Ewe targets the enclitic affix /e/, which serves as the 3SG marker and the focus marker across all dialects of Ewe.[10] According to Clements

9 Odden (1991) has a one-page discussion of back-round harmony in Ewe, which itself builds on descriptions by Westermann (1965).

10 This clitic, however, serves other grammatical functions in the language. It is homophonous with the vocalic prefix in some dialects as well as a preverbal 2SG pronoun. In the 2SG, it optionally occurs as nè.

(1974:289), "the clitic assimilates to the immediately preceding stem vowel in terms of the features" [low] and [high],[11] a process which I hereafter refer to as Height harmony. Clements proposes that the clitic is underlyingly /e/. His position "is based upon environments in which the normally harmonic affix alternates with a non-harmonic form; in this case the vowel always has the form [e]" (Clements 1974:295). This statement is supported by the examples in (26), where we see instances where harmony is blocked by intervening consonants between the enclitic and the root vowel.

(26) Non-harmonic form of /e/ suffix[12] Clements (1974:295)

a.

mə̀	nú	fíá	-ḿ	è
1SG	thing	teach	-PROG	3SG

'I'm teaching him'

b.

mə̀	fíá	nú	-í
1SG	teach	thing	-3SG

'I taught him'

c.

àsí	kà	-yè
hand	which	-FOC

'which hand is it?'

d.

àsí	kɛ̀-ɛ̀
hand	which-FOC

'which hand is it?

11 The original feature specification proposed by Clements (1974) are [ATR] and [high]. This has been modified to align with Capo's (1985) specifications which I use in this study.

12 (26a-b) are from the Anlo dialect, whereas (26c-d) are taken from Adangbe. Also, Clements (1974) treated the affix 'e' as a topicalization marker, but the grammatical function of that has since been updated as a focus marker; thus, the original translation will indicate TOP instead of FOC. The topicalization marker is realized as [(l)a], [(y)a] or [ɖe].

According to Clements (1974), the enclitic does not harmonize whenever a consonant intervenes between it and the stem vowel. In these instances, the enclitic is realized as /e/; hence it is posited as the underlying form. In (26b) and (26d), where there are no intervening consonants between the root vowel and the enclitic, harmony occurs. However, in (26a) and (26c), an intervening consonant between the suffix /e/ and the root vowel prevents harmony from occurring. Let us also consider the following examples from the northern dialect of Ewe. Just as we saw in the above examples, in the northern dialect, intervening consonants block the application of harmony, as in (27).

(27) Non-application of harmony in the northern dialect of Ewe

a.	àká	yé	cf.	àká-ɛ́
	charcoal	FOC		
	‘it’s a charcoal’			
b.	àyɛ̀	yé	cf.	àyɛ̀-ɛ́
	trick	FOC		
	‘it’s a trick’			

Thus, the underlying form of the enclitic is /e/.

In bare, mono-morphemic forms of words, vowels do not need to harmonize; there are no restrictions on the distribution of vowels. This is seen in (28), where both [+low] and [-low] vowels can co-occur in polysyllabic words that do not involve the enclitic ‘e’. Also, vowels of different height values co-occur without any form of assimilation or harmony.

(28) Words without vowel restrictions

a. àɖūɖɔ̌ 'garbage'
b. àtádí 'pepper'
c. kúkɔ́ 'to stutter'
d. àhɔ̀nɛ́ 'dove'
e. dʒòmɛ̀ 'December'
f. dʒùdʒɔ̀ 'to stop (an activity)'

From (28), we can observe that harmony does not apply internally in roots since there are intervening consonants between vowels in the root, and instances of CVV syllables in mono-morphemic words are only found in ideophones and interjections, which have the same vowels adjacent to each other as in (29).

(29) Ewe Ideophones

a. fű̋ű̋ű̋
b. kpóó
c. bóóó

Other instances of CVV found in Ewe are contentious in that they can be analyzed as CGV sequences.[13] In sum, vowels freely occur in roots.

To summarize, harmony is only attested when the enclitic is attached to either the verb or the noun stem. Given the limited context in which harmony occurs, Ewe is not a prototypical example of vowel harmony, as I discussed in section 2.7.2 of the previous chapter. I will nonetheless continue to refer to the Ewe pattern as harmony rather than assimilation.

13 Words like sia 'to dry', sue 'small' and others with similar vowel sequences have been analyzed in the literature as CGV sequences (Duthie 1988; Ameka 1991), and without further evidence to suggest otherwise, I analyze them as such.

Even though Clements (1974) proposed an analysis that he extended to all Ewe dialects, he only provided data showing the harmony process in Adangbe. I will show later that his analysis cannot be extended to the northern dialect, and thus I will refer to Clements' (1974) proposal as a description of the Adangbe vowel harmony system. To show why Clements' analysis comes short of accounting for the northern dialect of Ewe, I first provide a detailed description of the Adangbe system, and then show how it departs from what is seen in the northern dialect of Ewe.

I begin with the examples in (30). Recall from example (19) that the focus marker must agree in [+high] specification with the root vowel, given that a [+high] root vowel induces the suffix to also become [+high]. This is seen in (30a-b).

(30) Height harmony in Adangbe Clements (1974:290)

a.	əsì	-í
	water	-FOC
	'it's water'	
b.	àvǔ	-í
	dog	-FOC
	'it's a dog'	
c.	əsɔ́	-ɛ́
	horse	-FOC
	'it's a horse'	
d.	əʋlɛ	-ɛ́
	weaver bird	-FOC
	'it's a weaver bird'	
e.	əyè	-é
	spider	-FOC
	'it's a spider'	
f.	əwò	-é
	2SG	-FOC
	'it's you'	

In addition to triggering the change to the [high] value of the focus marker, the root vowel also triggers agreement of the feature [low], as in (30c-d). Finally, (30e-f) show instances where the enclitic has the same height specification as the root vowel; in these instances, the enclitic remains unchanged. According to Clements (1974), only vowels belonging to the same class can co-occur in phrases with the 3SG pronoun or the focus marker. Clements proposed the three-way classification of vowels in Table 5 below.

Table 5: Classification of Ewe vowels based on the harmony system (adapted from Clements 1974:297)

	Class 1	Class 2	Class 3
Features	[+high, -low]	[-high, -low]	[-high, +low]
Members	[i, u]	[e, o]	[ɛ, ɔ]

Note that both /a/ and /ə/ are not realized in any form that has undergone harmony, given that they undergo a process that fronts all central vowels when they occur before other vowels. This rule applies before the vowels harmonize, as in the following Adangbe examples.

(31) Stem vowel fronting Clements (1974:290)

a. àgbà -é = àgbɛ̀-ɛ́
   load -FOC 'it's a load'

b. əɲə̀ -é = əɲè-é
   1SG -FOC 'it's me'

Clements' (1974) analysis captures the harmony process in the northern dialect, when the 3SG morpheme is cliticized to a verb. This is seen in (32). In (32a), the enclitic harmonizes to the [+high] feature of the root vowel, while it harmonizes to the [+low] feature of the root vowel in (32b). When the root vowel has the same height specification as the enclitic, the enclitic remains unchanged, as we can see in (32c).

(32) Height harmony in the northern dialect of Ewe

a.	kù	-è	=	kù-ì
	fetch	-3SG		'fetch it'
b.	tsɔ́	-è	=	tsɔ́-ɛ̀
	take	-3SG		'take it'
c.	kò	-è	=	kò-è
	laugh	-3SG		'laugh at him/her'

However, additional aspects of vowel patterning suggest that Clements' proposal needs to be amended to account for the facts of the northern dialect of Ewe. First, even though the enclitic behaves the same way whether it functions as a focus marker or third person singular pronoun in Adangbe (as correctly observed by Clements 1974), the same does not apply to the northern dialect. When the enclitic functions as the 3SG pronoun in the northern dialect, it assimilates to the height feature of the root vowel unless the root vowel is /ɛ/, in which case, the root vowel harmonizes to the enclitic. For instance, the verb *fɛ́* 'to split' is realized as *féè* 'split it'. This observation is not reported by Clements (1974), who states that in all instances the enclitic assimilates to the root vowel. Further, when the enclitic functions as the focus marker, it only harmonizes to [+low] root vowels. Thus, it remains the same if the root vowel is [-low], as illustrated in (33). For ease of reference, I will hereafter refer to this process as Low harmony.

(33) Low harmony in the northern dialect of Ewe

a.	tú	-é	=	tú-é
	gun	-FOC		'it's a gun'
b.	tǒ	-é	=	tò-é
	mortar	-FOC		'it's a mortar'
c.	àtɔ́tɔ́	-é	=	àtɔ́tɔ́-ɛ́
	pineapple	-FOC		'it's a pineapple'
d.	àgbà	-é	=	àgbà-ɛ́
	trouble	-FOC		'it's a trouble'

In (33a-b), the enclitic remains the same since the root vowels are [-low]. However, the enclitic vowel harmonizes to the [+low] feature of the root vowels in (33c-d). This departs from Clements' (1974) analysis discussed above, which predicts that the enclitic will harmonize to both [+high] and [+low] vowels in this case. Further, in the Low harmony, /a/ does not undergo stem vowel fronting as we saw in the Adangbe data in (31).

So far, I have discussed the harmony process in Adangbe as analyzed by Clements (1974), highlighting areas where Clements' analysis makes the right predictions for the northern dialect as well as areas where it departs from it. Next, I delve into the analysis proposed by Kpodo (2017). Following the same structure, I first discuss Kpodo's proposal and then bring to light points of departure from the data in the northern dialect of Ewe.

2.2 Kpodo's (2017) analysis of Ewe vowel harmony

Kpodo (2017), unlike Clements (1974), does not argue for a vowel harmony system in Ewe. He suggests instead that Ewe displays a vowel height agreement system which is neither harmony nor metaphony based on the defining characteristics of these two processes. I will however not focus on the issue of system classification; instead, I will focus only on his account of the northern dialect of Ewe.

According to Kpodo (2017), the enclitic vowel and the stem vowel must agree in terms of tongue height. This process leads to either vowel raising or vowel lowering. Kpodo posits that the 3SG pronoun is underlyingly /e/ in the northern dialect. He argues that, in the northern dialect, the enclitic vowel raises in order to agree with the tongue height of the stem vowel, as in (34).

(34) Vowel raising in Ewe (Kpodo 2017:212)

a.	mù	-è	=	mù-ì
	fall	3SG		'fall it'
b.	fì	-è	=	fì-ì
	steal	-3SG		'steal it'

According to Kpodo, when the root vowel is /a/, this vowel raises and then fronts to /ɛ/ when the enclitic vowel is attached to the verb. The enclitic vowel then lowers to agree in height with the stem vowel, as exemplified in (35).

(35) Harmony involving /a/ in Ewe

a.	sà	-è	=	sɛ̀-ɛ̀
	tie	-3SG		'tie it'
b.	dà	-è	=	dɛ̀-ɛ̀
	throw	-3SG		'throw it'

While this analysis seems simple and straightforward at first sight, it fails to capture additional generalizations about the harmony process. Kpodo (2017) wrongly assumes that harmony only occurs when the 3SG enclitic vowel is cliticized to the verb in Ewe.

However, as already noted, in the northern dialect of Ewe, harmony also occurs when the enclitic vowel is a focus marker. Kpodo's (2017) proposal, when extended to the focus marker in the northern dialect of Ewe, thus fails to capture the Low harmony process. Recall that, in Low harmony, the enclitic only harmonizes to the [+low] feature of the root vowel. Thus, [+high] root vowels do not trigger this process. Given that Kpodo's proposal only accounts for vowel raising, it fails to explain why [+high] vowels do not trigger assimilation in the Low harmony process.

2.3 Interim summary

In the section above, I discussed previous analyses of the phonology of Ewe, focusing on how different scholars parse the vowel inventory of Ewe into distinctive segments. I also reviewed past proposals on the harmony system of Ewe. I highlighted the challenges each of these proposals face when particular dialects of the language are considered. I showed that Clements' (1974) proposal could only account for harmony in the Adangbe dialect of Ewe. Similarly, while Kpodo's (2017) analysis focuses on various dialects, thereby providing an analysis of the northern dialect of Ewe, it fails to consider all the contexts within which harmony occurs. Thus, his proposal cannot be extended to all of the harmony contexts in the northern dialect of Ewe.

One implication of these shortcomings is that each dialect of Ewe needs to be studied independently. This is the only way to ensure that inadequate general descriptions of the language do not shroud the facts about each dialect. Also, there is the need to offer a theoretical analysis of the harmony system of Ewe. Clements' (1974) analysis offers a good starting point in this regard. However, it is set in theories that have evolved over the years. Even though Kpodo's (2017) work is more recent, it does not offer theoretical explanations for the facts of the harmony system, given that his study focuses on classifying the feature agreement system in Ewe.

In the next section, I discuss in fine detail the harmony system of the northern dialect of Ewe. I argue that we must account for what features are specified on vowels in underlying representations in order to capture the alternations seen in this particular dialect of the language.

3 Vowel harmony in northern dialect of Ewe

In this section, I discuss the vowel harmony processes of the northern dialect of Ewe. I show that there are three kinds of harmony in the northern dialect, Height, Low, and Place harmony. In Height harmony, the 3SG enclitic /e/ harmonizes to the height feature [+high] or [+low] of the root vowel. This process is similar to what we saw in Adangbe in section 2.1 above. In Low harmony, the focus marker /e/ harmonizes to [+low] root vowels. Place harmony targets /a/ irrespective of whether it occurs as the root vowel or as an enclitic. This process is triggered by all vowels except the central vowels. In addition to the harmony processes seen in the northern dialect of Ewe, I also show that the asymmetric behaviour of /ɛ, a/ first discussed in section 2.7 of Chapter 1, which I will expand upon in this chapter, requires that all vowel specifications in underlying representation be accounted for in order to capture the vowel harmony processes in the northern dialect of Ewe. Before that, let us discuss the details of the Height harmony process attested in the northern dialect of Ewe.

3.1 Height harmony

Recall that Height harmony occurs when the enclitic vowel /e/ functioning as the 3SG marker is cliticized to a verb.[14] In the northern dialect, the enclitic /e/ harmonizes in height to the root vowel, as exemplified in (36).

(36) Height harmony in northern dialect of Ewe

a.	kù	-è	=	kù-ì
	fetch	-3SG		'fetch it'
b.	mlì	-è	=	mlì-ì
	roll	-3SG		'roll it'
c.	kò	-è	=	kò-è
	laugh	-3SG		'laugh at him/her'
d.	tsɔ́	-è	=	tsɔ́-ɛ̀
	take	-3SG		'take it'
e.	tá	-è	=	tɛ́ɛ̀
	draw	-3SG		'draw it'

In (36a-b), the enclitic is realized as [+high] when it occurs adjacent to a high vowel. In (36c), the enclitic appears in its underlying form since it has the same height specification as the root vowel whereas, in (36d-e), the enclitic is realized as [+low] following the [low] specification of the root vowel. In (36e), however, a different phonological process, Place harmony, is responsible for the change in the root vowel. The examples above provide evidence for root dominance. However, in words where the root vowel is /ɛ/, this vowel rather harmonizes to the enclitic, as in (37). Note that this pattern differs from that seen in Adangbe in (19) above.

14 The proposal presented here uses the feature specifications proposed by Capo (1985). Even though Capo (1985) mentioned that the analysis of harmony would be simpler with these specifications, he does not show how the analysis actually applies to specific data from any dialect of Ewe.

(37) Height harmony in the northern dialect involving /ɛ/

a.	fɛ́	-è	=	féè
	split	-3SG		'split it'
b.	kpɛ́	-è	=	kpéè
	invite	-3SG		'invite him/her'
c.	tɛ́	-è	=	téè
	sting	-3SG		'sting him/her'
d.	gbɛ́	-è	=	gbéè
	refuse	-3SG		'refuse it'
e.	trɛ́	-è	=	tréè
	set	-3SG		'set it (a trap)'
f.	tɛ̀	-è	=	tèè[15]
	tempt	-3SG		'tempt him/her'

As the examples in (37) show, the root vowel /ɛ/ harmonizes to the enclitic, thereby going contrary to the root dominance observation made earlier about both Adangbe and the northern dialect. This behaviour of /ɛ/ is not limited to only this process. As I have pointed out earlier, in the compounding process in (13b) and the deletion process in (14), /ɛ/ displays an asymmetric behaviour in morpho-phonological processes attested in the northern dialect of Ewe. This behaviour of /ɛ/ demands an explanation, which I address in the next chapter. Before this, let us consider other alternations found in the northern dialect of Ewe.

3.2 Low harmony

Similar to the Height harmony process described earlier, the Low harmony process is triggered by [+low] root vowels and targets the enclitic /e/ only when it functions as a

15 This verb is used with an obligatory complement, 'kpɔ́' to convey the meaning 'to tempt'. The addition or otherwise of this complement does not block the change seen in the example. If the complement is used, the 3SG pronoun occurs between the verb and the complement.

focus marker. In this case, it only harmonizes to the [+low] feature of the root vowel. I show this in (38) below.

(38) Low harmony in the northern dialect

a.	tú	-é	=	tú-é	(cf. kù-ì 3SG)
	gun	-FOC		'it's a gun'	
b.	tsī	-é	=	tsīé	(cf. mlì-ì 3SG)
	water	-FOC		'it's water'	
c.	tǒ	-é	=	tò-é	
	mortar	-FOC		'it's a mortar'	
d.	àtɔ́tɔ́	-é	=	àtɔ́tɔ́-ɛ́	
	pineapple	-FOC		'it's a pineapple'	
e.	àtɛ́	-é	=	àtɛ́-ɛ́	(cf. tɛ́-è = téè 3SG)
	ant	-FOC		'it's an ant'	
f.	àgbà	-é	=	àgbàɛ́	(cf. tá-è = tɛ́-ɛ̀ 3SG)
	trouble	-FOC		'it's a trouble'	

In (38a-c), the enclitic retains its underlying height feature since the root vowels are [-low]. However, in (38d-f), the enclitic is realized as [+low], as it harmonizes to the [+low] feature of the root vowels. Also, in (38), a clear case can be made for root dominance. In all the examples, the root vowel always triggers the harmony process, in contrast to the pattern seen in Height harmony above. The root vowel /ɛ/ is not a target of harmony in this case, and the root vowel /a/ does not assimilate to the place feature of the enclitic vowel. These observations raise questions about how the two processes described in (37) and (38) can be accounted for in a unified and principled way: How can a vowel segment trigger a process involving a height specification (i.e. [+low] in the Low harmony) in one instance but be a target of a similar process involving the same height specification in another (Height harmony)? Similarly, why is /a/ a target of a phonological process in one instance (here, Height harmony) but remains neutral to it in another (Low harmony)? Before I attempt to answer these questions, let us look at a final harmony process found in the northern dialect that (to my knowledge) has not been reported in any other dialect of Ewe.

3.3 Place harmony

A third harmony process observed in the northern dialects of Ewe is referred to in the literature as back-round harmony. This process was first mentioned by Westermann (1965) and partially reported on by Clements (1974) and Odden (1991). I refer to it as Place harmony since the target vowel actually harmonizes to the place features of the root vowels. According to Odden (1991), an enclitic /a/[16] is realized as /ɛ/ when it occurs after front vowels, and as /ɔ/ after back vowels. Thus, the enclitic assimilates to the front and back features of the root vowel. Even though Odden (1991) treats this as a single process, I describe it here as a combination of separate processes, which I name Front and Back harmony, below, in order to show how each of these processes is triggered, as well as to uncover the behaviour of /a/ in Ewe. I begin with the Front harmony process. In the Front harmony process, illustrated in (39), /a/ assimilates to

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16 The enclitic can serve as the determiner in Ewe (realized optionally as [l]a) or as the habitual marker (it can also optionally occur with 'n' as [n]a). Intervening consonants block harmony as in the following examples:

1. àsí lá cf. àsí-έ
   hand DET
   'the hand'
2. tsí ná cf. tsí-έ
   turn off HAB
   'turn off-HAB'

the front feature of an adjacent front vowel. This is seen in (39a-b), where the enclitic is realized as [+low] front vowel.

(39) Front harmony in the northern dialect

a.	blí	+	á	=	blí-ɛ́
	corn		DET		'the corn'
b.	ɛ̀tɛ̀	+	á	=	ɛ̀tɛ̀-ɛ́
	yam		DET		'the yam'
c.	fà	+	è	=	fɛ̀-ɛ̀
	cry		3SG		'mourn him/her'
d.	gà	+	á	=	gà-á
	money		DET		'the money'

This process also applies when the root vowel is /a/ and the enclitic /e/ is the 3SG pronoun (39c). In (39d), however, the enclitic is unchanged since it already agrees in frontness with the root vowel. In the Back harmony process, an enclitic /a/ harmonizes to the [+back] feature of an adjacent vowel (40). Here, /a/ is realized as /ɔ/ because of this harmony process.

(40) Back harmony in the northern dialect

a.	ɖù	+	à	=	ɖù-ɔ̀
	eat		HAB		'eat-HAB'
b.	nò	+	à	=	nò-ɔ̀
	drink		HAB		'drink-HAB'
c.	dɔ́	+	à	=	dɔ́-ɔ́
	send		HAB		'send-HAB'
d.	gbà	+	à	=	gbà-à
	break		HAB		'break-HAB'

As we can see in (40a-c) above, the enclitic takes on the [+back] feature of the root vowel, as it is realized as a [+back, +low] vowel. Just as in Front harmony, when the root vowel has the same place specification as the enclitic, the underlying form of the enclitic remains unchanged, in (40d).

Thus, the enclitic /a/ harmonizes to the place specification of an adjacent vowel. Also, in instances where /a/ is realized as a root vowel followed by an enclitic (as was seen in the Height harmony), it harmonizes to the place feature of that enclitic as well.

4 Summary

In this section, I described the various harmony processes found in Ewe. In Height harmony, an enclitic vowel /e/ harmonizes to the height feature of the root vowel. However, if the root vowel is /ɛ/, the enclitic causes it to harmonize to the [-high, -low] value of the enclitic. In instances where the root vowel is /a/, the enclitic causes it to assimilate to its [+front] feature while the enclitic assimilates to the [+low] value of /a/. I also discussed Low harmony. Despite the similarities between this and the Height harmony, these two processes differ such that in the Low harmony, all [+low] root vowels are triggers, including /ɛ/, which is not the case in Height harmony. I concluded this section by looking at the Place harmony process where /a/ assimilates to the place value of an adjacent vowel. I summarize these findings in Table 6.

Table 6: Summary of facts

Process	**Triggers**	**Targets**	**Examples**	**Other facts**
Height harmony	Triggered by root high vowels /i, u/ and root low vowels /a, ɔ/.	It targets /e/ when it acts as a 3SG pronoun.	1. tù–è = tù–ì ‘grind it’ 2. tsɔ́–è = tsɔ́–ɛ̀ ‘take it’ 3. fɛ́ –e = fé–è ‘split it’ 4. tá–è = tɛ́–ɛ̀ ‘draw it’	/ɛ/ does not trigger this process as a root vowel. It is a target when it is a root vowel. See (3)
Place harmony	Triggered by front vowels /i, e, ɛ/ and back vowels /u, o, ɔ/.	It targets /a/ in roots or when it acts a habitual marker.	1. nò–à = nò–ɔ̀ ‘drink-HAB’ 2. mlì-à = mlì-ɛ̀ ‘roll-HAB’	none
Low harmony	Triggered by low vowels /ɛ, a, ɔ/.	It targets /e/ when it functions as the focus marker.	1. àtɛ́-é = àtɛ́-ɛ́ ‘its an ant’ 2. àtá-é = àtá-ɛ́ ‘its a thigh’ 3. àfɔ̀-é = àfɔ̀-ɛ́ ‘its a leg’ 4. àtí-é = àtí-é ‘its a tree’	/a/ does not undergo Place harmony even when the conditions for this process are met. Compare (2) and (4). /ɛ/ is trigger of this process but not a target, as was seen in the Height harmony.

In the next chapter, I offer an analysis for the specification of vowels in the northern dialect of Ewe. I employ the mechanisms of Optimality Theory to specify features on these vowels. I argue that vowels only need to be specified for features that are necessary to capture the phonological processes found in the language. In addition, in order to account for the asymmetries of /ɛ/ and /a/, I propose that the processes found in the northern dialect can be divided into lexical versus post-lexical processes.

Chapter 3 Feature specification in the northern dialect of Ewe

1 Introduction

In the previous chapter, I showed that the vowel harmony system of the northern dialect of Ewe does not follow the analysis proposed by either Clements (1974) or Kpodo (2017). First, the general vowel harmony system proposed by Clements needs to be divided into two independent patterns: the first, Height harmony, occurs when the 3SG enclitic vowel is cliticized to a verb, and the second, Low harmony, is seen when the focus marker (FOC) is cliticized to a noun. This separation is necessary since the alternations both differ from one another in the patterns they yield and relate to morphologically different enclitic markers (3SG vs. FOC). We also noted that the vowel /ɛ/ in the northern dialect displays an asymmetric behaviour. It acts as a target of some phonological processes where all other root vowels are triggers, and it is the only vowel that undergoes deletion in a hiatus, with the exception of /a/, which also undergoes deletion in the context of compounding.

To explain these asymmetries in the behaviour of /ɛ/, we must first arrive at a specification, in terms of phonological features, for the vowels of Ewe. This is the focus of this chapter. I argue that vowels in Ewe are specified based on the phonological processes they trigger. A direct implication of this argument is that segments are underspecified for at least some features. I discuss this further in section 3 below. The proposal to specify segments based on phonological activity follows the arguments put forth by Reiss (2017). Reiss proposes that underlying feature specifications need not be contrastive; that segments should be specified for all and only the features needed to account for the phonological processes found in the language. I further argue that the vowel harmony processes seen in the northern dialect of Ewe must be understood in terms of lexical versus post-lexical processes. In a nutshell, I propose that the Height, and Place harmony processes are lexical processes, whereas Low harmony applies post-lexically. This distinction will help us explain why /a/ and /ɛ/ can trigger some phonological processes while acting as targets or neutral vowels in others.

Let us first discuss the argument proposed by Reiss (2017).

2 The role of contrast in phonological computations

Contrast has been central to phonology since at least the 19th century. According to Sweet (1877), cited in Dresher's (2016) summary of the history and development of the notion of contrast in phonology, languages differ in what sounds they use contrastively. While a pair of sounds may lead to changes in the meaning of words in one language (say language A), the same pair of sounds may not cause change in the meaning of words in another language (language B). Methods on how contrastive sounds can be distinguished from non-contrastive ones in a language have been discussed in works such as Scobbie & Stuart-Smith (2008) and Dresher (2011). The study of contrast has also evolved significantly since the era of Sweet (1877). In generative phonology, pioneered through the work of Chomsky & Halle (1968), the idea of distinctive features is used to capture the differences that exist between segments in languages.[17] According to Clements & Halle (2010:3), "features provide a necessary basis for understanding the

17 Clements & Halle (2010) provide an overview of various arguments on distinctive features and feature specification.

structure and economy of phonological systems and provide a frame of reference for models of production and comprehension in speech communication." Building on distinctive features of segments and related contrasts between segments in a language, many phonological processes can be explained in much simpler terms. Vowel harmony is no exception to this. Relying on features and contrasts, harmony processes can be explained as agreement relations in specific features between segments in a word. It is therefore important for segments in the inventory of a language to be properly parsed into contrasting feature units. Thus, there is the need to specify segments in any given language for the various features that make them different from other segments in that language. But before we do this, let us take a look at some methods that are used in computing phonological contrast.

2.1 Methods of computing phonological contrast

In this section, I discuss two methods of computing contrasts between segments: contrast by minimal difference and contrast by feature hierarchy. According to Dresher (2016), these methods can be traced back to Trubetzkoy (1939). First let us discuss the minimal difference approach.

2.1.1 Minimal difference approach to computing contrast

The minimal difference approach holds that a feature is only contrastive if it is the only unit that distinguishes a phoneme A from another, B. As Dresher (2016:25) puts it, "a feature [αF] is contrastive for a phoneme P if and only if there is another phoneme Q which has the same specifications as P except that it is [-αF]." This method has been generally accepted for computing contrastive features and has been used in works such as Calabrese (2005) and Nevins (2010). However, Hall (2011) identifies some challenges with this method. Hall observes that in theories such as Contrastive Specification which use this method of specification, certain sound inventories are challenging to parse. For instance, Hall considered the inventory of Arapaho in (41). Starting with a full specification in (41a), he observes that the minimal difference method fails to distinctly parse the inventory as in (41b). /i/ and /u/ are not distinct, and neither are /e/ and /o/.

(41) Arapaho vowel inventory

a. Full specification

	i	e	o	u
[±high]	+	-	-	+
[±back]	-	-	+	+
[±round]	-	-	+	+

b. Contrastive specification

	i	e	o	u
[±high]	+	-	-	+
[±back]				
[±round]				

As I will show in Chapter 6, the inventory of Ewe presents challenges to this method of computing contrast in the same way as we see in the Arapaho inventory. For now, I continue this discussion with the feature hierarchy method of determining contrast.

2.1.2 Feature hierarchy approach to computing contrast

Under the feature hierarchy approach, "features – and thus contrasts – are organized into a hierarchy, so that some contrasts take scope over others" (Hall 2011:8). According to Dresher (2016), this method can be traced back to the works of Jakobson & Halle (1956). The feature hierarchy approach operates through assigning features that distinguish segments, beginning with no specification, and does not stop until all segments have been fully distinguished from one another. Thus, unlike the minimal difference approach, the feature hierarchy method "will necessarily produce a set of feature specifications that is sufficient to distinguish all segments in the input inventory" (Hall 2011:8), I discuss this method further in Chapter 6, where I highlight the challenges it faces when we consider the vowel inventory of Ewe. In the next section, I discuss the role of contrast in phonological computation.

2.2 Reiss' (2017) proposal on the role of contrast in phonological computation

It is a generally accepted idea that contrast is essential in phonology. As Reiss (2017:24) puts it, "[i]t is almost universally accepted as a truism that the notion of contrast is important in phonology." Many phonological theories, for example, theories of underspecification (Pulleyblank 1986, 1988; Steriade 1987) as well as the Contrastive Hierarchy (Hall 2007; Dresher 2009) rely on the idea of contrast, with major studies on the role of contrast in phonological computations (see, for instance, Avery 1996; Hall 2007; Dresher 2009, 2016, 2018; and various studies in Avery, Dresher & Rice 2008). These studies focus mainly on explaining the behaviours of sounds in phonological processes by making reference to contrast. Dresher (2016) argues that redundant features are not present in phonological computation. In other words, redundant features are inert. Thus, if a feature is not contrastive in a language, then phonological rules cannot make reference to such features.

In its strongest form, this assertion has been found to be problematic. For instance, Hall (2008), in his discussion of voicing assimilation in Czech, argues that the Contrastivist Hypothesis in its strong form makes wrong predictions about the behaviours of certain segments. Hall proposes that redundant features are present during phonological computation, but that these features are not active in the language and thus are not referred to in phonological computations. Nevins (2015), however, takes a different stance and argues that redundant features can be active in phonological computations. Nevins proposes the Parametrized Visibility Hypothesis, which states that phonological rules "may parametrize whether they are sensitive to contrastive-values-only or to all values of a feature" (Nevins 2015:13). Reiss (2017), on the other hand, rejects the role of contrast in phonological computation. He argues that contrast with respect to features is irrelevant to phonology: "[c]ontrast with respect to a feature F is neither a necessary nor a sufficient condition for predicting phonological behavior" (Reiss 2017:44). Reiss exemplifies his point by looking at ATR harmony in Tangale and the idiosyncratic behaviour of /v/ in Russian. I present his arguments here, beginning with the ATR harmony in Tangale.

Tangale has nine surface vowels: the four [+ATR] /i,e,u,o/, each with a [-ATR] counterpart /ɪ,ɛ,ʊ,ɔ/, and the low [-ATR] vowel /ɑ/. First, when the low vowel occurs in suffixes, the suffix can appear with both [+ATR] and [-ATR] root vowels, as in (42a-b). Second, the suffix U (underspecified for [ATR]) harmonizes to the [ATR] value of the preceding vowel, as illustrated in (42c-g). Finally, evidence for /ɑ/ having a [-ATR] specification is seen in (42e, g), where it triggers ATR harmony.

(42) Tangale ATR harmony (van der Hulst & van der Weijer 1995, cited in Reiss 2017:29)

a.	peer-nɑ	[peernɑ]	‘compelled’
b.	pɛd-nɑ	[pɛdnɑ]	‘untied’
c.	seb-U	[sebu]	‘look’ (imp.)
d.	kɛn-U	[kɛnʊ]	‘enter’ (imp.)
e.	ʔwɑr-U	[wɑrʊ]	‘go’ (imp.)
f.	dob-Um-gU	[dobumgu]	‘called us’
g.	dib-nɑ-m-gU	[dibnɑmgʊ]	‘called you (pl.)’

According to Reiss, these patterns are simple and straightforward unless one assumes that the ATR value on /ɑ/ should be phonologically inactive since there is no ATR contrast in low vowels. He concedes that reference to the presence or absence of contrast in the segment inventory is satisfactory in explaining patterns in other languages. However, in the case of Tangale, contrast is not a predictor of phonological behaviour. As he rightly puts it, “Tangale is sufficient to demonstrate that even features that do not contrast in a given environment can be phonologically active” Reiss (2017:29). It is worth pointing out that Reiss’ analysis of Tangale assumes a minimal difference definition of contrast; thus, his conclusion is only fully valid when considered from that perspective. Within the Contrastive Hierarchy, Reiss’ argument against contrast in Tangale is not problematic because /ɑ/ can be contrastively specified for

[ATR] if [ATR] is ordered highly in the hierarchy.[18] Thus, Tangale would not present a challenge to the idea of contrast in phonological computation.

Further evidence to show that contrast does not necessarily determine the patterning of segments can be seen when we consider the behaviour of /v/, which has a contrastive counterpart /f/ in Russian. Russian has a robust word final devoicing process whereby voiced obstruents in final position become voiceless. This process only affects obstruents. Final devoicing feeds a rule of voicing assimilation where consonants in a cluster at the end of words or across certain word boundaries assimilate to the voicing feature of the rightmost consonant. Voicing assimilation applies iteratively from right to left (Reiss 2017). Sonorants do not undergo final devoicing and also do not trigger voicing assimilation. Interestingly, /v/ in Russian patterns similarly to both obstruents and sonorants. On one hand, it undergoes final devoicing, which affects only obstruents, as illustrated in (43ai-iii). This behaviour makes it appear to pattern as an obstruent. On the other hand, /v/ does not trigger voicing assimilation, a pattern exhibited by sonorants as we can see in (43b).

(43) Russian /v/ patterns (from Reiss 2017)

a. Final devoicing

i.	prav-a	‘right (fem.)	praf (masc.)
ii.	krov-i	‘blood (gen.)	krof (nom.)
iii.	lʲubv-i	‘love (gen.)	lʲubof (nom.)
iv.	porok-a	‘vice (gen.)	porok (nom.)
v.	porog-a	‘threshold (gen.)’	porok (nom.)

18 Reiss does not consider the Contrastive Hierarchy in his analyses; thus, he does not have an argument either for or against this approach to feature specification.

b. Voicing assimilation

i.	ot-jexat^j	'to ride off'
ii.	ot-stupit^j	'to step back'
iii.	od-brosit^j	'to throw aside'
iv.	ot-vesti	'to lead away'

This problem has received considerable attention in the literature. Hayes (1984) and Kiparsky (1985) have argued that /v/ is underlyingly a /w/. This prevents it from triggering voicing assimilation. However, this analysis must also stipulate a late strengthening rule that changes it to /v/, after which it can pattern as an obstruent. Padgett (2002), however, argues that /v/ is phonetically intermediate between obstruents and sonorants. This account has been refuted by Hall (2004), who argues that such a representation is phonetically untenable in other Slavic languages like Czech, where /v/ exhibits similar properties. Reiss (2017) argues that /v/ in Russian is underspecified for voicing. In accounting for final devoicing, Reiss proposes that the devoicing process is two-step in nature. At the first step, the [+voice] of voiced obstruents is deleted, while for the second step, Reiss proposes a 'feature-filling-by-unification' rule which fills in [-voice] on all segments without a voicing specification. Thus, /v/ undergoes final devoicing because, at the second step of the devoicing process, the feature-filling-by-unification rule fills in a [-voice] specification for /v/, which thus surfaces as /f/. Concerning voicing assimilation, /v/ cannot trigger the process since it does not have a voicing feature to transmit. However, it is a target of voicing assimilation by a similar process as final devoicing: /v/ surfaces as [+voice] if the feature-filling-by-unification rule is filling [+voice] through voicing assimilation.

Based on these facts of /v/ in Russian, Reiss observes that even though /v/ is phonetically contrastive with /f/, it still "behaves in a non-parallel fashion with respect to the feature that determines contrast" (Reiss 2017:43). Combining the observations of Tangale ATR harmony and the behaviour of /v/ in Russian, Reiss (2017:44) "[...] rejects the role of contrast in phonological computation and phonological theorizing." Thus, according to Reiss, segments do not need to contrast in a feature to alternate in a particular manner related to this feature.

I follow Reiss in arguing that, in the northern dialect of Ewe, featural contrasts do not predict the behaviours of vowel segments. I contend that vowels need to be specified for features and feature values necessary to first, account for phonological activity, and second, distinguish them from one another in the language. When needed for phonological activity, these features and feature values are specified regardless of their contrastive status. I arrived at this analysis given the varying arguments in the literature on the role that contrast plays in phonological computation as well as the challenges posed by the inventory and patterning of the vowels of the northern dialect of Ewe. It is worth mentioning that I assume a weaker version of Reiss' (2017) argument against contrast in phonological computation. While Reiss argues that contrast is irrelevant to phonological computation, I propose that contrast is necessary in some languages where there is not enough evidence from phonological processes to parse the inventory based on activity. I pursue this further in section 5 of this chapter and in Chapter 6. I now turn to the notion of underspecification and why it is relevant to our current discussion.

3 Underspecification

In the previous section, I discussed the role of contrast in phonological computation as well as the argument against the role of contrast in phonological computations. I proposed that vowels in the northern dialect of Ewe are specified for only features necessary to trigger phonological processes in the language. A logical conclusion that can be drawn from this proposal is that segments are underspecified for at least certain features. In this section, I discuss the evidence supporting the idea that some segments in the northern dialect of Ewe are featurally underspecified. I provide theoretical and empirical justifications for underspecification. Specifically, I show that /a/ and /ɛ/ violate some assumptions used in diagnosing specification and, as such, can be considered to be unspecified for some features in underlying representation.

4 Why underspecification?

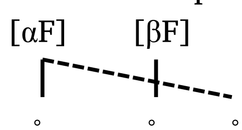
Features specification of segments is often evident in the phonological processes in which segments bearing relevant features act as triggers or as participants. However, there are instances where a feature fails to be apparent in a phonological process where it would be expected to operate. According to some theories, such features are designated as underspecified. The basic tenet of any theory of underspecification is that segments are not specified for all distinctive features in underlying representation (see Archangeli 1988 for discussion on the need for underspecification compared to full specification). Although underspecification is often tied to predictability (e.g. Archangeli 1988), the use of featural underspecification need not be tied to any particular notion of contrast, as illustrated in the discussion of Reiss (2017) above.

Underspecification can be diagnosed by observing facts about segments that violate three basic assumptions: locality, generality, and invariance (Steriade 1995). I discuss these in turn, beginning with locality.

4.1 The assumption of locality

It is argued that phonological rules apply between segments that are adjacent to each other on some representational tier. Thus, rules do not skip specified elements represented on the same tier. Consider the illustration in (44), adapted from Steriade (1995:121).

(44) Assimilation: spread [αF]



The process in (44) above is prohibited by the assumption of locality. This is because the rule spreading [αF] skips over the immediately adjacent segment with the specification [βF]. Thus, a process where a phonological rule seems to skip an element on the surface can be regarded as evidence of underspecification, where the skipped element lacks a value for the feature being spread.

There are some processes, however, that look like the prohibited structure in (44). Such cases have been analyzed by making a distinction between an earlier stage of derivation, where the spreading feature is unspecified on the relevant tier at the point the rule applies, and then a later stage where this feature is specified by the application of some redundancy rule. The Russian rule of voicing assimilation mentioned earlier illustrates this, where sonorant consonants fail to trigger assimilation, and intervening sonorants fail to block voicing assimilation. Consonant clusters with intervening consonantal sonorants still undergo voicing assimilation, as exemplified in (45). In (45b-c), /m/ is transparent to assimilation. [+voice] or [-voice] features can be passed to the leftmost consonant from the rightmost one. In (45a), however, we see that when /m/ is the rightmost consonant in the cluster, it fails to trigger voicing assimilation.

(45) Russian voicing assimilation

a.	o**t-m**elodii	*o**d-m**elodii	'from the melody'
b.	**iz-Mts**enka	**is-Mts**enka	'from Mtsensk
c.	o**t-mzd**y	o**d-mzd**y	'from the bribe'

These cases present a situation where features appear to be spreading across a segment. However, this need not be the case. Russian consonantal sonorants have been analyzed as lacking voicing features, as discussed in the previous section. According to Steriade (1995), voicing is later specified on sonorants through a redundancy rule.

4.2 The assumption of generality

The assumption of generality holds that "if some process manipulates [αF], then all segments possessing [αF] will participate in it" (Steriade 1995:122). This assumption ensures that all segments specified for a certain feature participate in phonological processes that make reference to that feature. Take, for instance, the height assimilation process of Lamba in (46), where a high vowel assimilates to the [-high] feature of a preceding [-high] vowel. Thus, this process is triggered by [-high] vowels. However, /a/ does not trigger height assimilation, even though it is phonetically [-high].

(46) Height assimilation in Lamba (Steriade 1995:92)

Past	**Neuter**	**Applied**	**Gloss**
tul-a	tul-ika	tul-ila	"dig"
fis-a	fiš-ika	fiš-ila	"hide"
kos-a	kos-eka	kos-ela	"be strong"
sek-a	sek-eka	sek-ela	"laugh at"
pat-a	pat-ika	pat-ila	"scold"

The analysis proposed by Steriade (1987) relies on the notion of underspecification. She argues that /a/ has a predictable [high] value such that it lacks any specification for this feature in underlying representation. This makes it impossible for /a/ to spread a [-high] feature, since it does not have this feature in the first place. Non-low vowels, on the other hand, have distinctive [high] features that will cause them to be either [+high] or [-high]. For example, mid vowels will be specified as [-high], and thereby act as triggers to height assimilation.

Consider also the Height harmony process of Ewe first discussed in section 3.1 of Chapter 2. Apart from /ɛ/, all other [+low] and [+high] vowels trigger Height harmony; they are thus specified for these features in underlying representation. I repeat example (36) below as (47) and also recapitulate the relevant facts. In Height harmony, the enclitic vowel /e/ harmonizes to the [high] feature of the root vowel such that it is realized as /i/ after [+high] vowels (47a-b) and as /ɛ/ after [+low] vowels (47c-d).

(47) Height harmony in Northern dialect of Ewe (repeated from (36))

a.	kù	-è	=	kù-ì
	fetch	-3SG		'fetch it'
b	mlì	-è	=	mlì-ì
	roll	-3SG		'roll it'
c.	tsɔ́	-è	=	tsɔ́-ɛ̀
	take	-3SG		'take it'
d.	tá	-è	=	tɛ́ɛ̀
	draw	-3SG		'draw it'
e.	fɛ́	-è	=	fée
	split	-3SG		'split it'

The only vowel that is phonetically [+low] on the surface but does not trigger harmony is /ɛ/. This violates the assumption of generality; I thus propose that /ɛ/ is unspecified for [low] in underlying representation.

4.3 The assumption of invariance

Finally, the assumption of invariance states that features that are specified lexically prefer to remain the same throughout the derivation (Steriade 1995). A segment specified for a feature will, in most cases, remain unchanged with regard to this specification. If a segment becomes a target of assimilation, it is an indication that the segment may be underspecified for the feature referenced by the assimilation process. It is worth noting, however, that not all instances where a segment is the target of some phonological rule should be interpreted as signalling some form of underspecification. For instance, dissimilation processes delete a feature due to pressure from more important phonotactic constraints (see Steriade 1995:117 for a more detailed discussion on this). In Ewe, the habitual marker /a/ must agree with the [front] and [back] features of the root vowel. Recall from section 3.3 above that the habitual marker /a/ is the only vowel that is a target of these harmony processes. This characteristic violates the assumption of invariance. Thus, I propose that /a/ is unspecified for place in underlying representations. It is indeed simpler to posit a rule to insert a feature missing in the underlying representation than to come up with a mechanism that first deletes a specified feature and then replaces it with a different value of the same feature. I show this in my analysis of the various harmony processes in Chapter 5. In addition to this, there are no processes in the language making reference to the place features [front] and [back] where /a/ is a trigger. Therefore, /a/ is underspecified for place.

So far, I have discussed some evidence for underspecification in Ewe. I have shown that /a/ and /ɛ/ violate some of the assumptions needed to properly diagnose specification; these vowels must instead be considered to be unspecified for some features in underlying representation. A question that arises from these discussions concerns which features must actually be specified in underlying representation. In other words, how can we determine what features are needed to distinguish segments in underlying representation? This has been a point of debate in the literature. While some scholars (e.g., Steriade 1987, 1995; Clements 1987) support the view that only contrastive features are specified underlyingly (Contrastive underspecification), others (e.g., Pulleyblank 1986; Abaglo & Archangeli 1989) hold that any feature value that can be predicted should not be present in the underlying representation (Radical underspecification), such that only unpredictable features and feature values are specified underlyingly. I return to the discussion of these views and how they apply to the inventory of the northern dialect of Ewe later in Chapter 6. For the time being, I return to Reiss' (2017) proposal that feature specification can be assigned not based on the notion of contrastiveness (whichever its implementation) but rather on the notion of feature activity.

5 Vowel specification in the northern dialect of Ewe

An implication from Reiss' (2017) argument for feature specification based on phonological activity, as outlined in the previous section, is that segments can be specified for whatever features they need to participate in phonological computation. It does not matter whether these features are contrastive or redundant. This position is similar to the one taken by Nevins (2015), even though Nevins does not formulate his proposal in this way. By arguing that redundant features can be active in phonological computation, segments can be specified for these redundant features, so long as these features are needed to account for phonological processes in the language. Thus, not only contrastive features are allowed to appear in the representation of segments.

For my analysis of the Ewe vowel harmony data, I follow Reiss' (2017) proposal that contrast is irrelevant to phonological computation. I propose specifications for the vowel segments in the northern dialect of Ewe by making reference to the phonological processes described above. I thus rely on phonological activity to identify the features and feature values of the vowels that participate in each harmony pattern.

One characteristic of /ɛ/ in the northern dialect of Ewe, as I discussed in Chapter 1, is that it behaves in a way similar to vowels analyzed as being completely unspecified in languages genetically related to Ewe (Gengbe and Yoruba). However, in this section, I argue that even though /ɛ/ has some of the characteristics of other fully unspecified vowels in related languages (as I show further below), this vowel does not behave as if it were completely unspecified. Let us begin with a look at how vowels can be specified for features using phonological activity.

First, we can hypothesize that all vowels except /ɛ/ need height specification. This is necessary since all vowels but /ɛ/ trigger Height harmony in the northern dialect of Ewe. As we saw in (36) above, /i, u, a/ all cause the enclitic to assimilate to their height values. However, /ɛ/ is the target of this harmony instead of being a trigger, as we saw in (37). I thus propose that /ɛ/ does not have a height specification in its underlying representation. A second general claim about the dialect is that all front vowels also need to be specified as [+front]. According to Clements (1974), /a/ is realized as /ɛ/ when the preceding stem vowel is a front vowel. I observe that this is also the case when /a/ is followed by a front vowel. Thus, front vowels trigger front harmony, as in (39) above. Similarly, all back vowels need to be specified as [+back]. This is necessary since they trigger back harmony, as we saw in (40). Finally, /a/ has only a height specification, since it does not trigger any other harmony process in the language except those affecting vowel height.

To summarize, the following constitutes our working hypothesis concerning feature specification of phonemic vowels in the northern dialect of Ewe.

Table 7: Proposed feature specifications for phonemic vowels in the northern dialect of Ewe

	[low]	[high]	[back]	[front]
/i/		+		+
/u/		+	+	
/e/	-			+
/o/	-		+	
/ɛ/				+
/ɔ/	+		+	
/a/	+			

I derive these feature specification in Chapter 4, using a constraint based approach. The feature specifications proposed in Table 7 capture phonological activity in the language and each segment is distinct from one another based on these specifications. Also, every feature in Table 7 can be motivated by phonological processes. However, the [-low] feature on /e/ is only needed to distinguish it from /ɛ/. Thus, contrast plays the role of requiring sufficient specification to distinguish segments from one another.

The asymmetric behaviour of /ɛ/ is among the phonological patterns motivating the features in Table 7. This behaviour is similar to that of vowels in related languages (Gengbe and Yoruba), which have been analyzed as unspecified for all phonological features. In the next section, I show that, despite the similarities between /ɛ/ in Ewe and underspecified vowels in other languages, /ɛ/ cannot be represented as a completely featureless vowel.

5.1 /ɛ/ as a featureless vowel?

In this section, I highlight the similarities in the behaviour of /ɛ/ and that of unspecified vowels in other languages. I argue that even though the /ɛ/ of Ewe patterns in ways similar to these vowels, it cannot be completely unspecified in underlying representation. I begin with a recapitulation of the asymmetric behaviour of /ɛ/ in the northern dialect of Ewe.

In the compounding process exemplified in (13), both /a/ and /ɛ/ are deleted to resolve the hiatus created with other vowels. Apart from their position as second vowels in a hiatus, I propose that /a/ and /ɛ/ are deleted as a result of their highly impoverished representations. Both /a/ and /ɛ/ are also targets of harmony processes (Place harmony for /a/ and Height harmony for /ɛ/) as exemplified in (39) and (37) respectively. When the underlying hiatus is made of /a + ɛ/, then /ɛ/ is deleted. For this reason, I propose that /ɛ/ is even more underspecified than /a/ in the language, given it is the only vowel that deletes in all hiatus contexts.

This hypothesis receives immediate support through a look at how hiatus is resolved in contexts other than compounding. The relevant examples, first described in (14), (15) and (16), are repeated as (48).

(48) Deletion in Ewe

a.	mɛ̀	ɸl**ɛ̀**	**à**bōlǒ		=	mɛ̀ ɸl **à**bōlǒ
	1SG	buy	bread			
	‘I bought bread’					
b.	Ámā	ts**ɔ́**	**ɛ̀**xá	lá	=	Ámā ts**ɔ́** xá lá
	A	take	broom	DET		
	‘Ama took the broom’					
c.	mɛ̀	w**ù**	**à**fì	lá	=	mɛ̀ w**ù** **à**fí lá
	1SG	kill	mouse	DET		
	‘I killed the mouse’					

In (48a), /ɛ/ is deleted in a hiatus created by the verb and an object beginning with a vowel. Apart from clauses like (48a) above, this process affects /ɛ/ whether it occurs in a verb stem or as a prefix in object nouns, as shown in (48b). All other vowels in this environment, including /a/, are fully realized in this context, as in (48c). Thus, /ɛ/ is deleted whether it appears in V_1 or V_2 positions. This characteristic is similar to the behaviour of vowels in related languages that have been analyzed as completely unspecified. Let us now discuss some of these cases. I begin with Gengbe in the next section.

5.2 Cross-linguistic comparison

As mentioned in the introduction, both Ewe and Gengbe are Kwa languages, belonging to the GBE language cluster. Gengbe has the same vowel inventory as the northern dialect of Ewe as well as the same surface restriction on monosyllabic nouns illustrated in (11) above. The only point of difference in relation to vowels is that Gengbe uses /e/

in instances where Ewe uses /ɛ/. (Differences can also be found among lexical items across the two languages, but these are immaterial to the current discussion.)

Let us first take a look at the verb phrase in Gengbe. Abaglo & Archangeli (1989) report that, in Gengbe, the initial /e/ in object nominals is deleted in the formation of the verb phrase. This is illustrated in (49).

(49) Verb phrases in Gengbe with /e/-initial nouns (Abaglo & Archangeli 1989: 467)

a.	j**i**	**e**te	=	j**i**te
	look	yam		'look for yam'
b.	b**u**	**e**tu	=	b**u**tu
	lose	gun		'lose gun'
c.	p**o**	**e**sɔ	=	p**o**sɔ
	beat	horse		'beat horse'
d.	syɔ**n**	**e**ci	=	syɔ**n**ci
	filter	water		'filter water'

Abaglo & Archangeli (1989) argue that /e/ is a featureless vowel that is only inserted in the appropriate environment. Thus, if the right environment is not met (i.e., in initial position), then the featureless vowel is not inserted, as we can see in (49).

Also, in verb phrases with /e/ as the underlying root vowel, /e/ is deleted when the verb is followed by /a/ in the surface form. This is seen in (50).

(50) Verb phrases in Gengbe with root vowel /e/ (Abaglo & Archangeli 1989: 468)

a.	pl**e**	**a**ti	=	pl**a**ti
	buy	tree		'buy tree'
b.	pl**e**	**a**ḍi	=	pl**a**ḍi
	buy	soap		'buy soap'
c.	j**e**	**a**go	=	j**a**go
	fall	bank		beach

Given that /e/ of Gengbe patterns similar to /ɛ/ in the northern dialect of Ewe, and that /e/ has been characterized as an unspecified vowel, it follows that /ɛ/ in the northern dialect of Ewe could be characterized as such.

A small step away from Ewe and Gengbe, Yoruba presents a similar pattern. It is worth noting that Yoruba also belongs to the Kwa language group of the Niger-Congo branch and has the same oral vowel inventory as the northern dialect of Ewe and Gengbe.

Yoruba displays a regressive assimilation process that spreads features from a trigger vowel to a target preceding it. This process is triggered by all vowels except /i/. This is illustrated in (51) below.

(51) Yoruba regressive assimilation (Pulleyblank 1988:239)

a.	ar**á ò**kè	=	aró òkè		'northern Yoruba'
b.	ow**ó a**dé	=	awá adé		'Ade's money'
c.	àw**ɔ̀ e**jò	=	àwè ejò		'colour of a snake'
d.	il**é A**yɔ̀	=	ilá Ayɔ̀		'Ayɔ's house'
e.	ar**á ì**lú	=	ará ìlú	*arí ìlú	'townsman'
f.	er**ù i**gi	=	erù igi	*erì igi	'bundle of wood'

In (51a-d), the initial vowel of the second word causes the preceding vowel to agree in all features. However, in (51e-f), where the initial vowel of the second word is /i/, assimilation fails to apply.

In addition to this process, /i/ displays an asymmetric behaviour in hiatus contexts. Pulleyblank (1988) reports that Yoruba has a robust process that deletes the V_1 of a hiatus. However, in a hiatus involving /i/, it is this vowel that is deleted, no matter the position it occupies in the sequence. I show this in (52). In the examples in (52a), /i/ is deleted in V_1 position whereas (52b) shows the deletion of /i/ in V_2 position.

(52) Yoruba vowel deletion (Pulleyblank 1988:243)

a. Deletion with /i/ as V_1

i.	**jí aṣ**ọ	=	jáṣọ	'steal clothes'
ii.	r**i ẹ**ja	=	rẹ́ja	'see fish'
iii.	t**i è**mi	=	tèmi	'mine'
iv.	n**i ọ**ja	=	lọ́jà	'at the market'[19]

b. Deletion with /i/ as V_2

i.	gb**é i**ná	=	gbéná	'lift the lamp'
ii.	gb**a i**ṣẹ́	=	gbaṣẹ	'take a job'
iii.	j**u i**gi	=	jugi	'throw a stick'
iv.	w**o i**lẹ̀	=	wolẹ̀	'look at the ground'

These asymmetries are similar to those that characterize /ɛ/ in the northern dialect of Ewe and /e/ in Gengbe. The facts about Gengbe and Yoruba and their analyses through underspecification support the hypothesis that /ɛ/ is a featureless vowel. In turn, this analysis offers a plausible explanation for the behaviours of /ɛ/ in hiatus contexts in Ewe.

However, I argue that /ɛ/ cannot be a completely featureless vowel. Key to this hypothesis is that, in both Gengbe and Yoruba, the featureless vowels /e/ and /i/ do not trigger any process in the language; they are completely inert. As reported by Pulleyblank (1988), /i/ is a target of harmony but never a trigger. Similarly, in Gengbe, /e/ only acts as a target of harmony and not a trigger (Abaglo & Archangeli 1989). Thus, a featureless characterization will fully capture the phonological behaviour of

19 The alternation between /n/ and /l/ is caused by a denasalization process which affects /l/ before a non-high vowel (Pulleyblank 1988).

these vowels in Gengbe and Yoruba. This is not the case in the northern dialect of Ewe. As we saw in section 3.3 of the previous chapter, /ɛ/ is a trigger of Place harmony. Treating /ɛ/ as a featureless vowel would thus make it impossible for it to trigger harmony, because, it would have no harmonic feature to start with. Yet /ɛ/ displays all other characteristics of a featureless vowel. It is always deleted in a hiatus, in contrast to all other vowels, including /a/. Based on the feature specification I proposed in Table 7 above, /a/ and /ɛ/ are the least specified vowels in the language. /a/ has a [+low] specification while /ɛ/ has [+front]. Building on the observations above about /ɛ/ and /a/, this suggests that the feature [front] is less marked than [low], making /ɛ/ the most unmarked of the two vowels. This hypothesis will provide an explanation for the asymmetric behaviour of /ɛ/. Alternatively, from the perspective of OT, preservation of, or faithfulness to, [low] may be more important than preservation of [front]. Further research is needed to determine whether or not this assertion holds. Since the discussion of markedness between features transcends the scope of this thesis, I leave it open for future research.

In the next section, I return to my discussion of the harmony processes observed in the northern dialect of Ewe. I attempt to explain the asymmetry of /a/ and /ɛ/ by appealing to the tenets of Lexical Phonology. I argue that Height and Place harmony are lexical processes and, thus, are applied early in the derivation process. I further argue that Low harmony, on the other hand, applies post-lexically, at a later stage of derivation.

6 Lexical Phonology and the harmony processes in Ewe

Lexical Phonology developed out of *The Sound Pattern of English* (Chomsky & Halle 1968; hereafter *SPE*) as a way to refine the structure of phonological and morphological aspects of grammar (Rubach 2008). Early works on Lexical Phonology include Kiparsky (1973, 1982), Halle (1978) and Rubach & Koziński (1981). Lexical Phonology holds that some phonological rules interact with morphological rules in the derivation of words in the lexicon. These phonological rules are referred to as lexical rules. These rules differ from other phonological rules that do not make reference to the internal properties of words and, thus, apply outside of the lexicon; these are post-lexical rules.

There is a large body of work on Lexical Phonology, which provides evidence for the existence of both lexical and post-lexical rules. Building on this evidence, Kiparsky (1982) proposes that rules be applied at different cycles of morphological processing (lexical and post-lexical). He argues that lexical rules interact with word formation rules, and that these operations take place within the lexicon. Additional research on this topic shows that lexical phonological rules operate alongside morphological rules in the derivation of words (Itô & Mester 2003). In other words, lexical phonological rules do not apply after all morphological rules have applied. Consequently, lexical rules apply in a cycle, and can thus be applied multiple times as morphologically complex words are built. In contrast to this, post-lexical rules operate at the level of sentences: “they apply to strings derived by syntactic operations” (Rubach 2008:459) and, as such, do not apply in a cycle.

However, the notion of cyclicity within the lexicon is not without controversy: in their review of Kiparsky (1982), Booij & Rubach (1987) argue that not all lexical rules are cyclic. They propose two kinds of lexical rules; cyclic and post-cyclic rules, with the distinction that post-cyclic rules "apply across the board to fully derived words" Rubach (2008:466), and apply once, while cyclic rules apply after each step of morphological derivation (see also Booij & Rubach 1987 for additional discussion). Rubach (2008) outlined some characteristics that can be used to determine whether a rule is lexical or post-lexical. Amongst them, a rule that applies across word boundaries is post-lexical, whereas one whose domain is the word must be lexical.

An example of a lexical process is Russian palatalization. In Russian, palatalization (marked on consonants as ^{j}) occurs when a front vowel follows a consonant. This is illustrated in (53).

(53) Russian Palatalization (Rubach 2008:457)

Nominative sg.		Locative sg.	Diminutive
[stɔl]	'table'	[stɔl^j + ɛ]	[stɔl^j + ik]
[vagɔn]	'carriage'	[vagɔn^j + ɛ]	[vagɔn^j + ik]
[brat]	'brother'	[brat^j + ɛ]	[brat^j + ik]
[nɔs]	'nose'	[nɔs^j + ɛ]	[nɔs^j + ik]
[dɔm]	'house'	[dɔm^j + ɛ]	[dɔm^j + ik]

As we can see in these examples, the final consonant of the stem is palatalized if the adjoining affix begins with a front vowel. This is seen in the locative singular as well as the diminutive. However, there are instances where the segmental environment for palatalization is met, but palatalization does not apply, as we can see in (54).

(54) Non-application of Russian palatalization (Rubach 2008:458)

[stɔl	+	ivana]	'Ivan's house'
[vagɔn	+	ivana]	'Ivan's carriage'
[brat	+	ivana]	'Ivan's brother'

Rubach (2008) argues that palatalization fails in this instance because it is a lexical process restricted to the word domain. In the formation of a phrase such as [stɔl ivana], both words go through the word formation process independently. Therefore the condition necessary for palatalization is not met within the lexicon.

Other features of lexical rules are that they make reference to morphological structure such as morpheme boundaries, whereas post-lexical rules apply across the board, without reference to morphological structure. Also, there are exceptions to lexical rules. Certain classes of words (loanwords, nouns, etc.) may be exempted from undergoing lexical processes. This is not the case for post-lexical rules, which do not have exceptions because they do not have access to lexical information about words.

In this section, I propose that all harmony processes described for Ewe, except Low harmony involving the focus marker, take place within the lexicon as lexical processes. The properties of Place harmony in the northern dialect of Ewe indeed make it an obvious lexical process. First the habitual form of a verb and the definite form of a noun are created through affixation, a process which refers to morpheme boundary. Second, Place harmony only applies when a morpheme (the habitual marker or determiner) is attached to a stem (verb stem for the habitual marker and noun stem for the determiner).

In contrast to this, Height harmony, which involves cliticizing the 3SG object pronoun to the verb, may not seem to bear the properties of a lexical process, given that formation of verb phrases is in the purview of syntax. Because Height harmony occurs within the verb phrase, it could indeed be a post-lexical process. However, I argue that the formation of the verb phrase is a lexical cliticization process. This follows similar properties found in Hebrew ethical datives, as I describe next.

Borer & Grodzinsky (1986) identify three types of datives in Hebrew; possessive, reflexive, and ethical. Possessive datives are coreferential to other arguments within the clause. Besides, they can either be a clitic or a non-pronominal dative. I provide an example of a possessive dative in (55a). Ethical datives, on the other hand, are not coreferential to any argument within the clause. Rather, they refer to entities outside of the clause. This is seen in (55b). Finally, reflexive datives fall somewhere between possessive and ethical datives. They are obligatorily clitics, and they must refer to some entity within the sentence, as seen in (55c).

(55) Datives in Hebrew (Borer & Grodzinsky 1986:179)

a.	ha	-yalda	kilkela	lə	-Dan	‘et	ha	-radio
	the	-girl	spoil	to	Dan	acc	the	-radio

‘the girl broke Dan’s radio’

b.	hem	kol	ha	-zman	mitxatnim	li
	they	all	the	-time	marry	to-me

‘they are getting married on me all the time (and it bothers me)’

c.	ha	-yalda$_i$	‘axla	la$_i$	‘et	ha	-tapu’ax
	the	-girl	ate	to-her	acc	the	-apple

‘the girl ate the apple’

Borer & Grodzinsly (1986) argue that the ethical dative in Hebrew undergoes a lexical cliticization process for which syntactic configuration is largely irrelevant. Some of the ethical dative properties include the fact that it is obligatorily adjacent to the verb in a clause.

A similar restriction is seen in the northern dialect of Ewe: the pronominal clitic must appear adjacent to the verb root to which it attaches. Thus, the addition of the third person singular pronoun in Ewe takes place as a lexical cliticization process. Thus, the pronominal clitic must receive case in the morphology where clitics are associated with theta grids in the word formation process. This idea is not new; it has been expressed in Borer (1983), who proposes that “pronominal clitics are indistinct from affixes morphologically, and that the word formation rule responsible for their affixation associates them with [theta]-grids of verbs” (as cited in Borer & Grodzinsky 1986:203). Given this, I argue that morphology, not syntax, plays the predominant role in the formation of the verb phrase; therefore, this process can take place within the lexicon.

An additional observation is that the Height harmony process is restricted to the edge of morphemes. The conditions for the application of Height harmony are not met word-internally since word-internal vowel sequences are not attested in the language. However, in constructions with the focus marker, which I claim is added in the syntax, height harmony fails to apply even though the conditions for the application of the process are met. This was illustrated in (38) repeated below as (56) for convenience. If height harmony were a post-lexical process, one would expect it to apply whenever there is a VV sequence in the string. However, as we see in (56), VV sequences created through the addition of the focus marker do not undergo Height harmony.

(56) Exceptions to Height harmony repeated from (38)

a.	tú	-é	=	tú-é	(cf ku-i 3SG)
	gun	-FOC		'it's a gun'	
b.	tsī	-é	=	tsī-é	(cf mli-i 3SG)
	water	-FOC		'it's water'	

Therefore, I conclude that Height harmony in the northern dialect of Ewe is a lexical process.

So far, I have argued for Place and Height harmony as lexical processes and discussed the properties of each that make them lexical processes. Next, I express my argument for Low harmony as a post-lexical process.

In the case of Low harmony involving the focus marker, the cliticization process applies late in the syntactic derivation; thus, cliticization arguably applies at the post-lexical level. Evidence for this comes from a closer look at sentential focus in the language. In the northern dialect of Ewe, only nouns or noun phrases can be focused. (57a-c) show simple sentences without focus marking, whereas (57d-f) show their focused counterparts. As mentioned earlier, focus is marked by the cliticization of the focus marker to the last element of the noun phrase, irrespective of the number of elements that qualify the noun. This is seen in (57e-f).

(57) Focus marking in northern dialect of Ewe

a. Kòfí ɖù àbōlǒ
K eat bread
'Kofi ate bread'

b. Ámā ɸlɛ̀ àgbàlɛ̃ -á
A buy book -DET
'Ama bought the book'

c. ɖèví -á wó yì àɸέ -mɛ̄
child -DET PL go house -POSTP.
'the children went home'

d. àbōlò -é Kòfí ɖù
bread -FOC K eat
'it was bread that Kofi ate'

e. àgbàlɛ̃ -á -έ Ámā ɸlɛ̀
book -DET -FOC A buy
'it was the book that Ama bought'

f. ɖèví -á wó -é yì àɸέ -mɛ̄
child -DET PL -FOC go house -POSTP.
'it was the children that went home'

It has been argued in the literature on focus in Ewe and other related languages that focusing involves syntactic movement (Aboh 1998, 2003; Badan & Buell 2012; Gotah 2019). According to this argument, focus marking involves movement of the focused element to the specifier position of the focus phrase. This movement is evident in the examples above in relation to the other words present in such sentences: the non-focused noun phrase in (57a-c) occur post-verbally, while their focused counterparts in (57d-e) appear at the beginning of each sentence. This implies that Low harmony involving focus marking can only occur after the syntactic operations to mark focus have taken place. Low harmony, is thus, a post-lexical process.

Now that I have laid out my argument for Place and Height harmony being lexical processes and Low harmony being a post-lexical process, we can return to our discussion that proper characterization of the Ewe vowel harmony system requires special attention to how phonological feature specifications can be used to explain the asymmetric behaviours of /ɛ/ and /a/ in the northern dialect of Ewe. This will be my focus in the next chapter.

7 Summary

So far, I have shown the features that vowels need to be specified for to account for the harmony processes seen in the northern dialect of Ewe. I have also shown that Low harmony needs to be a post-lexical process, given its formal characteristics, while Height and Place harmony processes apply within the lexicon.

My proposed feature specification and analysis of the harmony processes further support the argument of Reiss (2017) that contrast is potentially irrelevant to at least some phonological computation. Given this, I relied on phonological activity to specify vowel segments for features and feature values that distinguish each segment from another. As I will show in Chapter 6, theories that rely on contrast in predicting the phonological behaviour of segments are unable to provide the necessary specifications for Ewe. Thus, even though contrast is useful in explaining phonological processes seen in some languages, that is not the case in the northern dialect of Ewe.

Also, I showed that the harmony processes attested in Ewe can be understood in terms of lexical versus post-lexical processes. Relying on the characteristics of the various processes and cross-linguistic evidence, I proposed that Height and Place harmony are lexical processes, while Low harmony is a post-lexical process. This distinction is essential in explaining the asymmetric behaviours of /ɛ/ and /a/ in the northern dialect of Ewe.

In the next chapter, I rely on violable constraints within Optimality Theory to show how the vowel specifications proposed in Table 7 can be derived. To this effect, I propose an OT analysis for the vowel harmony processes seen in the northern dialect of Ewe.

Chapter 4 Optimality Theory and feature specification in Ewe

1 Introduction

Optimality Theory (hereafter OT), first proposed by Prince & Smolensky (1993), is a theory of phonology based on interactions between grammatical constraints. Within OT, the phonological grammar consists of a set of hierarchically ordered, violable constraints whose relative rankings determine well-formedness in surface representations. These constraints can oppose each other, but the resolution of such oppositions is ultimately determined by the relative ranking of each relevant constraint in any given language; higher ranked constraints are grammatically 'more important' than low ranked ones.

OT is motivated by the fact that certain phonological processes can be blocked or triggered by constraints. These constraints and their relationships, even though easy to understand at an intuitive level, are hard to express formally in derivational linguistic theory (McCarthy 2007a). Early attempts, before the introduction of OT, to formalize the relationship between output constraints that trigger phonological processes and those that block them were unsuccessful (see McCarthy 2007a for some early approaches). A second motivation for OT is the problem of whether or not there are universal constraints and the accompanying challenge of distinguishing between universal and language particular constraints. According to McCarthy (2007a), OT creates a dichotomy between the component of the grammar that takes care of operations (Gen) and the constraints component (Eval). Gen generates a set of output candidates that differ from the input in various ways, while Eval screens the candidates generated by GEN against the ranked constraints to select one as the optimal output form.

Theories of phonological representation and underspecification as well as lexical phonology have been modelled in the OT framework. See Mackenzie & Dresher (2003) and Inkelas (1995) for how theories of representation and underspecification can be modelled in OT; and Itô & Mester (2003); Kiparsky (2015); and Bermúdez-Otero (2017) on modelling Lexical Phonology in OT. This latter modelling, named Stratal Optimality Theory (hereinafter, Stratal OT) (Itô & Mester 2003; Bermúdez-Otero 2011, 2012, 2017; Kiparsky 2015), deals with phonology-morphology interactions by segmenting the grammar into strata, following the spirit of Lexical Phonology. Processes in each stratum go through the OT mechanism described in the previous paragraph, whereby the output of an early stratum is the input of the later stratum. In addition to this, constraints may be ranked differently on each stratum of derivation.

My aim in this chapter is to show that we can use violable constraints to derive the feature specification of the northern dialect of Ewe proposed in Table 7 above. I assume the Richness of the Base hypothesis, according to which the input of a phonological derivation can take any form possible in any human language. Based on this, I argue that vowel feature specification in Ewe, which results in underspecification of segments, operates at the stem level of derivation. Before we delve into this analysis, let us discuss the mechanisms of Stratal OT.

2 Stratal Optimality Theory

Generally, phonological processes apply when the conditions for their application are met. However, there are scenarios where the relevant context needed for a given phonological process to apply is not apparent from the surface form. In the first, the process applies even though the environment necessary for its application is not present on the surface (i.e., over-application). In the second, the process fails to apply even though the conditions for its application are visible on the surface (under-application). Together, these scenarios are referred to as phonological opacity. Lexical Phonology has been central to our understanding of phonological opacity since the early 1980s, with influential works by Kiparsky (1982) and Booij & Rubach (1987), among others. Since the inception of Optimality Theory, several attempts have been made to capture instances of phonological opacity within this framework. This has led to proposals such as Output-Output constraints, which demand an optimal candidate to be faithful to some independently occurring surface form (Hale, Kissock & Reiss 1997; Benua 1995; McCarthy 1995); sympathy constraints, that allow for a failed candidate's sympathetic ally to be selected as the optimal candidate (McCarthy 1999); as well as candidate-chains, which effectively introduce derivational sequences as part of candidate selection (McCarthy 2007b). These attempts all maintain OT constraints to be evaluated in a parallel manner as per the original formulation of the theory. "An alternative to this is to abandon full parallelism in favour of stratified constraints systems" (Kiparsky 2000:1). This is where Stratal OT comes in. Stratal OT deals with interactions between phonology and morphology, by organizing the grammar into levels (strata) commensurate to those proposed in Lexical Phonology (i.e., stem, word, phrase). Each stratum operates as a purely parallel OT system. In addition to this, Stratal OT preserves the general categories of constraints proposed in the original formulation of OT, such as markedness and faithfulness constraints.

Despite the similarities between Stratal OT and Lexical Phonology, the two models are not fully compatible. For example, Stratal OT rejects the ideas of strict cyclicity and structure preservation, both of which limit how phonological processes can apply at the stem level. However, because these differences are immaterial to the analyses below, I will not discuss them further in this thesis. I continue with the tenets of Stratal OT in the next section.

3 Tenets of Stratal OT

Stratal OT is based on the tenet of grammatical modularity, which states that the "grammar is organized into components that interface via their input and output representations" (Kiparsly 2015:4). For instance, phonology is considered a separate grammatical subsystem from morphology, and the interactions between these subsystems are seen by studying the phonology-morphology interface. This principle of modularity can be extended within phonology and morphology through cyclicity and stratification (Bermúdez-Otero 2017).

3.1 Cyclicity

Cyclicity holds that morphosyntax controls the amount of structure visible in a specific round of phonological computation. This is done by submitting only morphosyntactic subconstituents of complete linguistic expressions to the phonology, which phonology, in turn, maps to surface representations (Bermúdez-Otero 2011, 2012). According to Bermúdez-Otero (2017), some nodes in the syntactic structure of complex expressions can be labelled as cyclic since they constitute the point where the conditions for the application of a phonological process are warranted. Cyclicity can lead to opacity, in cases where there seems to be a misapplication of phonological rules. Some of these misapplications are induced by the morphosyntax and can be addressed by looking at part-whole relationships in the structure of the linguistic expression (Chomsky, Halle & Lukoff 1956, cited in Bermúdez-Otero 2011). Let us take, for instance, post-nasal plosive deletion in English, first discussed by Borowsky (1993:202) and further analyzed by Bermúdez-Otero (2011). Examples of this process are shown in (58) and (59) below. In English, homorganic clusters made up of a nasal followed by a non-coronal voiced stop are allowed only if the non-coronal stops are syllabified as onsets. Else, they undergo deletion as in (58).

(58) Normal application of post-nasal plosive deletion in English

a.	bomb	[bɒm]
	crumb	[kɹʌm]
	long	[lɒŋ]
b.	bombard	[bɒm.**b**ɑːd]
	crumble	[kɹʌm.**b**l]
	elongate	[iː.lɒŋ.**g**eɪt]

(58a) shows instances where non-coronal voiced stops are syllabified as codas and thus undergo deletion. In (58b), these consonants are maintained since they are in the onset of the following syllable. Thus, both sets show normal application and non-application of the process. However, in (59) below, we see an apparent over-application of post-nasal plosive deletion; non-coronal voiced stops are deleted even though they would otherwise be syllabified in syllable onsets (as opposed to codas).

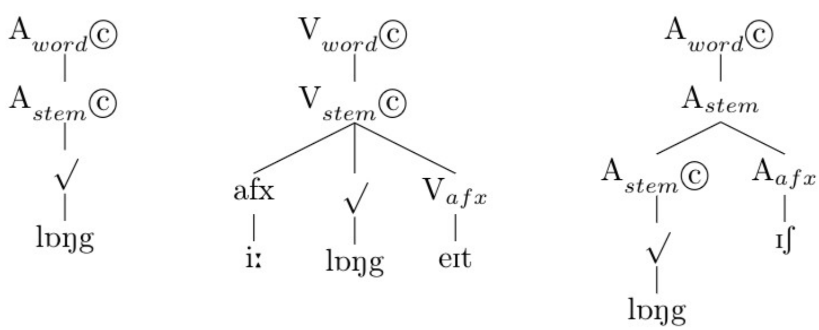
(59) Over application of post-nasal plosive deletion in English

bomb-ing	[bɒ.mɪŋ]	*[bɒm.**bɪ**ŋ]
crumb-y	[kɹʌ.mɪ]	*[kɹʌm.**bɪ**]
long-ish	[lɒ.ŋɪʃ]	*[lɒŋ.**gɪ**ʃ]

To understand how the forms in (59) came about, let us look at the morphological composition and structure of the adjectives ‘long’ and ‘longish’, and of the verb ‘elongate’, in Figure 2 below.

Figure 2 Syntactic structure showing cyclic nodes (Bermúdez-Otero 2011:2021)

a. b. c.



Some of the constituents shown in Figure 2 above define domains for phonological computation. These are referred to as cyclic nodes. A cyclic node from the above diagrams includes every stem that has been derived from a root and every fully inflected, free grammatical word. These are marked by the superscript ©. For example, while ‘e-long’ and ‘long-ate’ do not form free grammatical forms, ‘long’ itself does and is fully grammatical, as in (a). The addition of '-ish' thus takes place within a separate cycle. The derivation proceeds such that parts of morphologically complex words are derived whenever they constitute a cycle before the whole word is derived. Thus, the output of each part feeds the whole. Given this assumption, in (a), the conditions for the application of post-nasal plosive deletion are met at the stem level; the process proceeds normally. In (b), the root /lɑŋg/ does not constitute a cycle. Therefore, post-nasal plosive deletion does not apply, and affixation takes place. Affixation then blocks deletion at the stem level since the conditions for deletion are no longer met. This accounts for the fact that we do not see post-nasal plosive deletion in (58b). Finally, in Figure 2 (c), assuming that the derivation of part words precedes the derivation of whole words, 'long' is derived in the lower cycle, since it constitutes a cyclic node by itself. This derivation then feeds the higher cycle where the affix 'ish' is added. Thus, in this case, deletion precedes affixation.

Let us now consider the data from Ewe in (60), with examples representative of Front and Low harmony.

(60) Opacity in the northern dialect of Ewe

a.	tá	–	è	=	tέ-὾
	draw		3sg		'draw it'
b.	fà	–	è	=	fὲ-ὲ
	marsh		3sg		'marsh it'
c.	àtá	–	é	=	àtá-έ
	thigh		FOC		'it's a thigh'
d.	àmà	–	é	=	àmà-έ
	herb		FOC		'it's an herb'

Recall that /a/ harmonizes to the place value of an adjacent vowel. This is seen in (60a-b). However, we find that in the Low harmony process in (60c-d), /a/ does not assimilate to the place feature of the adjacent vowel. This apparent under-application of the Place harmony rule cannot be explained by postulating a single level of phonological derivation; multiple levels are thus needed. In a nutshell, I propose that the two processes seen in (60) do not apply at the same level of derivation. The third person singular as in (60a-b) is added at the word level, where segments are not fully specified for features, whereas the focus marker in (60c-d) is added at the phrase level, where the rule of place assimilation does not apply. Details of this analysis are provided in Chapter 5 below.

In summary, post-nasal plosive deletion in English and the harmony processes in Ewe both exemplify how cyclicity can capture cases of opacity observed across languages. The data from Ewe also provides motivation to treat the harmony processes discussed as operating at different levels of derivation. The main question that remains concerns how to determine cycles. More specifically, what constitutes a cycle and what does not? This is answered by looking at the concept of stratification, which I discuss next.

3.2 Stratification

As mentioned earlier, within Stratal OT, stratification holds that phonology and morphology are organized into levels (or strata), each of which consists of a complete system of parallel constraint-based evaluation. Each domain of phonology corresponds to a phonological or morphosyntactic stratum which itself defines a phonological cycle.

Kiparsky (2015) relates this to the level ordering of lexical phonology and morphology. Thus, the domain of a stem is considered a stratum, similar to the word and phrasal domains. These levels coincide approximately with the cyclic, post-cyclic, and post-lexical strata proposed by Booij & Rubach (1987). A root, however, does not constitute a stratum, since it lacks lexical information. Bermúdez-Otero (2017) provides a summary of what can constitute a phonological cycle in (61) below.

(61) Stratification generalization (Bermúdez-Otero 2017:112)

a. Roots do not define cyclic domains
b. Some stems and some affixes define cyclic domains for the stem-level phonology
c. Words define cyclic domains for the word level phonology
d. Utterances define cyclic domains for the phrase level phonology

In addition to the above summary, it has been argued that categories smaller than the utterance but larger than the maximal grammatical word cannot trigger phonological cycles (Kiparsky 2000; Bermúdez-Otero 2017).

According to Stratal OT mechanisms, cycles operate in a serial manner, where the output of one cycle serves as the input to a later cycle. Several arguments have been advanced to support this claim, through the study of phonological opacity across several languages (see Kiparsky 2000, 2015; Bermúdez-Otero 2017, among others) as well as through comparisons of the mechanisms of Stratal OT to that of other approaches such as output-output correspondence.

In this section, I highlighted the tenets of Stratal OT and the motivations for it. I also showed evidence for opacity in the northern dialect of Ewe, which provided motivation for the use of Stratal OT. In the next section, I employ the mechanisms of Stratal OT to account for how vowels are specified for phonological features based on activity.

4 OT specification of Ewe vowels

In previous sections, I introduced OT and Stratal OT. I also discussed the major assumptions behind these theories. Building on this, my aim in this current section is to show how vowels in the northern dialect of Ewe can be specified for features through interactions between constraints in the grammar. I do this by employing two groups of markedness constraints. The first group of constraints allows for representations to be richly specified phonetically. The other group is antagonistic to phonetic richness (Itô, Mester & Padgett 1995). These constraints and their interactions ensure that there is specification of vowels in the output, but that this specification is kept to a minimum. Employing these two groups of constraints will account for the underspecification effects that affect the realization of the vowels of the northern dialect of Ewe, as well as the relationship between phonological activity and feature specification (Mackenzie & Dresher 2003). Also, as I show in the next section, I assume that inputs are not constrained; thus, I need to derive all forms of underspecification through the interaction of constraints. Furthermore, I employ faithfulness constraints which demand that output forms preserve features found in the lexical input. My analysis draws partly from the proposal made by Mackenzie & Dresher (2003) on modelling contrastive hierarchies within OT. Mackenzie & Dresher argue that arbitrary rankings of constraints to express featural specification fail to show the relationship between contrast and phonological activity. Thus, even though OT rankings can be used to specify features in a language, such specifications cannot explain the role that phonological activity plays in relation to contrast in a language. Mackenzie & Dresher propose that feature specific IDENT constraints, as well as contextual markedness constraints, can be used to model a contrastive hierarchy in OT which captures the relationship between contrast and activity. My approach does not model a contrastive hierarchy in OT, but is motivated by some assumptions about how contrastive hierarchies can be modelled in OT to derive the specification of features in a language. More specifically, my approach in this section highlights the role of phonological activity in the specification of segments. Thus, I show how OT can be used to derive the feature specifications in Table 7. First, let us briefly discuss assumptions about the nature of the input within the OT framework.

4.1 The input

The most common assumption about the input in OT is that it is not constrained by the grammar. Thus, the input can take any linguistically possible form or shape. This position was first advocated by Prince & Smolensky (1993) and is referred to as the Richness of the Base hypothesis. There has been some debate in the literature on the Richness of the Base hypothesis (see for instance, Itô, Mester & Padgett 1995; Smolensky 1996 for arguments in favour, and Vaysman 2002 for arguments against this hypothesis). In my analyses below, I embrace this hypothesis and argue that vowel segments can be specified for any combination of features in the input, and that their feature specifications in the output are derived through the interactions of various constraints. For the purpose of my analysis, I start with full specification of vowels in the input, and derive the specifications argued for in previous chapters through the mechanisms of OT.

4.2 The constraints and constraint ranking

As I mentioned earlier, there are two basic types of OT constraints: faithfulness and markedness constraints. I utilize both groups in order to obtain the specifications needed to account for the phonological activity of vowels in Ewe. I begin with the markedness constraints.

Recall first that the inspection of the vowel inventory of the northern dialect of Ewe revealed some obvious redundancies in the inventory. For example, if full specification is assumed, [+front] vowels are redundantly specified as [-back], and [+low] vowels are redundantly specified as [-high]. Redundancies such as these are based on the idea that certain feature combinations are logically or articulatorily incompatible. For instance, high vowels need not be specified for the feature [low]. This is because a segment specified as [+high], is by implication, [-low], and for obvious reasons cannot be [+low] at the same time (one would need two independent tongue bodies). There is thus no need for the [low] specification on high vowels. Also, some features are not relevant in accounting for any phonological process in the language, nor are they relevant to distinguish one vowel segment from another. These features are therefore not needed in underlying representation. In order to account for these redundancies, I adopt a general group of constraints called REDUNDANCY, in particular the following redundancy constraints.

(62) Redundancy constraints

a. *[+high, -low]: Assign a violation mark for a segment specified as both [+high] and [-low]
b. *[+back, -front]: Assign a violation mark for a vowel specified as both [+back] and [-front]
c. *[-back, +front]: Assign a violation mark for any vowel specified as both [-back] and [+front]

(62a) ensures that high vowels are not specified for [-low]. Any segment specified for these two features receives a violation of this constraint. The relative ranking of the constraints in (62b) and (62c) ensures that front vowels do not get specified as [-back] and that back vowels are not specified as [-front]. Thus, any such specification receives a violation mark.

As I mentioned earlier, I group all of these constraints into a single one, which I refer to as REDUNDANCY (RED). The constraints in this group are similar to the contextual markedness constraints of Mackenzie & Dresher (2003) in that neither group of constraints relies on the fact that certain feature combinations such as [+high, +low] are articulatorily incompatible. Rather, the constraints rely on the idea that the occurrence of a feature α bars the occurrence of another β either because β does not have scope in the domain of α (this is the idea by Mackenzie & Dresher 2003) or because the occurrence of α necessitates the occurrence of β in a segment.

In addition to the constraints in RED, I also propose the feature co-occurrence constraint *[+front, +low], which requires that outputs not be specified for both [+front] and [+low]. I define this constraint as follows.

(63) *[+front, +low]: Assign a violation mark for any output specified as both [+front] and [+low]

This constraint differs from those in the RED group. Whereas RED constraints are based on the idea that the presence of one feature rules out the presence of another, *[+front, +low] is based on articulatory compatibility. According to Archangeli & Pulleyblank (1994), certain feature combinations are typologically more common than others. For instance, [+high, +ATR] is more common than [+low, +ATR]. In fact, Archangeli (1995) observes that feature combinations range from very common to very rare across languages; [+front, +low] is thus at the rare end of the range, since there is some articulatory tension between simultaneous vowel fronting and lowering. This fact is captured through a high ranking of this markedness constraint.

Another group of constraints I adopt prevents the specification of particular feature values. I refer to this as *[αF], where α corresponds to the + or – values of a feature F. This constraint is adopted in Bakovic (2000:11) and defined as follows.

(64) *[αF]: An output segment must not be specified as [αF]

This group includes constraints such as *[-back], which prevents the occurrence of [-back] vowel segments in output representations.

To modulate the effects of *[αF] in the grammar, I employ the faithfulness constraint MAX(F), which requires given features in the input to express themselves in the output. This constraint prevents the deletion or underspecification of features that are present in the input. I define it formally as follows.

(65) MAX(F): Assign a violation mark for any feature $\pm$F in the input that is not present in the output

Some members of the *[αF] group are ranked higher than MAX(F) while others are ranked lower than it. There is no ranking argument between *[αF] constraints ranked higher than MAX(F), and the same applies for those ranked below MAX(F). I, therefore, propose that *[αF] constraints ranked either above or below MAX(F) are ranked equally relative to one another. The ranking of MAX(F) relative to the other constraints described above ensures phonetic richness in the output.

Finally, I employ the constraint SPEC(F), which requires that outputs are specified for the feature [F] irrespective of whether it is present in the input or not. This constraint is used by Dresher (2009) and by Mackenzie (2016) and resembles other constraints that require rich specification in output forms, such as HAVEPLACE in Padgett (1995). According to Mackenzie, additional constraints that demand phonetic richness, such as SPEC(F) are needed to ensure contrast preservation among segments. This is consistent with the basis of Richness of the Base, which allows unconstrained inputs, including inputs that are not fully specified for all features. Specifically, I adopt SPEC(LOW) which demands that outputs are specified for the feature [low]. I define SPEC(LOW) formally as below.

(66) SPEC(LOW): Assign a violation mark for any segment for which [low] is not specified in the output

This constraint is ranked low at the stem level of evaluation but becomes crucial at the phrase level of evaluation as I will show in section 4 of Chapter 5.

In my analysis, MAX(F) and SPEC(LOW) are ranked relatively low as per the ranking in (67) below.

(67) Constraint rankings for the specification of vowels in Ewe
RED, *[+FT, +LOW], *[-HI], *[-FT], *[-BK] >> MAX(F) >> *[+LOW], *[-LOW] >> SPEC(LOW)

The constraint ranking in (67) is based on the ranking arguments presented in (68) below. This ranking argument is based on the vowel /a/ represented in the input through the features [-back, +low, -front, -high].

The tableau only displays the relevant subset of the ranking in (68). Also, the tableaux below seek to capture the specification of Ewe vowels at the output of the stem level, as proposed in Table 8.

Table 8: Proposed stem level specification for vowels in the northern dialect of Ewe

	[low]	[high]	[back]	[front]
/i/		+		+
/u/		+	+	
/e/	-			+
/o/	-		+	
/ɛ/				+
/ɔ/	+		+	
/a/	+			

The tableau in (68a) presents ranking arguments for some of the *[αF] constraints ranked above MAX(F). First, *[-HI] must be ranked above MAX(F), to ensure that candidates such as (b) and (c) are not selected as optimal. If MAX(F) were ranked higher than the four markedness constraints, the optimal candidate (a) would indeed lose against any of the other candidates, all of which incur fewer violations of MAX(F) than does candidate (a). Further, there is no clear argument for how RED, *[-HI], *[-FT], and *[-BK] should be ranked relative to one another.

(68) Ranking arguments

a. RED, *[-HI], *[-FT], *[-BK]* >> MAX(F)

	a [-HI, +LOW, -FT, -BK]	RED	*[-HI]	*[-FT]	*[-BK]	MAX(F)
a. ☞	[+low]					***
b.	[-hi, +low]		*			**
c.	[-hi, -ft]		*	*		**
d.	[+low, -bk]				*	**
e.	[-HI, +LOW, -FT, -BK]	*	*	*	*	

b. MAX(F) >> *[+LOW]

	ɔ [-FT, +LOW, +BK, -HI]	MAX(F)	*[+LOW]
a.	[+bk]	**!*	
b. ☞	[+low, +bk]	**	*

c. MAX(F) >> *[-LOW]

	o [-FT, -LOW, +BK, -HI]	MAX(F)	*[-LOW]
a.	[+bk]	**!*	
b. ☞	[-low, +bk]	**	*

In order to capture the specification of vowels at the stem level of derivation, *[+LOW] and *[-LOW] must be ranked below MAX(F), as can be seen in (68b-c). These tableaux show that ranking MAX(F) above *[+LOW] and *[-LOW] results in the segment with the specifications proposed in Table 8 being selected as optimal. Should either of these constraints be ranked above MAX(F), the wrong candidate would be selected as the output. Finally, for the other *[αF] constraints, there is no ranking argument between *[+LOW] and *[-LOW] thus, they are ranked equally.

In the next section, I implement these constraint rankings to show the featural specification of vowels in the northern dialect of Ewe.

4.3 Specification of vowels in the northern dialect of Ewe

So far, I have discussed the constraints needed to capture the specification of vowels in the northern dialect of Ewe. In this section, I show how these constraints can be ranked to derive the vowel feature specifications needed to capture the various phonological processes discussed in earlier chapters. The process of feature specification of vowels shown in this section occurs at the stem level of derivation.

I begin by deriving the featural specifications of /u/ in the tableau in (69) below. For this and all the other tableaux, I only show the relevant constraints needed to account for the process being discussed. The optimal candidate (c) incurs the fewest violations of highly ranked constraints. It receives two violations for MAX(F) but satisfies all other constraints in the tableau. Candidate (a) has the same number of violations of MAX(F) as well as other highly ranked constraints as the optimal candidate. However, it violates the lowly ranked constraint *[-LOW], which is not violated by (c). Candidate (b) receives a fatal violation for RED, whereas candidate (d) fatally violates *[-FT] even though it performs better on MAX(F) than any other candidate in the tableau. Thus, candidate (c) is selected as optimal, which implies that /u/ is specified for the features [+high, +back] at the stem level in Ewe.

(69) Stem level: OT specification of /u/

	u [+HI, -FT, +BK, -LOW]	RED	*[-FT]	MAX(F)	*(-LOW)
a.	[-low, +bk]			**	*!
b.	[-low, +hi]	*!		**	*
c. ☞	[+hi, +bk]			**	
d.	[+hi, -ft, +bk]		*!	*	

In the tableau showing the specification of /a/ in (70), candidates (a), (b) and (c) all incur violations of highly ranked constraints and are thus ruled out as optimal candidates. In contrast to these, the optimal candidate (d) satisfies all highly ranked markedness constraints at the expense of the faithfulness constraint MAX(F), which it violates three times. Since it performed better that the other candidates on the higher ranked constraints, it is selected as optimal. Under this analysis, /a/ is thus only specified for [+low] in the output of the stem level.

(70) Stem level: OT specification of /a/

	a [-HI, -FT, -BK, +LOW]	*[-HI]	*[-FT]	*[-BK]	MAX(F)
a.	[-hi, -ft, -bk, +low]	*!	*	*	
b.	[-hi, +low]	*!			**
c.	[+low, -ft]		*!		**
d. ☞	[+low]				***

The same constraint rankings predicts that the vowel /o/ has the specification [-low, +back] at the stem level, as illustrated in (71). Both candidates (a) and (c) satisfy the highly ranked *[αF] constraints. However, candidate (a) is selected as optimal over candidate (c) because it incurs fewer violations of MAX(F) than (c). In contrast to these, candidates (b) and (d) incur the same number of violations of the lowly ranked constraint MAX(F) as the optimal candidate. However, they violate highly ranked *[αF] constraints and are thus ruled out by the ranking.

(71) Stem level: OT specification of /o/

	o [-HI, -FT, +BK, -LOW]	*[-HI]	*[-FT]	MAX(F)
a. ☞	[-low, +bk]			**
b.	[-ft, +bk]		*!	**
c.	[-low]			***!
d.	[-low, -hi]	*!		**

Compared to the specification of /o/ just above, /ɔ/ is specified as [+low, +back] in the output. As we can see in (72), candidates (a) and (c) incur fatal violations of the highly ranked *[αF] constraints; (a) violates *[-FT] while (c) violates *[-HI]. Candidates (b) and (d) satisfy all the highly ranked constraints. However, candidate (d) receives more violations of the lowly ranked constraint MAX(F) than candidate (b). Thus, candidate (b) is chosen as optimal.

(72) Stem level: OT specification of /ɔ/

	ɔ [-HI, -FT, +BK, +LOW]	*[-HI]	*[-FT]	MAX(F)
a.	[-ft, +bk]		*!	**
b. ☞	[+low, +bk]			**
c.	[-hi, +bk]	*!		**
d.	[+low]			***!

I now turn to the specifications of the front vowels of Ewe. First, I show how the same grammar captures the front high vowel /i/, whose account also requires both RED and the lowly ranked *[-LOW] constraints from the full ranking in (67). As we can see in (73), candidates (a) and (d) incur a violation of highly ranked *[-BK] and RED, respectively. These violations are fatal, ruling out both of these candidates. Candidates (b) and (c) tie on the number of violations of MAX(F), and both of these candidates satisfy all highly ranked constraints. However, candidate (c) violates lowly ranked *[-LOW]; it is thus less optimal than candidate (b). The optimal candidate in addition to MAX(F) also violates SPEC(LOW). However, SPEC(LOW) is ranked lower than *[-LOW], which is violated by candidate (c). This yields the specification [+high, +front] for /i/.

(73) Stem level: OT specification of /i/

	i [+HI, +FT, -BK, -LOW]	RED	*[-BK]	MAX(F)	*[-LOW]	SPEC(LOW)
a.	[-low, -bk]		*!	**	*	
b. ☞	[+hi, +ft]			**		*
c.	[-low, +ft]			**	*!	
d.	[+hi, -low]	*!		**	*	

In (74), I show the derivation of the specification for /e/. Candidates (a), (b) and (d) are ruled out by the grammar since they each incur some violation of highly ranked constraints. This leaves us with candidate (c) as optimal, which incurs two violations of MAX(F) but satisfies all other constraints. Therefore, the vowel /e/ is specified as [-low, +front] by this analysis.

(74) Stem level: OT specification of /e/

	e [-HI, +FT, -BK, -LOW]	*[-HI]	*[-BK]	MAX(F)
a.	[-low, -hi]	*!		**
b.	[-low, -bk]		*!	**
c. ☞	[-low, +ft]			**
d.	[-hi, -bk]	*!	*	**

The tableau in (75) below shows how the grammar accounts for the specification of /ɛ/. Here, I consider *[+front, +low] and other highly ranked *[αF] constraints as well as MAX(F) in order for the grammar to capture the specification of this vowel. Candidates (a), (b) and (c) incur fatal violations for the highly ranked *[αF] constraints as well as two violations of MAX(F) each. They are therefore ruled out as optimal outputs. Candidate (d), the optimal one, violates MAX(F) three times, but it satisfies all of the higher ranked constraints. Note in this context that comparing candidates (c) and (d) provides a ranking argument for *[+front, +low] being ranked higher than MAX(F). If *[+front, +low] were ranked lower than MAX(F), candidate (c) would win the competition. Candidate (e) performs equally as the optimal candidate on all constraints except lowly ranked *[+LOW]. This violation rules it out and provides a ranking argument for the *[+LOW] and MAX(F) constraints. Thus, the current analysis predicts that /ɛ/ is only specified as [+front] in the northern dialect of Ewe, in line with the facts discussed in Chapter 3, section 5, concerning the behaviour of this vowel in both harmony and hiatus contexts.

(75) Stem level: OT specification of /ɛ/

	ɛ [-HI, +FT, -BK, +LOW]	*[+FT, +LOW]	*[-HI]	*[-BK]	MAX(F)	*[+LOW]
a.	[+ft, -hi]		*!		**	
b.	[+low, -bk]			*!	**	
c.	[+low, +ft]	*!			**	
d. ☞	[+ft]				***	
e.	[+low]				***	*!

In this section, I showed how the proposed specification of features in the northern dialect of Ewe can be captured by a specific ranking of violable constraints. Using a combination of markedness and faithfulness constraints, I obtained the feature specifications required to account for the phonological alternations in the northern dialect of Ewe. Also, my discussion above shows that, at the stem level of derivation, the grammar of the northern dialect of Ewe disfavours highly specified vowel segments. However, MAX(F) is needed at the stem level so that features can be preserved in the output. Even though it is lowly ranked at this level, it is crucial in preventing vowels from losing all of their features due to the relative ranking of the *[αF] constraints. The importance of MAX(F) is better illustrated when we discuss the phonological alternations seen in Ewe in the next chapter.

Inherent to the current proposal is the hypothesis that the grammar targets only specific features and feature values to be specified on segments at the stem level. Only features and feature values necessary to distinguish the inventory and capture phonological activity are present on vowel segments at the stem level. Thus, this proposal emphasizes the argument that although segments must be distinguished, contrast does not play a determining role on their representation. The grammar specifies segments for features that are necessary for phonological computation without regard to whether these features are contrastive or not. As we will see in my discussion of the harmony system in the next chapter, the grammar of Ewe preserves these features on vowels at the stem level of derivation in order to meet language-specific preference for certain features. The implication of this is that the harmony system of Ewe is one of feature preservation and dominance, as opposed to a basic system of root dominance.

5 Summary

In this chapter, I provided an OT account for how the feature specifications I proposed in the previous chapter can be captured by the grammar of Ewe. I argued that vowels are specified for these features at the stem level, which then feeds the later levels of derivation where the harmony processes occur. I proposed two types of constraints to derive the representation of Ewe vowels based on activity. The first are antagonistic to phonetic richness, whereas the other group encourage phonetic richness. In my analyses, highly ranked markedness constraints prevent phonetic richness. This results in impoverished output forms. Even though the faithfulness constraint MAX(F) is ranked lowly at this level of derivation, I showed the vital role it plays in selecting some optimal candidates. Similarly, the high ranking of RED ensures that feature combinations that are redundant and those that are articulatorily incompatible are absent from the representation. Finally, the relative ranking of *[+ft, +low] is crucial in the selection of the correct representation of /ɛ/. Without this constraint, the wrong candidate would be selected as optimal.

In the next chapter, I continue my analyses by using the outputs from this level as inputs to derive the various vowel harmony processes discussed in the previous chapter. I highlight how Stratal OT can be used to derive the vowel harmony processes of the northern dialect of Ewe.

Chapter 5 Optimality theoretic account of Ewe vowel harmony

1 Introduction

In the previous chapter, I showed how vowels in the northern dialect of Ewe can be specified for features using the mechanisms of Optimality Theory. I also highlighted the need for stratification in explaining phonological processes in Ewe. In this regard, I proposed a Stratal OT approach to capture both feature specification effects and the harmony system. Specifically, I argued that feature specification takes place at the stem level of derivation, separate from other phonological processes.

In this chapter, I employ Stratal OT to provide an account of the various harmony processes discussed in the earlier chapters. I use faithfulness constraints to ensure that the output only minimally deviates from the input, and an AGREE group of constraints that require adjacent vowels to be identical in some features. First, I discuss the lexical processes (Height and Place harmonies), after which I delve into how Stratal OT accounts for the post-lexical process (Low harmony). I then show how Stratal OT can account for the asymmetries we observed between different vowels in the context of the vowel harmony system.

2 Height harmony

Recall that the Height harmony process is triggered when the third person singular pronoun is attached to a verb ending in a vowel. The adjacent vowels must agree in the feature [high] or [low], as we saw in (32), repeated in (76) for convenience.

(76) Height harmony (repeated from (32))

a.	kù	-è	=	kù-ì
	fetch	-3SG		'fetch it'
b	mlì	-è	=	mlì-ì
	roll	-3SG		'roll it'
c.	tsɔ́	-è	=	tsɔ́-ɛ̀
	take	-3SG		'take it'
d.	fɛ́	-è	=	fée
	split	-3SG		'split it'

The enclitic (posited to be /e/ underlyingly) agrees in the feature [high] with the root vowel if the root vowel is a high vowel, as in (76a-b). In instances where the root vowel is low, the enclitic agrees with the feature [low] of the root vowel, in (76c). We however find that in cases where the root vowel is /ɛ/, the enclitic passes a [-low] feature to this root vowel, as in (76d). A rule-based account of this would have to assume some form of underspecification where all vowels but /ɛ/ have a height specification. However, as I discuss further in Chapter 6, different theories of underspecification and the Contrastive Hierarchy are insufficient to properly characterize the underspecifications needed to explain all the phonological processes attested in the language. In this section, I focus on how Stratal OT can account for Height harmony. First, I discuss my assumptions about the input, building on the considerations laid out in section 7 of Chapter 3.

2.1 The input

I argue that the Height harmony process occurs at the word level of derivation, which is fed by the output of the feature specification process (which itself occurs at the stem level of derivation). Thus, I use the outputs of the feature specification process as illustrated in Chapter 4 as the input to the Height harmony process. All vowel specifications for both roots and affixes in the input are thus the outputs of the feature specification process. It is worth mentioning here that Place harmony, discussed in detail in section 3 below, also occurs at the same level of derivation as Height harmony. Its inputs will thus also be the outputs of the stem level. Keeping this in mind, I discuss the constraints needed for analyzing both harmony patterns and the relative rankings of these constraints in the next section.

2.2 Constraints and constraint rankings

The first category of constraints I discuss involves faithfulness to input features through constraints which enforce identity between the input and the output. The first is MAX(F), introduced and defined in Error: Reference source not found) above. This constraint demands that all vowels in the output are faithful to their feature specifications in the input. Any variation in the specification of [F] between the input and the output thus incurs a violation of MAX(F).

I also employ the faithfulness constraints DEP(+LOW), DEP(-LOW), and DEP(+HI). I categorize these into the general constraints DEP(F). This is defined formally as follows.

(77) DEP(F): Assign a violation mark for every instance of [F] in the output that does not have a correspondent in the input

A violation of DEP(F) is incurred whenever there is a + or – feature specification on a segment in the output that is not present in the input. For instance, DEP(+HI) will bar the insertion of [+high] on output segments.

In addition to the faithfulness constraints, there are markedness constraints that evaluate the well-formedness of the output. One such constraint is AGREE(F), proposed by Bakovic (2000:4). It requires that adjacent vowels agree in some feature (F). I postulate two such AGREE constraints for the Height harmony system. The first, AGREE(HI), is defined in (78).

(78) AGREE(HI): Assign a violation mark whenever adjacent vowels do not have the same value of [high] or one of them is specified and the other is not

Given this constraint, adjacent vowels must have the same height specification else neither must be specified at all for the feature [high]. For instance, a high vowel adjacent to a mid vowel will attract a violation of this constraint if both have [high] specifications. Similarly, if a high vowel is specified as [+high] and it is adjacent to a mid vowel not specified for the feature [high], AGREE(HI) will be violated. The second AGREE constraint is defined in (79).

(79) AGREE(LOW): Assign a violation mark whenever adjacent vowels do not have the same value of [low] or one of them is specified and the other is not

This constraint, similar to AGREE(HI), is violated when adjacent vowels do not have the same [low] value or both vowels are not unspecified for the feature [low]. As we will see below, the two AGREE(F) constraints are ranked equally and above DEP(+LOW).

I also propose that some members of the MAX(F) group of constraints are ranked above the AGREE constraints while others are ranked below the AGREE(F) constraints. This ranking directly captures the need for adjacent vowels to harmonize. I further propose that

MAX(+LOW) and MAX(+HI) are the most highly ranked constraints. Immediately below them is the AGREE(F) group, while the MAX(-LOW) constraint is ranked below AGREE(F). DEP(F) constraints are ranked differently for different features and feature values but below MAX(-LOW). In order to capture the data, DEP(-LOW) must be ranked below MAX(-LOW) but above DEP(+LOW). DEP(+HI) is ranked equal to DEP(+LOW). Leaving fine details aside, this ranking of DEP(-LOW) over the other two DEP constraints militates against the creation of low vowels in derived forms. This ranking argument can be summarized as in (80).

(80) MAX(+LOW), MAX(+HI) >> AGREE(F) >> MAX(-LOW) >> DEP(-LOW) >> DEP(+LOW), DEP(+HI)

In (81), I illustrate the ranking arguments for the constraint ranking in (80).

(81) Word level: Ranking arguments for Height harmony

a. MAX(-LOW) >> DEP(-LOW)

			MAX(-LOW)	DEP(-LOW)
	+FT fɛ	+FT -LOW -e		
a. ☞	+FT -LOW fe	+FT -LOW -e		*
b.	+FT +LOW fɛ	+FT +LOW -ɛ	*!	

b. DEP(-LOW) >> DEP(+LOW)

			AGREE(LOW)	DEP(-LOW)	DEP(+LOW)
	+BK +LOW tsɔ	+FT -LOW -e			
a. ☞	+BK +LOW tsɔ	+FT +LOW -ɛ			*
b.	+BK +LOW tsɔ	+FT -LOW -e	*!		
c.	+BK -LOW tso	+FT -LOW -e		*	

c. AGREE(LOW) >> MAX(-LOW)

			AGREE(LOW)	MAX(-LOW)
	+BK +LOW tsɔ	+FT -LOW -e		
a. ☞	+BK +LOW tsɔ	+FT +LOW -ɛ		*
b.	+BK +LOW tsɔ	+FT -LOW -e	*	

Given the ranking of AGREE(F) and MAX(F) over DEP(F), features specified on inputs are thus not deleted unless deletion is necessary to satisfy AGREE(F). This logic applies across all analyses below. With this general logic in mind, let us now discuss the tableaux.

In (81a) above, MAX(-LOW) needs to be ranked above DEP(-LOW) for the right candidate to be chosen as the optimal form. If these two constraints were ranked differently relative to one another, the wrong candidate, (b), would surface as optimal. Thus, MAX(-LOW) must be ranked above DEP(-LOW). In (81b), I show the ranking argument between DEP(LOW) and DEP(+LOW). As we can see, the relative ranking of DEP(-LOW) and DEP(+LOW) determines the winner. When DEP(-LOW) is ranked above DEP(+LOW), candidate (a) is correctly selected as the optimal candidate. The reverse would lead to the wrong candidate selection. (81c) shows the ranking argument between AGREE(F) and MAX(-LOW). Ranking AGREE(F) above MAX(-LOW) ensures optimal candidate selection, while their reverse ranking would lead to the wrong candidate being selected.

The relative ranking of MAX(+LOW) and the AGREE constraints reflect the importance of keeping [+low] specifications as well as harmony in the language. Their relative rankings determine how the output deviates from the input in terms of features and feature values.

Using this constraint ranking, I will now continue and show how the harmony process proceeds at the word level in the northern dialect of Ewe.

2.3 Analysis

So far, I have argued for the nature of the input as well as for the constraints necessary to capture the Height harmony pattern in the northern dialect of Ewe. I have also proposed a general constraint ranking and provided arguments for all relevant specific rankings. In this section, I discuss the analysis of the Height harmony process, which takes place at the word level of derivation. I begin with the harmony process involving high vowels.

Building on the constraint ranking in (80) above, I generated the tableau below to show the derivation of [ku-i] 'fetch it' from the input /ku-e/. Recall that from the specifications derived at the stem level in section 4.3 of Chapter 3, /u/ is specified as [+high, +back] at the stem level. Thus, at the word level, where Height harmony applies, it is specified as [+high, +back] in the input. Similarly, the 3SG pronoun is specified as [+front, -low]. As we can see in (82), the faithful candidate in (a) violates the highly ranked constraint AGREE(HI). This violation rules it out as the preferred candidate. In candidate (b), the root vowel lowers to harmonize with the height of the enclitic. This violates MAX(+HI), ruling it out as the preferred candidate. The optimal candidate (c) satisfies all highly ranked constraints at the expense of violating the lower-ranked DEP(+HI). This candidate is thus selected as optimal by the grammar.

(82) Word Level: Height harmony with /u/ as root vowel

	MAX(+HI)	AGREE (HI)	DEP(+HI)
+HI +FT +BK -LOW ku -e			
a. +HI +FT +BK -LOW ku -e		*!	
b. -HI +FT +BK -LOW ko -e	*!	*	
c. ☞ +HI +FT +BK +HI ku -i			*

The derivation of [ko-e] 'laugh at him/her' in (83) proceeds as follows. With the root vowels specified as [-low, +back] in the input, the faithful candidate (a) is the optimal candidate. It satisfies all constraints in the tableau. Candidate (b) records a fatal violation of AGREE(LOW) in addition to violating DEP(+LOW), due to the insertion of [+low] in the root vowel. Candidate (c), which records two violations of DEP(+LOW), is also ruled out. Candidate (d) satisfies the highly ranked constraints but receives two violations of DEP(+HI) since this candidate involves [+high] feature insertion on both the root and enclitic vowels.

(83) Word level: Height harmony with /o/ as root vowel

+BK +FT -LOW -LOW ko -e	AGREE(LOW)	DEP(+LOW)	DEP(+HI)
a. ☞ +BK +FT -LOW -LOW ko -e			
b. +BK +FT +LOW -LOW kɔ -e	*!	*	
c. +BK +FT +LOW +LOW kɔ -ɛ		*!*	
d. +BK +FT +HI +HI ku -i			*!*

Now we turn our attention to the context where the root vowel of the input is specified as [+low, +back]. The tableau in (84) below, which shows the derivation of [tsɔ-ɛ] 'take it' from /tsɔ-e/, illustrates why MAX(+LOW) must be ranked above DEP(+LOW). The optimal candidate, (c), violates lowly ranked DEP(+LOW). This violation is however necessary for other, higher ranked constraints to be satisfied. In comparison, candidate (a) satisfies all faithfulness constraints but violates AGREE(LOW). It is therefore evaluated as suboptimal. Candidate (b) on the other hand violates highly ranked MAX(+LOW) in addition to relatively lowly ranked DEP(-LOW); thus, it is ruled out as optimal.

(84) Word level: Height harmony with /ɔ/ as root vowel

	+BK +FT +LOW -LOW tsɔ -e	MAX(+LOW)	AGREE(LOW)	DEP(-LOW)	DEP(+LOW)
a.	+BK +FT +LOW -LOW tsɔ -e		*!		
b.	+BK +FT -LOW -LOW tso -e	*!		*	
c. ☞	+BK +FT +LOW +LOW tsɔ -ɛ				*

In all the instances of Height harmony that we have derived so far, the process targets the enclitic vowel. We have seen the roles that various constraints play in predicting the surface forms attested in the language. Let us focus now on the instance where Height harmony targets the root vowel.

In (85), I show the effect of constraint interaction in selecting the output [fe-e] 'split it' from /fɛ-e/. As we discussed in section 4.3 of Chapter 3, the root vowel /ɛ/ enters the derivation only specified as [+front]. Candidate (a), the faithful candidate, violates AGREE(LOW) since the root and the enclitic do not have the same specification of [low]. Should neither vowel be specified for [low], AGREE(LOW) would be satisfied at the expense of MAX(-LOW). Candidate (c), which has a [+low, +front] specification on both vowels, satisfies the highly ranked constraint. However, it violates MAX(-LOW) because the [low] value of the enclitic in the output varies from that in the input. The optimal candidate, (b), with [-low, +front] specification on both vowels, satisfies all highly ranked constraints in the tableau at the expense of DEP(-LOW). Thus, it is correctly chosen as the optimal candidate.

(85) Word level: Height harmony with /ɛ/ as root vowel

	+FT fɛ	+FT -LOW -e	AGREE(LOW)	MAX(-LOW)	DEP(-LOW)
a.	+FT fɛ	+FT -LOW -e	*!		
b. ☞	+FT -LOW fe	+FT -LOW -e			*
c.	+FT +LOW fɛ	+FT +LOW -ɛ		*!	

Our observations so far show that the grammar of the northern dialect of Ewe at the word level of derivation preserves a majority of underlying features present in the input. Feature values are only lost under the pressure of higher ranking AGREE constraints. Even in these cases, feature values are retained if the relevant AGREE constraint can be satisfied by feature insertion rather than deletion. Features are only lost if two disagreeing features are specified in the input to the word level, leaving no way to satisfy AGREE without feature deletion, as in tableau (84) where the [-low] suffix vowel is adjacent to a [+low] vowel in the root. In all other cases, the AGREE constraints can be satisfied by adding a feature to an underspecified segment, rather than through feature deletion. This is an effect of the relative ranking of MAX(F) in the tableaux discussed above. As we will see in light of other phonological processes in the language in the remainder of this chapter, the grammar tends to preserve certain features with preference given to some feature values. For instance, the features [high] and [low] are preserved in Height harmony in order to prevent further impoverishing of segment specifications. I discuss this further in section 5 below.

In this section, I showed how the Height harmony process in the northern dialects of Ewe can be accounted for through constraint interaction. I also showed the role played by faithfulness constraints in determining the winning candidates. Even though faithfulness constraints are not the most highly ranked constraints, they are important in determining the optimal candidate for the processes involving each underlying vowel in the language. In the next section, I employ the same category of constraints to account for Place harmony.

3 Place harmony

In the previous section, we saw how the word-level constraint ranking of Ewe proposed in (80) captures the Height harmony process. We saw that the grammar seeks to preserve certain features and feature values on segments. This is most evident in the analysis of words with /ɛ/ as the root vowel, where the relative lack of feature specification for /ɛ/ results in the root assimilating to the affix. In this section, I provide further evidence highlighting feature preservation in the grammar of the northern dialect of Ewe by looking at the Place harmony process. First, let us recapitulate the facts about this process.

In the northern dialect of Ewe, in addition to adjacent vowels agreeing for their height features, /a/ must agree in place of articulation with any adjacent vowel. /a/ can be a root vowel, as in (86e-f) or serve as the habitual marker or determiner when it is cliticized to verbs or nouns as in (86a-d). In instances where the root vowel is neither [+back] nor [+front], the enclitic /a/ remains unchanged, as seen in (86g).

(86) Place harmony

a.	blí	+	á	=	blí-ɛ́	
	corn		DET		'the corn'	
b.	ɛ̀tɛ̀	+	á	=	ɛ̀tɛ̀-ɛ́	
	yam		DET		'the yam'	
c.	nò	+	á	=	nò-ɔ̀	
	drink		HAB		'drink-HAB'	
d.	ɖù	+	á	=	ɖù-ɔ̀	
	eat		HAB		'eat-HAB'	
e.	fà	+	è	=	fɛ̀-ɛ̀	
	cry		3SG		'mourn him/her'	
f.	gbà	+	è	=	gbɛ̀-ɛ̀	
	break		3SG		'break it'	
g.	gbà	+	à	=	gbà-à	
	break		HAB		'break-HAB'	

To account for these processes in OT, let us first discuss the input.

3.1 The input

As I have argued for in section 2.1 of this chapter, the input to the Place harmony process is the output of the stem level of derivation. This is because Place harmony takes place at the word level of derivation, just as the Height harmony process does. With this in mind, I discuss the constraints and their relative ranking necessary to account for this process.

3.2 Constraints and constraint rankings

To account for the Place harmony process, I employ the same category of constraints as I did for the Height harmony process. However, some of the members of these groups are different and are ranked differently from what we saw in the Height harmony process.

First, I discuss the AGREE group of constraints.

(87) AGREE(F): Assign a violation mark whenever adjacent vowels do not have the same value of a feature (F)

This constraint requires that adjacent vowels do not only have the same value of a feature (F), but both must either be specified, or underspecified, for this feature. This constraint must be highly ranked relative to other constraints to ensure agreement in the output, similar to the other AGREE constraints used in the analysis so far. Also, members of this group of constraints are ranked equally since there is no ranking argument between them, as was the case in our earlier analysis of Height harmony. In addition to AGREE(F), I also propose a number of faithfulness constraints. The first is the MAX(F) group of constraints as defined in Error: Reference source not found) above. Just as we saw in the Height harmony process, MAX(+LOW) is ranked higher than AGREE and other MAX(F) constraints. And the other members of MAX(F) are ranked equally due to the lack of a ranking argument between them. These other MAX(F) constraints are also ranked on par with the AGREE(F) group of constraints. This ranking differs from what we saw in Height harmony, since members of the MAX(F) constraints in place harmony make reference to place features and not height features. In sum, the grammar of Ewe here again favours both harmony and feature preservation.

In order to minimize the introduction of new features and feature values, I use the constraint DEP(F), defined in (77) above, which requires that a feature (F) is not inserted in the output. Members of this group include DEP(+BK) and DEP(+FT), and they are ranked equally relative to one another. DEP(+BK) ensures that [+back] is not inserted in the output. Thus, any [+back] feature in the output that is not in the input receives a violation mark. This constraint is ranked below the MAX(F) constraints.

Together, the constraints above and their general rankings form the proposal in (88) to account for the Place harmony process in Ewe.

(88) Constraint ranking
MAX(+LOW), MAX(+HI) >> AGREE(FT), AGREE(BK), MAX(+FT), MAX(+BK) >> DEP(+FT), DEP(+BK)

This constraint ranking is based on the following arguments.

(89) Word level: Ranking arguments for Place harmony

a. AGREE(FT) >> DEP(+FT)

	+FT +HI bli	+LOW -a	AGREE(FT)	DEP(+FT)
a. ☞	+FT +HI bli	+FT +LOW -ɛ		*
b.	+FT +HI bli	+LOW -a	*!	

b. MAX(FT) >> DEP(+FT)

	+FT +HI bli	+LOW -a	MAX(FT)	DEP(+FT)
a. ☞	+FT +HI bli	+FT +LOW -ɛ		*
b.	+HI blu	+LOW -a	*!	

Starting with (89a) above, we can see that the AGREE(F) group of constraints must be ranked above DEP(F) constraints to ensure that the correct output is selected. Similarly, in (89b), we can see that MAX(F) must be ranked higher than DEP(F) to prevent the selection of the wrong candidate as optimal. Finally, because there is no ranking argument between AGREE(F) and some MAX(F) constraints, both of which effectively play prominent roles in Ewe (vowels must harmonize and input features must be maximally preserved), I rank these constraints equally.

In a next section, I show how these constraints and their rankings account for the Place harmony data.

3.3 Analysis

I begin with the derivation of the Front harmony process, after which I discuss the derivation of the Back harmony process.

3.3.1 Front harmony

Using the constraints above, I show the derivation of [bli-ɛ] 'the corn' from the input form /bli-a/ in (90).

(90) Word level: OT derivation of [bli-ɛ] ‘the corn’

			MAX(+LOW)	MAX(+HI)	AGREE(FT)	MAX(+FT)	DEP(+FT)
	+FT +HI bli	+LOW -a					
a.	+FT +HI bli	+LOW -a			*!		
b.	+HI blu	+LOW -a				*!	
c. ☞	+FT +HI bli	+FT +LOW -ɛ					*
d.	+FT +HI bli	+FT -LOW -e	*!				*
e.	+FT +LOW blɛ	+FT +LOW -ɛ		*!			*

Candidate (a) in (90) violates highly ranked AGREE(FT), which rules it out as the optimal candidate. Candidates (b), (d) and (e) also incur fatal violations, as they all violate some MAX(F) constraint, all of which are highly ranked as well. In comparison, the optimal candidate, (c), only violates the lowly ranked DEP(+FT); it is thus chosen as optimal. Note that the ranking of MAX(FT) relative to DEP(+FT) is crucial, since ranking MAX(FT) below DEP(+FT) would yield the selection of the wrong candidate. Similarly, the high ranking of MAX(+LOW) and MAX(+HI) ensure that candidates (d) and (e) do not perform equally well as the optimal candidate. Putting this together, the relative ranking of the MAX(F) constraints plays a critical role in selecting the right candidate as optimal.

I now illustrate the effect of this same ranking for the derivation of [ɛtɛ-ɛ] ‘the yam’ from /ɛtɛ-a/, in (91).

(91) Word level: OT derivation of [ɛtɛ-ɛ] ‘the yam’

	+FT ɛtɛ	+LOW -a	AGREE(FT)	MAX(+FT)	DEP(+FT)
a.	+FT ɛtɛ	+LOW -a	*!		
b.	+BK +LOW ɛtɔ	+LOW -a		*!	
c. ☞	+FT +LOW ɛtɛ	+FT +LOW -ɛ			*
d.	+LOW ɛta	+LOW -a		*!	

The faithful candidate, (a), violates AGREE(FT) and, due to the relatively high ranking of this constraint, this candidate receives a fatal violation and is ruled out of the derivation. In candidates (b) and (d), the [+front] feature of the root vowel is assimilated. Thus, each of these candidates violates MAX(FT), which makes them both suboptimal. The optimal candidate, (c), violates DEP(+FT) but satisfies AGREE(FT) and MAX(FT), the two highly ranked constraints relevant to this evaluation. Thus, it is the better candidate and surfaces as the output of the tableau.

3.3.2 Back harmony

The tableau in (92) below shows the evaluation of [ɖu-ɔ] ‘eat-HAB’. Candidate (a), the optimal candidate, does not violate any of the higher ranked constraints due to the insertion of [+back] in the input of the enclitic vowel, yielding [ɔ]. Candidate (b), the faithful candidate, satisfies all other constraints except AGREE(BK), a highly ranked constraint. Therefore it receives a fatal violation. Candidates (c),, (d) and (e) violate

MAX(+LOW), MAX (+BK) and MAX(+HI), respectively. These violations are fatal to each of these candidates.

The evaluation shown in (92) also showcases the importance of MAX (+BK) and its ranking. Without this constraint, candidate (d) would be wrongly chosen as the optimal candidate since it performs better on other constraints than candidate (a). Thus, the high ranking of the faithfulness constraint is critical in predicting the right output in this context.

(92) Word level: OT derivation of [ḍu-ɔ] 'eat-HAB'

	+BK +HI +LOW ḍu -a	MAX(+LOW)	MAX(+HI)	AGREE(BK)	MAX(+BK)	DEP(+BK)
a. ☞	+BK +BK +HI +LOW ḍu -ɔ					*
b.	+BK +HI +LOW ḍu -a			*!		
c.	+BK +BK +HI -LOW ḍu -o	*!				*
d.	+FT +HI +LOW ḍi -a				*!	
e.	+BK +BK -HI +LOW ḍo -ɔ		*!			*

I now turn to the derivation of [no-ɔ] 'drink-HAB'. The faithful candidate, (b), fatally violates highly ranked AGREE(BK) since the adjacent vowels do not agree in the feature [back]. In candidate (a), the enclitic takes on the [-low] as well as the [+back] features of the root vowel while, in candidate (d), the enclitic assimilates to the [-low] feature of the root and the root assimilates to the [-back] feature of the enclitic. This candidate thus incur violations of some highly ranked MAX(F) constraint. In comparison, candidate (c), the optimal candidate, receives a violation of lower ranked DEP(+BK) since [+back] is inserted on the enclitic. This candidate, however, does not violate any highly ranked constraints. It is thus selected as optimal.

(93) Word level: OT derivation of [no-ɔ] 'drink-HAB'

			MAX(+LOW)	AGREE(BK)	MAX(+BK)	DEP(+BK)
	+BK -LOW no	+LOW -a				
a.	+BK -LOW no	+BK -LOW -o	*!			*
b.	+BK -LOW no	+LOW -a		*!		
c. ☞	+BK -LOW no	+BK +LOW -ɔ				*
d.	-BK -LOW ne	-BK -LOW -e	*!		*	*

3.3.3 Interim summary

So far, I showed how the lexical processes (Height and Place harmony) can be accounted for in a constraint-based account through the ranking of faithfulness and markedness constraints. Under the analyses I proposed, AGREE constraints and their rankings relative to other constraints yield harmony between adjacent vowels. Faithfulness constraints also play a key role in determining optimal candidates. Their high ranking in the tableaux ensures that outputs do not lose feature specifications present in the input within the current stratum if there are other ways to satisfy AGREE constraints. In accounting for both Height and Place harmonies, some faithfulness constraints are ranked equal to the markedness AGREE constraints, while MAX(+LOW) is ranked higher than the markedness constraints. In comparison, other faithfulness constraints such as DEP(+BK) are ranked lower, where they still play a role in some of the candidate selections, especially where the highly ranked constraints block some other competing candidates from surfacing as optimal. This can be summarized as in Table 9.

Table 9: Crucial rankings and facts for which they account

Ranking	Process	Facts
AGREE(F), MAX(F) >> DEP(F)	Height and Place harmony	This ranking ensures that adjacent vowels agree in some feature. This ranking is crucial for harmony to apply in the language.
MAX(F) >> DEP(F)	Height and Place harmony	This ranking is crucial to account for which vowel undergoes assimilation and which vowel acts as the trigger, maintaining its input features.
MAX(+LOW) >> AGREE(F) MAX (+FT) >> DEP(+FT)	Place harmony	The relative ranking of these constraints is necessary to prevent the application of Height harmony in specific vowels. Without this ranking, candidates with height assimilation would surface as the optimal candidates or perform equally as the optimal candidate.

In addition, the impoverished nature of the input to this stratum of derivation requires the grammar to rank MAX higher at this level and other later levels of derivation in order to preserve features on segments, an observation made earlier in section 2 of this chapter. This is accounted for through the high ranking of MAX relative to other constraints at the word level of derivation. Also, the derivations illustrated above provide further evidence that the grammar of the northern dialect of Ewe preserves specific features and feature values of segments. Thus, it is not the location of the trigger of harmony, which determines the segment that undergoes assimilation.

In the next section, I continue to explore how Stratal OT can be used to account for post-lexical processes, through the analysis of the Low harmony process.

4 Low harmony

I have argued in Chapter 3 that the harmony system of Ewe must be classified into lexical and post-lexical processes. I proposed that Height and Place harmonies are lexical processes that occur at the word level, while Low harmony is a post-lexical process that takes place at the phrasal level of derivation. I also showed in sections 2 and 3 of this chapter how we can account for the lexical harmony processes seen in the northern dialect of Ewe using a constraint-based phonological grammar. In this section, I show how Stratal OT can capture the Low harmony post-lexical process. I offer an explanation for the non-application of Front harmony even though the conditions for its application are met, as noted in section 3.2 of Chapter 2, and show why /ɛ/ is a trigger of Low harmony even though it fails to pass on the same feature through the Height harmony process. Following the same structure as above, I begin by discussing the nature of the input to this level of derivation as well as the constraints needed to capture the derivation of the Low harmony process.

4.1 The input

In order to account for the post-lexical harmony process in the northern dialect of Ewe, I continue to adduce to the assumptions of Stratal OT. I hold that the output of the word level serves as the input to the post-lexical (or phrasal) level of phonological processing.

4.2 The constraints and constraint ranking

To account for the Low harmony process, I employ the same categories of faithfulness and markedness constraints described earlier. More specifically, I use the agreement constraint AGREE(LOW) and AGREE(FT) already defined in (87) above. I also use the DEP(F) constraint defined in (77) above. In addition to these constraints, I also use the constraint SPEC(LOW), defined in (66) above. This constraint requires segments to be specified for [low] whether the feature is present or absent in the input.

Consistent with the tenets of Stratal OT, the relative ranking of these constraints within the post-lexical stratum may be different from that within the lexical stratum. As we will see, to account for the Low harmony process, AGREE(FT) must be ranked lowly. This ranking is different from what we saw at the lexical level, where AGREE(FT) is ranked highly. It is indeed necessary to rank AGREE(FT) lowly at the post-lexical level to ensure that Place harmony does not apply within this stratum. On the contrary, AGREE(LOW) is ranked highly, just as we saw within the lexical stratum. The high ranking of AGREE(LOW) is important to account for the Low harmony process. In addition, SPEC(LOW) is ranked highly at this level of evaluation. This is necessary to preserve segmental contrast. In the following analysis, SPEC(LOW) prevents harmony-driving constraint AGREE(LOW) from being satisfied through underspecification of [low] on the focus marker. Thus, I propose the constraint ranking in (94).

(94) AGREE(LOW), SPEC(LOW), MAX(+HI), MAX(+LOW), DEP(-LOW) >> DEP(+LOW), DEP (PLACE) >> AGREE(FT), MAX(-LOW)

As we can see from this ranking, MAX(+LOW) is undominated alongside AGREE(LOW), MAX(+HI), SPEC(LOW) and DEP(-LOW). Together these constraints are ranked above DEP(+LOW) and DEP (PLACE), which are themselves ranked higher than AGREE(FT). These rankings are based on the ranking arguments in (95) below. The tableaux in (95) show the derivation of [agba-ɛ] 'it's a load' which involves the focus marker. (95a-b) show that both AGREE(LOW) and MAX(+LOW) need to be ranked above DEP(+LOW). Ranking DEP(+LOW) above either of them would lead to the wrong candidate emerging as optimal.

(95) Phrase level: Ranking arguments for Low harmony

a. AGREE(LOW) >> DEP(+LOW)

			AGREE(+LOW)	DEP(+LOW)
	+LOW agba	+FT -LOW -e		
a. ☞	+LOW agba	+FT +LOW -ɛ		*
b.	+LOW agba	+FT -LOW -e	*!	

b. MAX(+LOW) >> DEP(+LOW)

+LOW agba	+FT -LOW -e	MAX(+LOW)	DEP(+LOW)
a. ☞ +LOW agba	+FT +LOW -ɛ		*
b. -LOW agbe	+FT -LOW -e	*!	

c. DEP(+LOW), DEP (PLACE) >> AGREE(FT)

+LOW agba	+FT -LOW -e	DEP(+LOW)	DEP(PLACE)	AGREE(FT)
a. ☞ +LOW agba	+FT +LOW -ɛ	*		*
b. +FT +LOW agbɛ	+FT +LOW -ɛ	*	*!	

In (95c), we can see that there is no ranking argument between DEP(+LOW) and DEP (PLACE). Thus, they are ranked equally relative to one another. This tableau also provides a ranking argument between DEP (PLACE) and AGREE(FT). The former must be ranked higher than the latter for the right candidate to surface as the output. Ranking AGREE(FT) higher than the two faithfulness constraints in (95c) would lead to the wrong candidate selection.

4.3 Analysis

We now turn to capturing the Low harmony of the northern dialect of Ewe, using the constraint ranking in (94) above. The tableau (96) shows the derivation of [agba-ɛ] 'it's a load' from the input /agba-e/.

(96) Phrase level: Low harmony with /a/ as root vowel

			AGREE(LOW)	MAX(+LOW)	DEP(+LOW)	DEP(PLACE)
	+LOW agba	+FT -LOW -e				
a.	+LOW agba	+FT -LOW -e	*!			
b.	+FT -LOW agbe	+FT -LOW -e		*!		
c. ☞	+LOW agba	+FT +LOW -ɛ			*	
d.	+FT +LOW agbɛ	+FT +LOW -ɛ			*	*!

As we can see, the faithful candidate, (a), as well as candidate (b), satisfy all lower ranked constraints, but each receives a violation of the highly ranked constraint, AGREE(LOW) and candidate (b) violates MAX(+LOW). Candidate (d) satisfies both highly ranked constraints just as the optimal candidate (c) does, and both receive violation marks for DEP(+LOW). However, candidate (d) violates DEP (PLACE) as well, which penalizes the insertion of place features. This violation is fatal, thus ruling candidate (d) out of the evaluation. From this analysis, we can also see that the ranking of DEP (PLACE) is crucial in ensuring that Place harmony does not apply at this level of derivation, since Place harmony would otherwise target /a/ irrespective of whether it occurs as the root vowel or enclitic; without this constraint, candidate (d) would perform equally well as the optimal candidate.

I now turn to how this analysis captures the Low harmony pattern as it applies when the root vowel is /ɛ/, in (97) below. This tableau shows the derivation of [atɛ-ɛ] 'its an ant' from /atɛ-e/.

Just as we saw in (96), the faithful candidate in (97) satisfies all the other relevant constraints at the expense of highly ranked AGREE(LOW) and SPEC(LOW). This rules them out as optimal candidates.

(97) Phrase level: Low harmony with /ɛ/ as root vowel

			AGREE(LOW)	SPEC(LOW)	DEP(-LOW)	MAX(-LOW)
	+FT atɛ	-LOW +FT -e				
a.	+FT atɛ	-LOW +FT -e	*!	*		
b.	-LOW +FT ate	-LOW +FT -e			*!	
c.	+FT atɛ	+FT -ɛ		*!*		*
d.☞	+FT +LOW atɛ	+FT +LOW -ɛ				*

Candidate (b) and (c) satisfy AGREE(LOW), but incur fatal violations of DEP(-LOW) and SPEC(LOW), respectively. In candidate (b), the root vowel assimilates to the [-low] feature of the enclitic, therefore violating DEP(-LOW). Candidate (c), on the other hand, has no [low] specification on either vowel. Thus, it receives two violations of SPEC(LOW). In the optimal candidate, (d), both vowels receive a [+low] specification to satisfy AGREE(LOW) and SPEC(LOW) This candidate incurs only a violation of low ranking MAX(-LOW). Candidate (c), therefore emerges as the optimal candidate.

Let us now see what happens when the root vowel is a [+high] vowel. Recall that [+high] vowels do not trigger Low harmony. I show this with the tableau in (98) showing the evaluation of [tu-e] 'it's a gun'.

(98) Phrase level: Absence of Low harmony with /u/ as root vowel

+HI +BK tu	-LOW +FT -e	AGREE(LOW)	SPEC(LOW)	MAX(+HI)	DEP(-LOW)	MAX(-LOW)
a. +HI +BK tu	-LOW +FT -e	*	*!			
b.☞ +HI +BK -LOW tu	-LOW +FT -e				*	
c. -LOW +BK to	-LOW +FT -e			*	*!	
d. +HI +BK tu	+FT -ɛ		**!			*

From (98), candidates (a), and (d) receive violations of highly ranked AGREE(LOW) and SPEC(LOW). Candidate (a) receives a violation each of these constraints while, (d) receives two violations of SPEC(LOW). This makes them suboptimal. Both candidates (b) and (c) receive violations of highly ranked constraint DEP(-LOW). However, candidate (c) receives a violation of MAX(+HI) for the deletion of the [+high] feature of the root vowel. This violation is fatal and the candidate is eliminated. Thus, the attested outputin (b) is selected as optimal.

So far, we have seen how features are specified, and how the various harmony processes are derived through different stages of derivation. Next, I put all these stages together to show the relationship that exists between the various stages of derivation. I do this by using the example of [tɛ-ɛ], which undergoes both Height and Place harmony at the word level from the underlying form /ta-e/. After that, I show how [agba-ɛ] 'it's a load', formed through phrase-level cliticization, with the underlying form /agba-e/ makes its way through the various levels of the grammar. I begin with how the specification of the root vowel /a/ is derived by violable constraints, using the constraint ranking for the stem level of derivation proposed in (67).

As we can see in (99a), candidate (c) is the optimal candidate since it incurs no violations of the highly ranked constraints against specific feature specifications. Candidates (a) and (b) each violate one of these highly ranked constraints and are therefore ruled out.

(99) Full Stratal OT derivation of tɛ-ɛ 'draw it'

a. Stem level evaluation of [ta] 'ta draw]

	-HI -FT -BK +LOW ta	*[-HI]	*[-FT]	MAX(F)
a.	-HI +LOW ta	*!		**
b.	+LOW -FT ta		*!	**
c. ☞	+LOW ta			***

b. Word level evaluation of [tɛ-ɛ] 'draw it'

+FT +LOW -LOW ta -e	MAX(+LOW)	AGREE(LOW)	AGREE(FT)	MAX(FT)	MAX(-LOW)
a. +FT +LOW -LOW ta -e		*!	*		
b. +FT +LOW +LOW ta -ɛ			*!		*
c. ☞ +FT +FT +LOW +LOW tɛ -ɛ					*
d. +FT -LOW -LOW te -e	*!				*
e. +LOW +LOW ta -a				*!	*

c. Phrase level evaluation of [tɛ-ɛ] 'draw it'

+FT +FT +LOW +LOW tɛ -ɛ	AGREE(LOW)	MAX(F)	AGREE(FT)
a. ☞ +FT +FT +LOW +LOW tɛ -ɛ			
b. +FT +LOW +LOW ta -ɛ		*!	*
c. +FT +FT +LOW -LOW tɛ -e		*!	

Recall that, in Ewe, when /a/ is the root vowel in the Height harmony context, it harmonizes to the [front] feature of the enclitic vowel while it also passes its [+low] feature to the enclitic. Thus, two processes are simultaneously attested in this situation. In (99b), I combine these two processes into one tableau in order to show how they apply in tandem and also to highlight that they apply at the same level of derivation. The constraint ranking used here is a fusion of the constraint rankings for the Height and the Place harmony processes proposed in (80) and (88), respectively. As we can see in (99b) above, the faithful candidate, (a), violates both AGREE constraints; due to the high ranking of these constraints, it is ruled out as the optimal candidate. Candidates (b) and (e) each incur a violation of either AGREE(FT) or MAX(FT), which are equally ranked. Both candidates also violate low ranking MAX(-LOW). Candidate (b) violates AGREE(FT), because neither of its vowels is specified for the same value of [front], while (e) violates MAX(FT) because the [front] specification of the enclitic vowel is deleted in order to satisfy AGREE(FT). This makes them less optimal than candidate (c). Candidate (d), on the other hand, performs equally as candidate (c) on all constraints except the highly ranked MAX(+LOW). This is due to the insertion of [-low] on the root vowel. It is therefore ruled out. The optimal candidate, (c), receives only one violation of MAX(-LOW) due to the change in the [low] value of the enclitic vowel; it is thus chosen as the optimal candidate.

At the phrasal level, the specifications of the input vowels are maintained. The constraints at this level ensure that the faithful candidate wins the competition and is chosen as the optimal candidate, as we can see in (99c). Candidate (b), in which the place feature of the root vowel in the input is deleted, incurs a violation of MAX(F) and AGREE(FT). Similarly, changing the low specification of the enclitic vowel violates MAX(F). Thus, the faithful candidate is selected as optimal.

Let us also see how the derivation of [agba-ɛ] 'it's a load' from /agba-e/ proceeds through the full Stratal OT grammar for Ewe.

The stem level of derivation is illustrated in (100a), with no morphological processes applying at this stage. This derivation is similar to the one for /ta/ in (99a) above. Thus, I will not discuss this further.

(100) Full Stratal OT derivation of [agba-ɛ] 'it's a load'

a. Stem level evaluation of [agba] 'load'

	-HI -FT -BK +LOW agba	*[-HI]	*[-FT]	MAX(F)
a.	-HI +LOW agba	*!		**
b.	+LOW -FT agba		*!	**
c. ☞	+LOW agba			***

b. Word level evaluation of [agba] 'load'

	+LOW agba	DEP(F)	MAX(F)
a.	-HI +LOW agba	*!	
b.	-LOW agbo	*!	*
c. ☞	+LOW agba		

c. Phrase level evaluation of [agba-ɛ] ‘it’s a load’

	+LOW agba	+FT -LOW -e	AGREE(LOW)	MAX(+LOW)	DEP(+LOW)	DEP(PLACE)	AGREE(FT)
a.	+LOW agba	+FT -LOW -e	*!				*
b.	+FT -LOW agbe	+FT -LOW -e		*!			
c. ☞	+LOW agba	+FT +LOW -ɛ			*		*
d.	+FT +LOW agbɛ	+FT +LOW -ɛ			*	*!	

Following the tenets of Stratal OT, the output of the stem level feeds the word level. Thus, the optimal candidate, (c) from (100a) above, is the input of the word level of derivation, in (100b). At the word level, the root vowel thus enters the derivation only specified as [+low]. Since focus marking does not apply at this stage, we do not see any harmony. The faithfulness constraints ensure that the input remains intact to be sent to the phrase level for processing. Candidate (a), where the root vowel gets an additional specification, is ruled out by DEP(F). In candidate (b), the [+low] specification is changed to [-low], which fatally violates DEP(F) as well as MAX(F). Thus, the faithful candidate, (c), is the optimal one and is sent out to the phrase level of derivation.

As we saw in section 4 of this chapter, the phrase level is where focus marking takes place in the language, triggered by a syntactic process which adds focus marking to the noun at this stage of derivation. As we can see in (100c) above, the focus marker has also passed through the early stages of derivation. It is therefore only specified for the features [-low, +front]. The optimal candidate, (c), violates DEP(+LOW), which is ranked relatively low in the tableau. This candidate also violates AGREE(FT) which is ranked below the faithfulness constraints at the phrase level. Candidates (a) and (b) violate the highly ranked constraints and are ruled out, while candidate (d) incurs a violation of DEP (PLACE) in addition to DEP(+LOW). This latter candidate is therefore ruled out of the evaluation. Further, the low ranking of AGREE(FT) plays a critical role in ensuring that the root vowel /a/ does not undergo Front harmony. Should AGREE(FT) be ranked highly as we saw in the word level derivation of [tɛ-ɛ] in (99), the winning candidate would be the unattested form. Thus, Stratal OT afforded us the ability to re-rank constraints between stratum to ensure the attested form is selected as optimal.

5 Discussion

In this chapter, I showed how the mechanisms of Stratal OT can be used to account for both lexical and post-lexical vowel harmony processes. I used faithfulness and markedness constraints to account for the harmony processes at the stem, word and phrase levels of derivation. The relative rankings of the various constraints ensure that all the facts about the harmony processes are captured in a principled manner. Generally, the ability to posit different constraint rankings across the different levels of derivation makes it possible to account for each harmony process. At the word level, some of the AGREE(F) constraints (such as AGREE(FT) and AGREE(HI)) are highly ranked to ensure that adjacent vowels agree in some feature (high or low in Height harmony, and front or back in Place harmony). This was seen in (99b). However, at the phrase level of derivation, AGREE(FT) is ranked lowly to account for the fact that Front harmony is irrelevant to this level of derivation, as illustrated in (100c). In addition to constraints showing different rankings across strata, the asymmetries in the behaviour of /a/ and /ɛ/ are easily accounted for in Stratal OT. /a/ and /ɛ/ are targets of Place and Height harmonies, when they occur in hiatus contexts created at the word level. These segments are not targeted by Low harmony even though the conditions for these processes may be present on the surface. In summary, this is because the context for Low harmony is generated at the phrase level, where the constraints motivating Place and Height harmony are low ranked. Height harmony is a word level process; therefore, both /a/ and /ɛ/ are targeted in these instances. However, concerning Low harmony, a different ranking of constraints ensures that neither of these vowels is targeted at this level of derivation.

In light of the facts and analyses discussed in this chapter, I conclude that the harmony processes seen in the northern dialect of Ewe are largely feature preserving. The grammar displays a general preference for preserving positive '+' values of features on vowel segments such that adjacent segments with varying values of a feature are penalized. This is achieved through high ranking of MAX constraints, relative to lower ranking DEP constraints. In Height harmony, which occurs at the word level of derivation, the grammar prefers adjacent vowels to have the + height specification such that the segment with this value passes it on to the other. Similarly, in Place harmony, the + place feature is passed on to the adjacent vowel with no place specification. Furthermore, at the word level, vowels that do not have a height or place specification inherit this specification from adjacent vowels, whether it is + or – value.

This is because, even though the grammar prefers the '+' values of features, it also has the added restriction that segments must have a height or place specification whenever there is an opportunity to get one. This is motivated in the grammar by the general ranking in which MAX(F) constraints outrank DEP(F) constraints. At the phrase level, there is only preference for the plus + value of the feature [low]. This is reflected in the high ranking of AGREE(LOW) and the low ranking of AGREE(FT). Thus any process that applies at this stage of derivation must reflect this fact about the grammar.

A virtue of this analysis is that, by relying on phonological activity to specify vowels and ensuring that the specified features are preserved throughout the multiple stages of derivation, the outputs of these levels are rendered transparent relative to the inputs. This transparency is the essence of recoverability, which "[...] requires that phonological representation and phonetic content be related" (Idsardi 1998:491). In other words, from my proposal, it is easy to tell the nature of underlying representations of Ewe vowels by observing the surface forms in the language. The relative ranking of faithfulness constraints, especially of the MAX constraints, ensures the preservation of phonologically active features through the various stages of derivation, which makes it possible for inputs to be easily derived by observing output forms. In addition, the rankings that govern the different phonological processes discussed can be easily traced through the various stages of derivation from the output form.

In the next chapter, I explore other possible theories of feature specification. I show that despite the successes chalked by these theories in the analysis of other languages, they are insufficient in accounting for the vowel specifications needed to capture the facts of the northern dialect of Ewe.

Chapter 6 Alternative analyses for Ewe vowel specification

1 Introduction

In Chapter 3, I argued that functional contrast is insufficient to predict the behaviours of vowels in the northern dialect of Ewe. I proposed that vowels in this dialect of Ewe can be parsed into distinctive segments based on phonological activity, independent of phonological contrast. In Chapter 4, I further showed how the specifications proposed based on phonological activity can be derived in OT through the interaction of violable phonological constraints. In Chapter 5, using the specifications proposed in Chapter 3, I showed how the mechanisms of OT can explain the harmony processes seen in the northern dialect of Ewe. The basic argument is that the grammar of Ewe has preference for preserving the positive values of height and place features at the word level. At the phrase level of derivation, preservation of [+low] is more important than place agreement.

In this chapter, I provide further evidence that contrast is not sufficient to account for the phonological processes discussed above. I do this by discussing various theories of feature specification, including the Contrastive Hierarchy (Hall 2007; Dresher 2009), Radical underspecification (Archangeli & Pulleyblank 1988), and Contrastive underspecification (Steriade 1987). Starting with the Contrastive Hierarchy, I attempt to parse the vowel inventory of Ewe into contrastive units. I show that the Contrastive Hierarchy, using active features, accurately parses all vowels into contrastive segments in some Ewe dialects but fails in the northern dialect. I then discuss other theories of underspecification (i.e., Radical and Contrastive). I highlight areas where these theories fail to capture the specifications needed to explain the harmony processes of the northern dialect of Ewe. Based on this, I argue that vowels in the northern dialect of Ewe do not make reference to contrast in morpho-phonological processes. Rather, vowels are specified for the features they need to be able to trigger processes in the language. The resulting set of specification is not consistent with any model of contrastive specification.

First, I discuss the main tenets of the Contrastive Hierarchy. I then show that this theory is efficient in parsing vowels into contrastive units in the Adangbe dialect of Ewe but fails when the northern dialect is considered, due to the asymmetric behaviour of /a/ and /ɛ/.

2 The Contrastive Hierarchy and vowel feature specification in Ewe

The Contrastive Hierarchy holds that distinctive features are hierarchically ordered in human languages. The order can be different across different languages. The theory was introduced in various forms by scholars such as Jakobson, Fant & Halle (1952), Halle (1959) and Trubetzkoy (1969). According to Dresher (2018), the Contrastive Hierarchy theory has been referenced under different names in works by Clements (2001, 2003, 2009). The basic tenet of the theory is that contrasts in languages are derived by hierarchically ordering features as branching trees. The ordering is done by a "[...] Successive Division Algorithm" Dresher (2018:19), defined in (101).

(101) Successive Division Algorithm (Dresher 2018:19)
Assign contrastive features by successively dividing the inventory until every phoneme has been distinguished.

Dresher (2018:20) argues that contrastive features must be selected and ordered "[...] so as to reflect the phonological activity in a language." He defines phonological activity as follows:

(102) Phonological activity

> A feature can be said to be active if it plays a role in the phonological computation; that is if it is required for the expression of phonological regularities in a language, including both static phonotactic patterns and patterns of alternation.

An additional consideration in selecting and dividing features is the Contrastivist Hypothesis by Hall (2007), cited by Dresher (2018:20).

(103) The Contrastivist Hypothesis

> The phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of L from one another.

The Contrastivist Hypothesis has a corollary in (104) below.

(104) Corollary to the Contrastivist Hypothesis (Dresher 2018:20)

> If a feature is phonologically active, then it must be contrastive.

A final assumption behind much work within the Contrastive Hierarchy is that features are binary. Dresher (2018) argues that every feature has a marked and an unmarked value specified in the contrastive hierarchy.[20] On the number of features required to be able to divide vowels in a language contrastively, Dresher (2018) observes that the minimum number of features can be derived by the $\log_2 n$ and a maximum by n-1 (where n is the number of vowels in the language). Thus, an eight vowel system will

20 There is some work within the Contrastive Hierarchy theory where privative features are used (see for instance Hall 2007). Thus, this assumption, while common, is not central to the theory.

need a minimum of three features and a maximum of seven. (See Dresher (2009) for a full list of the number of features needed for each vowel inventory.) Dresher also observes that, even though languages have a maximum number of features that can be used to divide their vowels contrastively, this maximum is largely unattainable in languages with larger inventories. Let us now look at how the Contrastive Hierarchy applies in Adangbe, which is the dialect that has received attention in earlier work by Clements (1974). I begin with the active features of the dialect.

2.1 Phonological activity in Adangbe

Clements (1974) discusses some phonological processes found in various dialects of Ewe. Recall from Chapter 2 that, in Adangbe, the clitic '-e' harmonizes to the [high] and [low] features of the root vowel. This clitic functions as either the third person singular pronoun or the focus marker across all dialects of Ewe. In addition to this, there is a Front harmony process that causes central vowels to agree in the feature [front] with adjacent vowels accross morpheme boundaries. I repeat the examples from (30) and (31) as (105) below. As we can see, the clitic harmonizes to the high and low features of the root vowels, respectively, in (105a-b). Front harmony causes the central vowels to become realized as front vowels, in (105c-d). These vowels, however, keep their height feature which they pass to the enclitic vowel in the Height harmony process.

(105) Adangbe vowel harmony

a. àvǔ -í
dog -FOC
'it's a dog'

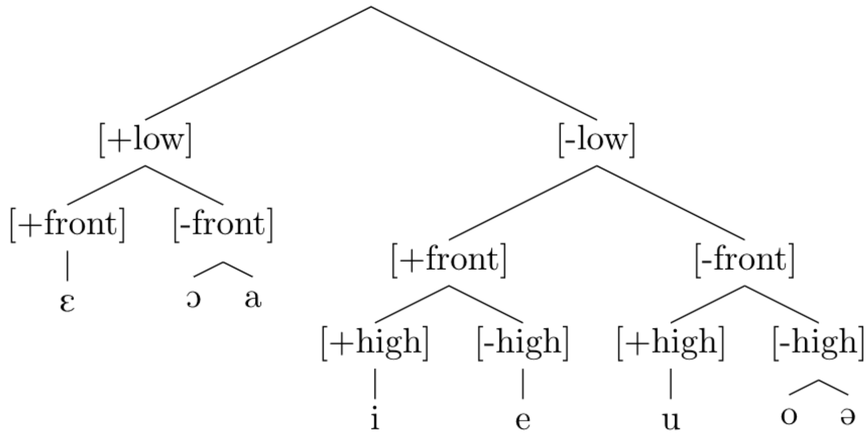
b. əsɔ́ -ɛ́
horse -FOC
'it's a horse'

c. àgbà -é = àgbɛ̀-ɛ́
load -FOC 'it's a load'

d. əɲə̀ -é = əɲè-é
1SG -FOC 'it's me'

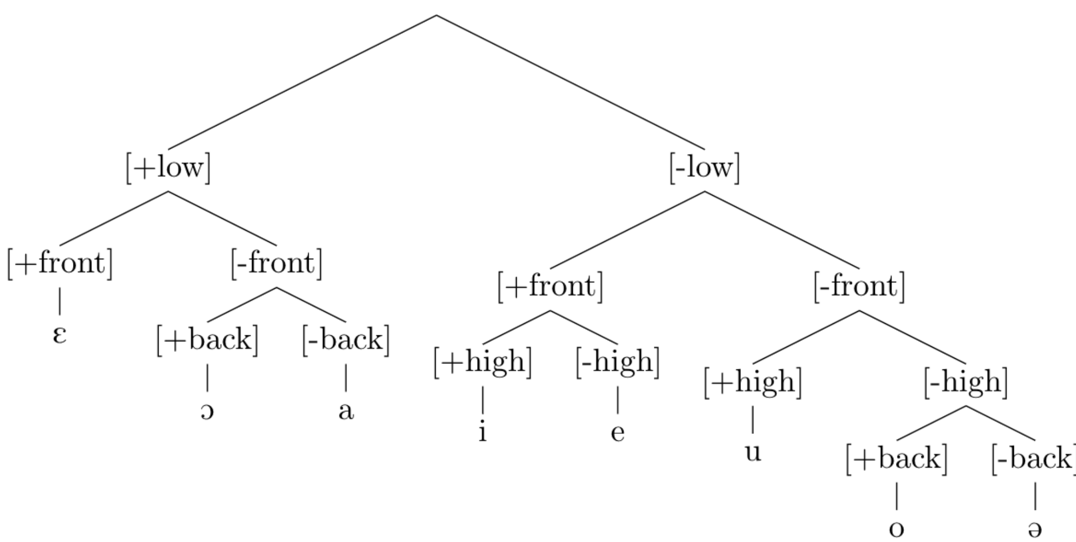
Based on these processes, the height features [high] and [low] can be considered active in Adangbe. In addition, the place feature [front] is also active. Thus, all three features must be contrastive in the dialect. Given the absence of other phonological processes affecting these vowels (to my knowledge), I parse the vowel inventory of Adangbe using these features in the contrastive hierarchy in (106). However, as we can see, the hierarchy using only the active features is not able to fully parse the inventory into phonemic segments: no contrast can be established between [ɔ] and [a] or between [o] and [ə].

(106) Contrastive hierarchy of Adangbe



The Contrastive Hierarchy allows for extra features to be proposed to account for inventory with fewer than enough active features. Such features may not be active in the language. Based on this, I follow Capo (1985) and propose an extra place feature, [back], to parse the remaining vowels. This generates the hierarchy in (107).

(107) Revised contrastive hierarchy of Adangbe



In (107), all vowels in the inventory of Adangbe are parsed into segmental contrasts. This hierarchy also accounts for all known phonological processes found in Adangbe.

Parsing vowels initially through the [low] feature ensures that all vowels have a [low] specification, needed to account for the harmony process described above in (105). All phonetically [+low] and [+high] vowels are accurately specified and can trigger harmony. Similarly, all front vowels are specified for [+front], which allows them to trigger fronting, as I illustrated in (105c-d).

The Contrastive Hierarchy can thus fully specify vowels in Adangbe, whose data thus supports the argument that contrast plays a role in phonological representation and computation. However, the same does not hold of the northern dialect of Ewe. As I discuss next, it is in fact impossible for the Contrastive Hierarchy to obtain feature specifications that can predict the phonological behaviours of vowel segments. First, I recapitulate some phonological processes seen in the northern dialect, which determine the active features in the dialect.

2.2 Contrastive hierarchy in the northern dialect of Ewe

The northern dialect of Ewe, as discussed earlier, has seven phonemic vowels /i,e,u,a,o,ɔ,ɛ/. According to the Contrastive Hierarchy, we need to establish which features are active in the language and then order them correctly within a hierarchy of contrasts. Based on the definition of activity proposed in Dresher (2018), phonologically active features can be derived based on the vowel harmony system of the language. Recall that the northern dialect of Ewe exhibits harmony patterns affecting the height and place features of vowels.

When the enclitic vowel '-e' is cliticized to a verb, this vowel agrees in its height feature with the root vowel, such that a [+low] root vowel causes the enclitic to be realized as [+low] and a [+high] root vowel causes the enclitic vowel to be realized as [+high]. Thus, the features [low] and [high] are active in Ewe, and consequently, contrastive. Another harmony process seen in the northern dialect of Ewe, which I introduced in section 3.2 of Chapter 2, and subsequently discussed in other chapters above, is Place harmony.[21] According to Odden (1991), an enclitic '-a' is realized as /ɛ/ when it occurs after front vowels, and as /ɔ/ after back vowels. Given that this process is triggered by [+front] and [+back] specifications on vowels, I propose that the features [front] and [back] are also active in the language and are thus contrastive.

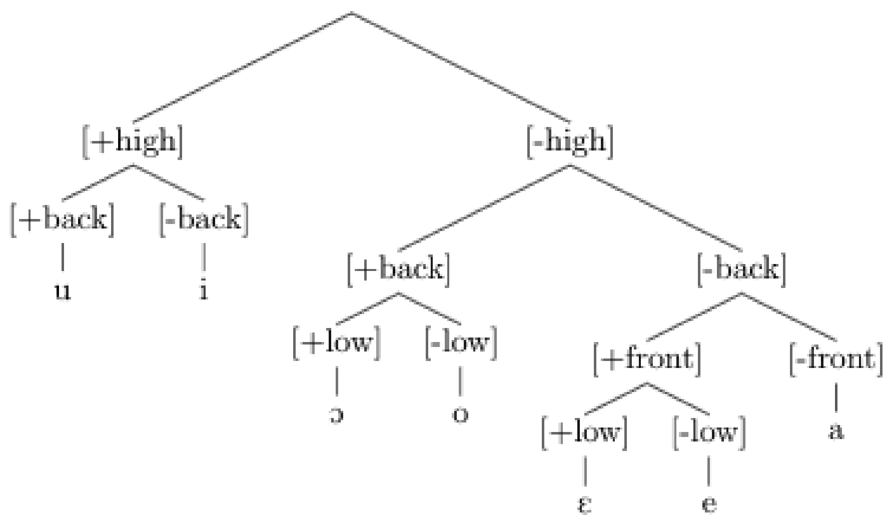
The features posited so far can account for the contrast among all vowels found in the phonemic inventory of Ewe. The ranking necessary to show contrast among these phonemic vowels must also capture the apparent underspecification of /ɛ/ and /a/, based on their failure to trigger harmony. Further, the four features posited as contrastive should be enough, given that the contrastive hierarchy requires a seven vowel system like the one seen in the northern dialect of Ewe to have a minimum of three features. Finally, I am not aware of any other phonological processes that would provide evidence of phonological activity involving any other features in the dialect.

Given the active and contrastive features suggested above, there is however no clear ranking of features that can account for the vowel specification necessary to explain the phonological processes of Ewe. Take for instance the ranking

21 I reported this as separate processes in my earlier discussions. However, I group the two processes together here for ease of description.

[high] > [back] > [front] > [low]. This ranking generates the hierarchy in (108) below. This hierarchy ensures that high vowels are separated from other vowels early on. It also assigns [high] to all vowels in the language. The feature [back] is ranked below [high] and above [front] so that back vowels are not specified for [front]. [low] needs to be ranked low because the facts seen so far show that only a few segments (i.e., /a, ɛ, ɔ/) are specified for it.

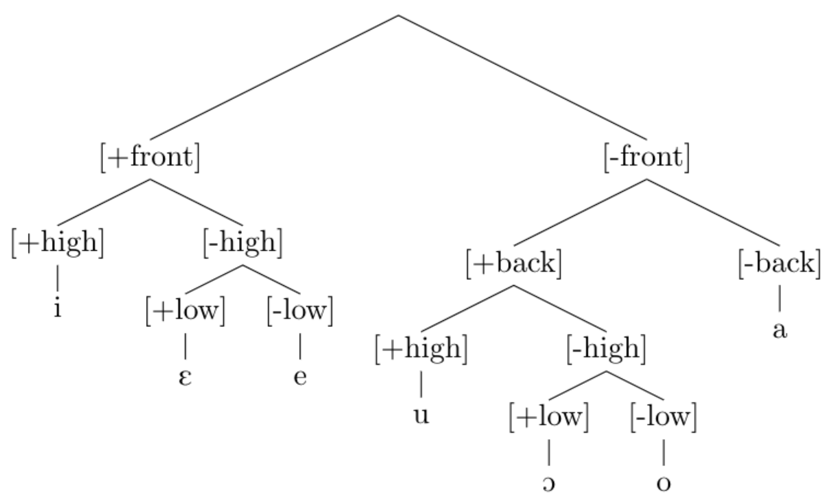
(108) Hypothetical hierarchy for the northern dialect of Ewe 1: [high] > [back] > [front] > [low]



The hierarchy above accurately predicts that /i, u/ are specified as [+high], which means they can trigger any process that makes reference to this feature. It also assigns [+back] to all the vowels that trigger back harmony. However, this ranking wrongly assigns [+low] to /ɛ/, which given the facts discussed in previous chapters, is not specified for [low]. Finally, /i/ is not specified for [front]; this is important since the fronting process makes specific reference to this feature and /i/ triggers this process. It should therefore be specified for it.

Another possibility would be to rank [front] above all other features, as per (109) below. This ranking correctly assigns [+front] to all front vowels and [+back] to all back vowels. However, this ranking assigns [+low] to /ɛ/ although this vowel does not act as a trigger of Height harmony. It also fails to assign [+low] to /a/ although this vowel does trigger assimilation to [+low] in the Height harmony process. Thus, the hierarchy in (109) does not make the right predictions about feature specification for this dialect.

(109) Hypothetical hierarchy for the northern dialect of Ewe 2: [front] > [back] > [high] > [low]



Despite the rigorous nature of the Contrastive Hierarchy in predicting feature specifications based on phonological activity, the inventory of Ewe in combination with the phonological processes in the northern dialect of this language pose non-trivial challenges to this theory. The Contrastive Hierarchy is unable to generate a specification that accurately predicts the features needed by phonemic vowels to reflect phonological activity.

The challenge that the inventory and facts of the northern dialect pose for the Contrastive Hierarchy is similar to the 'oops I need that' problem described in Nevins (2015). Nevins observes that the Contrastive Hierarchy sometimes eliminates feature specifications on segments that are actually needed when other phonological processes in the language are considered. This is attested here with respect to the segment /i/ and the feature [front] in the hierarchy in (108). In this hierarchy, /i/ is underspecified for [front] even though it needs the feature [front] to trigger Front harmony. Similarly, from the hierarchy in (109), /a/ does not receive a [low] specification even though it needs this specification to trigger Height harmony.

In addition to the 'oops I need that' problem presented by the northern dialect of Ewe, the data from Ewe discussed so far also shows instances where segments are specified for features that they should otherwise be underspecified for when phonological processes are considered. Specifically, we know that /ɛ/ fails to trigger [+low] assimilation in Height harmony. However, no feature combination will give us underspecification of [low] in /ɛ/ without having serious consequences for other segments. This is partly because /ɛ/ contrasts at least in the feature [low] with /e/. Without this specification, these two sounds cannot be distinguished from one another in the language.

The challenge posed by the inventory and processes of Ewe can also not be explained under the parametrized visibility hypothesis (Calabrese 1995; Nevins 2010), which states that "phonological rules may parametrize whether they are sensitive to contrastive-values or to all values of feature" (Nevins 2015:54).[22] Neither can the challenges presented by the northern dialect of Ewe be accounted for by using a weaker version of the Contrastivist Hypothesis proposed by Hall (2008), where non-contrastive features can be specified on segments but not referred to in phonological processes. Thus, no versions of the Contrastive Hierarchy which rely on contrast in phonological representation are adequate to capture the facts about the northern dialect of Ewe.

In the next section, I turn to other theories of underspecification (i.e., Contrastive and Radical Underspecification) to attempt specifying features for the vowel segments in the northern dialect. I show that these theories, which also rely on the idea of contrast, are unable to parse the inventory of the northern dialect of Ewe to account for the processes discussed in the dialect.

3 Theories of underspecification and Ewe feature specification

In the previous section, I discussed the Contrastive Hierarchy and how it could be used successfully to specify vowel segments in Adangbe. I also highlighted the challenges that the northern dialect of Ewe poses to the Contrastive Hierarchy and the Contrastivist Hypothesis. In this section, I argue that both theories of Contrastive and Radical Underspecification face challenges in accounting for what features must be specified underlyingly in the northern dialect of Ewe. I do this by first introducing both theories of underspecification. I then discuss how each of these approaches to underspecification fails to specify vowel segments to capture the facts about the northern dialect of Ewe.

22 Nevins (2010) does not use the Contrastive Hierarchy in his definition of contrastive features.

It is worth noting that, even though these theories have not received much attention since the inception of OT, they remain relevant to this study for a number of reasons. First, some of the important works on the development of both Contrastive and Radical underspecification have been based on languages related to Ewe (see for instance, Pulleyblank 1986, 1988; Abaglo & Archangeli 1989). Also, using both theories of underspecification supports the proposal that activity, as opposed to any theory of contrast, determines feature specification in the northern dialect of Ewe. I begin with Contrastive underspecification.

3.1 Contrastive Underspecification

In section 3 of Chapter 3, I showed how underspecification can be diagnosed by determining whether processes violate three basic assumptions about phonological processing (i.e., locality, generality and invariance). Using these assumptions, I showed that some segments in Ewe may be underspecified for some features. However, questions remain about how to determine features that are specified on segments. In this section, I discuss some of the methods proposed in the literature and then attempt to specify vowel segments in Ewe using these methods. As we will see, the idea of Contrastive underspecification (Steriade 1987, 1995; Clements 1987) fails in predicting what features are specified on vowel segments in Ewe.

Contrastive underspecification assigns values to a feature in underlying representation only when that feature is needed to distinguish a pair of segments in the language. Features that are not contrastive are left out of the underlying representations of segments. Contrastive Underspecification generally assumes binary features in underlying forms; both values of contrastive features need to be specified underlyingly. Thus every feature present in underlying representation has both marked and unmarked feature values. To specify features for a vowel system, the theory of Contrastive underspecification follows what has been referred to in the literature as the pairwise algorithm (Archangeli 1988).

(110) Pairwise algorithm (Archangeli 1988:192)

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 specifications as contrastive on the members of that pair
e. once all pairs have been examined and appropriate feature specifications have been marked as contrastive, delete all unmarked feature specifications on each segment

Following this procedure, the seven vowel system of the northern dialect of Ewe can be represented as in (111).

(111) Contrastive specification of Ewe vowels.

	Full specification							Contrasts	Contrastive specification						
	i	e	ɛ	u	o	ɔ	a		i	e	ɛ	u	o	ɔ	a
[high]	+	-	-	+	-	-	-	{i, e},{u, o}	+	-		+	-		
[front]	+	+	+	-	-	-	-	{ɛ, a}			+				-
[back]	-	-	-	+	+	+	-	{ɔ, a}						+	-
[low]	-	-	+	-	-	+	+	{e, ɛ}, {o, ɔ}		-	+		-	+	

All vowels are fully specified for features to begin. Consider the segments /i, e/ and /u, o/. Each pair differs only by the feature [high], so this feature is designated as contrastive and each of the four vowels is specified as either [+high] or [-high]. /ɛ, a/ differ only in the feature [front]; thus, they are specified for [front]. No other pair of segments differs in the feature [front]; therefore, all other segments are underspecified for this feature. Similarly, only /ɔ, a/ are identical in all features except [back]. Thus, they are the only segments with a [back] specification. Finally, each pair in /e, ɛ/ and /o, ɔ/ is identical in all but the feature [low]; thus, all of these four vowels are specified for some value of [low].

3.2 Implication of the proposed contrastive specification in Ewe

The specification in (111) fails in two ways. First, it does not capture the contrast between /i/ and /u/ or between /e/ and /o/ because the segments in each pair have the same feature specification. Also, the contrastive specification fails to capture the true nature of Ewe vowels based on what we already know about phonological activity in the language. For instance, the vowels /u, o/ trigger Place harmony in Ewe but are not specified for any place features in the contrastive specification. Similarly, /a/ triggers Low harmony but it is unspecified for [low] under the contrastive view of vowel specification.

Apart from the challenges mentioned above, the feature specification derived by contrastive underspecification is not enough to show the asymmetries in the vocalic processes found in the northern dialect of Ewe. Based on the feature specification of

/ɛ/, one can assume that this vowel may trigger assimilation to [+low] and [+front]; it however only triggers the latter. Thus, contrastive specification not only fails in deriving contrast between segments, it also fails in specifying features on vowels that are necessary to capture triggers and targets of various processes in the language.

In the next section, I rely on Radical underspecification to propose feature specifications for vowels in the northern dialect of Ewe. As we will see, this approach also yields spurious results.

3.3 Radical Underspecification

In the previous section, I showed how Contrastive underspecification fails to both parse the vowel inventory of Ewe and provide specifications that reflect phonological activity in the language. Here, I attempt to specify vowels in Ewe using Radical underspecification.

Radical underspecification holds that "the two values of a feature do not have the same status in phonological patterning" (Mohanan 1991:287). In other words, every feature has a dominant value, while non-dominant feature values are absent from underlying representations. This approach to underspecification also implies that all forms of redundancy are absent from underlying forms; any feature value that can be predicted must be absent from the underlying representations. Predictable features are in turn assumed to be inserted by fill-in rules, which apply during the course of derivation. The fill-in rules can be context-free or content-dependent. According to Stevens et al. (1986), cited by Keating (1988:276), fill-in rules supply "feature values without reference to context beyond the segment in question". Keating (1988) asserts that one value (the marked value) of a feature may be underlying such that a fill-in rule will have to supply the predictable value which is not specified in the underlying representation. Fill-in rules can be default rules (supplied by universal grammar based on cross-linguistic markedness) or complement rules (based on language particular markedness). Now that we are aware of the basic tenets of Radical Underspecification, let us see how the featural representation of vowels in Ewe can be modelled using this approach.

The representation in (112a) shows fully specified feature values on all vowels. I propose the fill-in rules in (113) to derive specifications consistent with Radical Underspecification in (112b). I provide motivation for the marked values of each feature below.

(112) Full specification and Radical underspecification of Ewe vowels

a.	i	e	ɛ	u	o	ɔ	a
[high]	+	-	-	+	-	-	-
[front]	+	+	+	-	-	-	-
[back]	-	-	-	+	+	+	-
[low]	-	-	+	-	-	+	+

b.	i	e	ɛ	u	o	ɔ	a
	+			+			
	+	+	+				
				+	+	+	
			+			+	+

(113) Fill-in rules

a. [ ] $\rightarrow$ [-high]

b. [ ] $\rightarrow$ [-front]

c. [ ] $\rightarrow$ [-back]

d. [ ] $\rightarrow$ [-low]

The fill-in rules in (113) are necessary to provide predictable features missing from underlying representations. I begin with the feature [high].

[high]: The choice of which value of the feature [high] is marked relates to the fact that some phonological processes in the language make reference to [+high]. For instance, Height harmony must make reference to [+high] since it is only [+high] vowels that cause the enclitic to harmonize to their height values. This suggests that [+high] must be specified in the underlying representation of vowels. This also implies that [-high] insertion be the default rule such that any vowel not specified as [+high] receives [-high] at some point in the derivation.

[low]: In Ewe, [+low] is the dominant value of the feature [low]. Recall that [+low] vowels are triggers, not targets, of harmony. Thus, [+low] is the more marked value that must be specified in the underlying representation, leaving [-low] as the default feature-filling value.

[front]: I argue that the non-redundant value of [front] is [+front], based on the Front harmony process in Ewe. Recall that, in this process, the habitual morpheme /a/ harmonizes to the [+front] feature of front vowels to become /ɛ/. This process is only triggered by front vowels, which makes [+front] the relevant value in underlying representation.

[back]: Just as the other features discussed above, [+back] is the non-redundant value of back. This is based on the Place harmony process attested in the language. Recall that the habitual morpheme /a/ is realized as /ɔ/ when it is adjacent to back vowels.

Thus, the habitual morpheme assimilates to the [+back] feature of the back vowel. Given this, [+back] must be the non-redundant value.

3.4 Implication of the proposed Radical underspecification in Ewe

Let us now turn our attention to the implications of the Radical underspecification provided in (112b). First of all, with this specification, each vowel segment is contrastively parsed. Similarly, Place harmony processes can be independently motivated, and these processes can be explained in a straightforward manner. In addition, the specification rightly predicts that only [+high] and [+low] vowels may trigger some form of height agreement process, since these are the only vowels with specifications for the features [low] and [high]. However, the specifications in (112b) fail in many regards. Given these specifications, all [+low] vowels are expected to trigger Height harmony, which contradicts the facts of Ewe. /ɛ/ does not trigger assimilation to the feature [low] in Height harmony even though all other [+low] vowels do. This implies that /ɛ/ is not specified for the feature [low] in its underlying representation.

A possible solution to this would be to posit [-low] as the non-redundant value of [low] in the underlying representation. However, this also faces some challenges, as follows. Let us assume that [-low] is the non-redundant value, and [+low] is derived by the fill-in rule in (114).

(114) [ ] $\longrightarrow$ [+low]

Following the redundancy rule ordering constraints proposed by Archangeli (1988), which states that a rule inserting a redundant features [αF] applies at the point a rule first makes reference to [αF], the default rule in (114) will apply before the harmony rule. Thus, all [+low] vowels would receive this specification before harmony applies. This is not a desirable result, because /ɛ/ would still have the potential to trigger [low] assimilation. The desired result is for all [+low] vowels to trigger [+low] assimilation with the exception of /ɛ/. Thus, the specification in (112b) does not yield the right results with regard to Height harmony.

In addition, the specifications in (112b) make the wrong markedness predictions about Ewe vowels. In Chapter 3, I make the argument that /ɛ/ is the unmarked vowel in the northern dialect of Ewe. One central implication of this is that /ɛ/ must have the fewer specifications of marked features in underlying representation. Based on my arguments in section 5 of Chapter 3 above, /ɛ/ must have a specification for [front] in the underlying representation. However, this is not the case in the specification in (112b). /a/ and /e/ have fewer features than /ɛ/. An implication of this is that /ɛ/ is more marked than /a/ and /e/ in the northern dialect of Ewe. This markedness prediction is also falsified based on the relative frequency of these vowels in the language, especially /e/. One of the characteristics of unmarked segments is that they generally have a more common occurrence in the language (Rice 2007). As I pointed out earlier, /e/ is less common than /ɛ/ in the northern dialect of Ewe. Thus, both frequency and phonological patterning suggest that /e/ is more marked than /ɛ/.

4 Discussion

In this section, I summarized the various arguments for underspecification and how it can be diagnosed. I showed that neither Contrastive nor Radical underspecification can derive the feature specifications necessary to capture the phonological processes found in the northern dialect of Ewe. I also showed that theories of underspecification are not enough to explain the asymmetries found in the vocalic processes of the language. The representations provided by Contrastive underspecification fail to distinguish certain vowels in the language. Also, these specifications are unable to capture the triggers and targets of the phonological processes discussed. On the other hand, Radical underspecification can fully distinguish each vowel in the language but fails in deriving the right specifications needed to account for the facts of Height harmony. It also makes the wrong markedness predictions about the language.

Prior to these demonstrations, I showed that the Contrastive Hierarchy cannot obtain the feature specifications necessary to account for the phonological processes seen in the northern dialect of Ewe. The Contrastive Hierarchy specifically faces challenges different from what was discussed in Nevins (2015) and referred to as the 'oops I need that' problem. Nevins (2015) points out that although it is convenient for the Contrastive Hierarchy to eliminate some features on specific segments in order to account for some phonological process when the entire phonological system of a language is considered, it may be determined that the eliminated feature is needed for some other phonological process. Nevins (2015) argues that there are some phonological processes that make reference to only contrastive features, whereas other phonological processes make reference to all features. This observation is consistent with Blumenfeld & Toivonen's (2016) observation that there may be double identity on some vowel features. Such features are active in some instances but inactive in others. These observations can account for the processes described in both Nevins (2015) and Blumenfeld & Toivonen (2016). However, in the northern dialect of Ewe, we find that the contrastive hierarchy fails to specify /ɛ/ as underspecified for [low]. This challenge is unique. While, in Nevins' observation, one can weaken the Contrastivist Hypothesis to include redundant features, this cannot be done in Ewe. The segment in question, /ɛ/, ends up being 'over-specified' for the feature [low]. A solution to this would be to propose an ad hoc rule that makes the low specification unavailable to phonological processes at an early stage of derivation. However, the literature does not provide any justification for treating /ɛ/ in this way. The only motivation for doing this would be that it works, which would pose a clear circularity issue. Furthermore, proposing such an ad hoc rule would complicate the processes described for Ewe, and this complication is not desirable.

The challenges faced by the Contrastive Hierarchy and other theories of underspecification further support my argument in Chapter 3 that no definition of contrast is sufficient for phonological representation and processing in the northern dialect of Ewe. As we have seen, relying on contrast in the representation of segments in Ewe is problematic in non-trivial ways. As such, segments should be specified for features in order to capture phonological activity and distinguish segments in the language.

In the next chapter, I summarize the major findings of this thesis and formulate a number of concluding remarks.

Chapter 7 Conclusion

1 Introduction

In the preceding chapters of this thesis, I discussed the harmony processes found in the northern dialect of Ewe. I showed how these processes contradict what has been proposed in earlier scholarly works to account for all dialects of the language. I also showed how the various vowel harmony processes can be explained by relying on the tenets of Lexical Phonology and Optimality Theory. In this chapter, I highlight the main arguments that I put forward in my analyses of the vowel harmony of the northern dialect of Ewe. I also recapitulate why phonological contrast is not the crucial factor in parsing the vowels of Ewe. I begin with a summary of the relevant vowel harmony processes.

2 Ewe vowel harmony

Previous studies on vowel harmony in Ewe focused on proposing a system that applies to all dialects of Ewe. While these studies have set the ground for further studies, I showed that the general descriptions offered in these studies overlooked data that is critical to systematic differences that exist between major dialects of the language. In Chapter 2 of this thesis, I highlighted some of the data that has been previously overlooked. Recall that Clements (1974) proposed that the enclitic vowel, represented as /e/ underlyingly, harmonizes to the [high] or [low] features of the root vowel. He further proposed that the enclitic vowel harmonizes when it serves as either the 3SG or focus marker. However, in the northern dialect of Ewe, the general process described by

Clements must be divided into two separate ones, depending on whether the enclitic is a focus marker or the 3SG enclitic. When the enclitic is functioning as the 3SG, it harmonizes to the [+high] and [+low] features of the root vowel (Height harmony) except when the root vowel is /ɛ/. In that instance, /ɛ/ harmonizes to the [-low] feature of the enclitic. In instances where the enclitic functions as the focus marker (Low harmony), /e/ only harmonizes to the [+low] feature of the root vowel. Thus, [+high] vowels do not trigger Low harmony.

Clements also observed that /a/ harmonizes to the place feature of the enclitic /e/. He proposed that this process applies before harmony. In my review of the literature and related data from the northern dialect of Ewe, I found that this process does not only target /a/ when it is adjacent to the enclitic. Rather, /a/ is targeted when it is adjacent to any vowel. Thus, the full generalization is that, in the northern dialect of Ewe, /a/ harmonizes to the place feature of adjacent vowels.

Another major finding is that, in the Low harmony process, /ɛ/ is a trigger but not a target. Also, Place harmony does not apply when /a/ is adjacent to the enclitic /e/ when this vowel functions as the focus marker.

Together, these observations posed a significant question about the representation of vowels in the northern dialect of Ewe, and how the harmony processes can be accounted for in light of current theory. This question was tackled from Chapter 3 through Chapter 6, which I summarize in the next section.

3 Representation of vowels and the asymmetric behaviours of /ɛ/ and /a/

The question regarding the representation of vowels in the northern dialect of Ewe pertains to why /ɛ/ and /a/ are targeted by Height and Place harmonies, respectively, but not by Low harmony. To address this question, I argued that, first, we need to understand the nature and representation of vowels in the language. In that direction, I explored various theories of feature (under-)specification (i.e., Radical and Contrastive underspecification as well as the Contrastive Hierarchy) in order to propose a system of features that can capture the vowel inventory of Ewe. I argued in Chapter 3, and later in Chapter 6, that methods that rely on contrast to parse the inventory of the northern dialect of Ewe are inadequate, as they fail to capture phonological activity within the dialect. Following Reiss (2017), I instead proposed specifications for the vowels in the northern dialect of Ewe based on phonological activity. Given the asymmetric behaviours of /ɛ/ and /a/, I proposed that /ɛ/ is underspecified for [low], and that /a/ has no place specification.

Building on these specifications, I proposed that the harmony processes of Ewe can be classified into lexical versus post-lexical derivations. Height and Place harmonies are lexical processes, and Low harmony is a post-lexical process. I made this distinction based on the characteristics exhibited by these processes. I also supplemented my argument using cross-linguistic data where necessary. Separating the processes in the northern dialect of Ewe is in fact critical to accounting for the asymmetric behaviour exhibited by /a/ and /ɛ/ in the harmony processes. In Chapter 4, I proposed violable constraints to capture the required specifications. Building on the tenets of Stratal OT, I showed how different rankings of constraints at different levels of derivation can capture the fact that /ɛ/ is a target of Height harmony but a trigger of Low harmony. For instance, in Chapter 5, I showed that AGREE(FT), whose high ranking is responsible for the Place harmony processes observed at the word level, is ranked lowly at the phrasal level of derivation; thus, /a/ is not targeted for Place harmony at this latter level. Similarly, the relative rankings of AGREE(LOW) and DEP(-LOW) play a vital role in selecting the attested candidates as optimal. In Height harmony, which applies at the word level, AGREE(LOW) is ranked higher than DEP(-LOW). This ranking ensures that candidates can have [-low] inserted without violating a highly ranked constraint. Thus, /ɛ/ can be realized as [-low] in the Height harmony process. However, at the phrasal level, both constraints are ranked highly and equally. Thus, candidates incur a violation of a highly ranked constraint if [-low] is inserted on them. The central implication of this analysis is that both /ɛ/ and /e/ can receive a [+low] specification in the Low harmony process, instead of [-low], to satisfy AGREE(LOW).

4 Concluding remarks

My observations about the specification of vowels in the northern dialect of Ewe and the failure of both the Contrastive Hierarchy and of different theories of underspecification call into question the role of contrast in the phonological computation of the northern dialect of Ewe. I have argued that the grammar of this dialect of Ewe does not need to make reference to contrast in phonological computation. Similarly, reference to contrast is not necessary in the phonological representation of vowels. This argument is in line with Reiss' (2017) position about the role of contrast in phonological processing. However, my position is somewhat different from that of Reiss. While he argues for no contrast in phonological computation cross-linguistically, my view is that contrast is relevant in languages where it can account for and predict phonological behaviour. In those languages where reference to contrast is insufficient to predict phonological behaviour, then phonological activity should be considered in explaining the processes seen in the language. Minimally, this also suggests that phonological computation can involve different properties of phonetically similar phones. More research is needed to investigate these questions more in depth.

Further, the Stratal OT analysis I proposed throughout this study highlights the nature of the grammar of Ewe. We saw that, at the stem level of derivation, the grammar allows for segments to be impoverished such that only features that are needed to account for phonological activity are kept within representations. This impoverished specification, in turn, requires a grammar that strictly constrains representation at later levels of derivation. Similarly, we saw that the grammar of Ewe exhibits a preference for certain feature values. Thus, the harmony system is constrained by feature preservation rather than directionality. It is also shaped by a multi-level processing of the phonological computations, which itself enables a straightforward explanation for the asymmetric vowel behaviours attested in the language.

More generally, the deviation of the northern dialect from what has been previously proposed as an analysis for the general language group highlighted the need to study individual dialects of Ewe. While this larger topic transcends the scope of the current work, it has the potential to bring to light variations that exist between these dialects, which will, in turn, improve our understanding of the language as a whole.

5 Future research

There are still some unanswered questions that fall outside of the scope of this thesis. For instance, it is still unclear what role language specific markedness plays in the processes attested in the language. Knowledge of this is important as it will help predict the behaviour of vowels and thus, better contextualize our undertanding of the phonological processes observed in the data. Similarly, other dialects need to be examined to ascertain whether or not harmony is attested and, if so, what the nature of these harmony systems are.

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