PROSODIC STRUCTURE-DEPENDENT SEGMENTAL ALTERNATIONS

4.1 Introduction

In this chapter, we will investigate several cases of segmental alternations that are best analyzed as depending on binary foot structure, either foot boundaries or headedness.

There are quite a few cases in the literature that are ambiguous as to whether stress or binary feet are responsible for (some aspects of) segmental alternations. After a brief survey of a few of these, we turn to case studies from Mwotlap, Kera and Ibibio.

In **Old Norwegian**, a Scandinavian language spoken in High Middle Ages (roughly XI – XIV centuries) described by Hagland (1978), the non-low unstressed vowels agree in height with the initial stressed vowels. In the behavior of low vowels, the length distinction has to be taken into consideration: long low vowels trigger a lowering of high vowels to mid, whereas short low vowels do not.

(1)   Vowel System of Old Norwegian

Short: Long:

i ü	u		i: ü:	u:
e ö	o		e: ö	o:
æ	a		æ:	a:

With the exception of loanwords and weakly accented prefixes, the word initial syllable carries the stress.

(2)

a.   **[+high] stressed vowel**   b.   **[-high] stressed vowel**

ínni	'inside'	*ínne	dȍmdo	'sentenced'	*dȍmdu
úndir	'under'	*únder	θésser	'these'	*θéssir
pínur	'plagues'	*pínor	ópet	'open'	*ópit
súnir	'sons'	*súner	rétto	'right'	*réttu
sȕstur	'sister'	*sȕstor	tóko	'took'	*'tóku

It might appear that all examples in (2) above show is that the language inherited harmonic stems from Old Norse, since we do not see any alternations. However, at least with respect to the plural suffix, that cannot be true: the suffix does appear as *-er* (with non-high vowel) when it follows a non-high vowel. Another issue in classifying the Old Norwegian case as one dependent on stress or the head of an unbounded foot, is that the stress is initial in all examples available to us, so the data is ambiguous as to whether it is the stressed or the initial vowel that causes the height harmony. In addition, the harmony clearly is sensitive to vowel length, in that long vowels are always followed by mid vowels, regardless of the height of the initial long vowel:

(3)

a.   **[+high] stressed vowel**   b.   **[-high] stressed vowel**

vá:rer	'our'	læ:rder	'learned'
á:re	'year'	væ:re	'were'
vá:rom	'owned'	mæ:lto	'said'

Similarly, regardless of the harmony, the final (unstressed) vowels of trisyllabic words are uniformly mid:

(4)

kælingom	'woman'
stúkunne	'chapel'
játtado	'affirmed'

Finally, short low vowels can be followed by either high or mid vowels:

(5)

ádrum	'other' (Dat sg masc)
ǽllu	'all' (Dat sg neut)
ǽller	'all' (Nom pl masc)

Both Hagland (1978) and Majors (1998) analyze the contrast between (3) and (5) as a condition that reduces all vowels outside the initial bimoraic foot to mid vowels.

Tzeltal (Slocum (1948), Kaufman (1971), Brown (1996), Dickey (1999)) is a Mayan language spoken in Southern Mexico, mostly in the state of Chiapas. The language currently has 150,000 speakers; the data reported here are taken from Brown (1996) and Dickey (1999) and are from a community of Tenejapa, which has about 10 thousand speakers. Tzeltal exhibits allomorphy similar to the type we will see later in this chapter, in the language called Mwotlap, and Northern Sámi, Estonian, and Shipibo that we examine later in this dissertation.

The vowel system of Tzeltal includes five vowels:

(6)

	Front	Central	Back
High	i		u
Mid	ɛ		o
Low		a	

The consonant system of the language is much richer, and includes 21 contrastive segments[1]:

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[1] I changed the transcription somewhat from different systems used in Kaufman (1971), Brown (1996) and Dickey (1999) for convenience.

(7)

	Bilabial	Apico-dental	Postalveolar	Palatal	Velar	Glottal
Stops voiceless	p	t			k	ʔ
voiced	b²					
Affricates		ts	tʃ			
Glottalized stops	pˀ	tˀ			kˀ	
Glottalized affricates		tsˀ	tʃˀ			
Fricatives		s	ʃ			h
Nasals	m	n				
Laterals		l				
Tap		ɾ				
Glides	w			j		

Tzeltal stress is always word-final, except for Spanish borrowings.

The allomorphy that we are interested in is the allomorphy of the perfective suffix -*oh*/-*ɛh*. The suffix is reported to be extremely productive, and is taken by transitive verbs to form the perfective. As the data below shows, when the stem is monosyllabic, the perfective suffix surfaces as [oh]:

(8)

Transitive Monosyllabic Verbs (Imperfective)	Perfective

ja s-mah 'he hits something'   s-mah-oh 'he has hit something'
ja j-il 'he sees something'   j-il-oh 'he has seen something'
ja s-pas 'he makes something'   s-pas-oh 'he has made something'
ja s-nɛtˀ 'he squashes something'   s-nɛtˀ-oh 'he has squashed something'
ja s-nuts 'he chases something'   s-nuts-oh 'he has chased something'
ja j-al 'he tells something'   j-al-oh 'he has told something'
ja s-tsak 'he takes something'   s-tsak-oh 'he has taken something'
ja s-jom 'he gathers something'   s-jom-oh 'he has gathered something'

In the left-hand column, we see the 3rd person singular forms of verbs, with required person marking since these monosyllabic roots are bound morphemes. In the right-hand column, the trimorphemic perfective forms of the verbs are given, with the perfective

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[2] The bilabial stop is implosive when not word-final.

suffix appearing as [oh] in all of the above forms. Other suffixes can be concatenated with the perfective forms, without changing the shape of the perfective suffix:

(9)

s-pas-oh   'he has made something'
s-pas-oh-ik   'they have made something'
s-pas-oh-bɛ   'he has made something for someone'
s-pas-oh-iʃ   'he has already made something'

When the stem itself has more that one syllable, on the other hand, the perfective suffix surfaces as [ɛh], as is illustrated below with disyllabic stems:

(10)

Transitive Monosyllabic Verbs (Imperfective)	Perfective
ja s-majlij 'he waits for something'	s-majlij-ɛh 'he has waited for something'
ja s-makˀlin 'he feeds someone'	s-makˀlin-ɛh 'he has fed someone'
ja s-tikun 'he sends something'	s-tikun-ɛh 'he has sent something'
ja s-maklij 'he listens to something'	s-maklij-ɛh 'he has listened to something'

The allomorph -ɛh also surfaces invariably if other suffixes are added between the root and the perfective suffix itself:

(11)

Imperfective	Perfective
ja s-hol-intaj 'he thinks about it'	s-hol-intaj-ɛh 'he has thought about it'
ja h-pakˀ-antaj 'I patch it'	h-pakˀ-antaj-ɛh 'I have patched it'
ja s-kutʃ-laj 'she carries it repeatedly'	s-kutʃ-laj-ɛh 'she has carried it repeatedly'
	cf. s-kutʃ-oh 'she has carried it'

While the allomorphy of the perfective suffix clearly depends on following the initial syllable as opposed to following any other syllable in the word, it can be analyzed as either dependent on the difference between being footed together with the initial syllable and being unfooted at all; the analysis would be based on the stipulation that it is only the

initial two syllables that comprise a binary foot, and the rest of the string is unfooted. While ambiguous, such an analysis is certainly possible.

Koniag Alutiiq is a group of dialects of Alutiiq (Pacific Yupik) that has the most well-studied phenomenon of foot-structure influenced fortition or tensing. The language has a left-to-right iambic stress system with main stress on the leftmost foot (Van de Vijver (1998)). Closed initial syllables are always stressed, unlike closed syllables in the rest of the word:

(12)

a.   án.ci.qùa   'I'll go out'
        áp.qaɣ.làa.qa   'I always ask her'

Fortition occurs for all onset consonants that are foot-initial and involves 'pre-closure' and complete lack of voicing for voiceless consonants. Fortition makes consonants 'more audible' (Leer (1942, 1989), van de Vijver (1998)). According to the sources, fortition always occurs foot-initially (fortis consonants are bold and underlined):

(13)
        kúm.**l**a.c̀i.**w**i.l̀i.ja.**q**u.tà.qu.**n**i.k̀i
        'if he (refl) is going to undertake constructing a freezer'

        mə́χ.**t**a.qán   'if she fetches water'
        nə́χ.**t**aá.qan   'if she (always) eats'
        qa.já:.kun   'by boat'
        qa.ját.xun   'by boats'

Fortition is claimed to be a key diagnostic of foot structure in Alutiiq. Leer (1985, 1989) describes fortition as having two main phonetic traits: complete voicelessness in voiceless obstruents, and preclosure. Preclosure apparently is similar to gemination, but does not close the preceding syllable (if it is open), thus a fortis consonant can occur even with a preceding closed syllable.

There is no distinction between a fortis geminate and a lenis geminate. Since fortition can occur with a preceding closed syllable, it cannot be the same as canonical gemination with a consonant linked to both coda and onset of the following syllable (see Topinzti (2008) for arguments motivating onset geminates in some languages). Leer sets the syllable template in Alutiiq to CV(V)(C) for non-initial syllables (initial syllables allow complex onsets in borrowings, and vowel-initial medial syllables may be created through fricative deletion).

The environment for fortition cannot be expressed merely in terms of either stressed or unstressed syllables without resorting to disjunctive rule statements. Leer's insight is that if we characterize all the strings above as feet we have a coherent environment for assigning fortition.

Several quantitative phenomena, such as degemination, vowel lengthening and shortening are also found in Koniag Alutiiq. Most researchers (see Leer (1985, 1989), Hewitt (1992, 1994), Baković (1996), Van de Vijver (1998), among others) attribute these quantitative adjustments to the iambicity of Koniag foot, as the adjustments serve to promote an optimal iambic foot on the surface.

Even though it seems clear that the foot-initial fortition cannot be triggered by the same cause as other quantitative adjustments, since consonants are only moraic in the coda of the initial syllable, fortition might have originated as such: if a consonant was geminated to occupy an onset position in the first syllable of the foot as well as coda position of the syllable of the preceding foot, the final, head syllable of a foot would be heavier than the initial, or non-head syllable of that foot, creating a better iambic foot. In fact, there still exists a phenomenon in Koniag Alutiiq, gemination, which allows a syllable with a schwa that cannot be lengthened to surface as its own foot word-initially, rather than to remain unparsed:

(14)

| /pəLu/-/t/ | (**p**əLút) | 'leaves' | (no gemination) |
| /pəLu/-/i/ | (**p**ə́L)(Luî) | 'its leaves' | gemination to prevent *pə(**L**uî) |

Moreover, gemination can also occur word-medially after a schwa that heads an iambic foot, perhaps suggesting that geminates in this position are also counted as moraic:

(15)

/agajutə/-/ma/-/ang/	(aɣá:)(j̠utə́m)(máɣ)[3]	'O my God' (vocative)
/pi/-/sur/-/pəkə/-/nii/	(p̠isúɣ)(pəkə́n)(n̍í)	'without my hunting'
/qəčəɣ-uq/	(q̠əčə́ɣ)ɣuq	'she is running'

In addition, degemination is also present in the language in the context where an underlying geminate follows a non-head syllable:

(16)

/atur/-/nnir/-/tuq/	(atún)(nirtúq)	'he stopped V-ing'[4]	(no degemination)
/iqʟu/-/nnir/-/tuq/	(íq)(L̠uníɣ)tuq	'he stopped lying'	(degemination)

Thus, while synchronically foot-initial fortition and (de)gemination in the language seem to be different phenomena, they might have started out as a uniform phenomenon driven by a constraint on foot form. This suggestion would at least begin to account for the fact that there is no contrast between lax and tense geminates, as tensing itself started out as geminat consonants, but was reinterpreted as tensing except in some cases.

Note that Koniag fortition differs from other foot-structure sensitive phenomena that we discuss in this dissertation in that the foot structure does not seem to **restrict** a differently motivated phenomenon like Nganasan intervocalic lenition or Kera vowel harmony (see below), but rather **cause** the alternation that marks the foot structure of the language, making it more similar to alternations that are influenced by stress rather than foot structure. The origin of the alternation in Koniag, if it indeed was a quantity-adjustment phenomenon, might account for this typological discrepancy: other foot structure-influenced phenomena started independently of foot structure, and later acquired an

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[3] Monomoraic final feet are common in Koniag due to vowel shortening in final syllables.

[4] Leer (1985), where this piece of data comes from, does not give a gloss for the root of this verb.

additional restriction that limited the occurrence of certain alternations to a particular position within a foot.

Similar to what the situation used to be in Koniag is the situation in **Huariapano**, a recently extinct Panoan language close to Shipibo that we will be investigating in the following chapter, as described in Parker (1994) and Parker (1998). Parker (1998) proposes that coda [h]-epenthesis is a rhythmic process. Parker argues that the coda [h]-epenthesis, though rhythmic, is not always directly related to stress, and there are cases where the two (stress assignment pattern, on the one hand, and /h/-insertion, on the other hand) have to be accounted for with two different autosegmental tiers, the stress tier and the foot structure tier.

In Huariapano, main stress occurred on the first syllable if the second was open, and on the second syllable if it was closed[5]:

(17)

a.   βí.na   'male'
        kóʂ.ni   'beard'
        bì.na.bó.ra   'males' (emphatic)
        hí.wi   'branch, stick'
        wín.ti   'oar, paddle'
        rís.βi   'rope'
        pó.a   'potato'

b.   ja.wíʃ   'opossum'
        hon.tsís   'claw, fingernail'
        ta.póʔ   'cot'
        ʂa.βín   'bee'
        ka.nó.ti   'bow (weapon)'

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[5] There are forms in Huariapano where primary stress falls on the second light (open) syllables. Words with this stress pattern form about a quarter of disyllabic nouns in the language (Parker 1994:98). Below are some of the examples of words with lexical stress:

βis.má   'to forget'
uʃ.tá   'garbage'
jo.βí   'witch'

bɨ.ná.bo	'males'
ram.βo.ʂó.βo	'knees'

Huariapano does show secondary stress, which is left-, instead of right-oriented:

(18)

tʃìh.kɨ.na.mán	'corner'
jò.mɨ.rà.no.ʂih.kájn	'they will hunt'
mà.na.páj.ri	'I will wait'
jò.mɨ.rà.no.ʂí.ki	'he is going to hunt'
kù.βjaj.βa.ʂí.ki	'I cooked'
wà.nɨ.ki.ráŋ.ki	'they have returned'
jò.mɨ.rày.βa.kan.ʂí.ki	'they hunted'
kàj.ba.kan.ʂí.ki	'they went'

Closed syllables in Huariapano attract secondary stress as well as primary stress:

(19)

ma.nàn.kih.ká.si	'I am going to speak to you'
mi.βòm.bi.rá.ma	'you (pl)'
kɨ̀.na.mah.kán.ki	'when they called'
ih.kàʂ.tʃan.ká.ri	'they will shake with fear'

The insertion of /h/ occurs in codas of odd-numbered syllables before voiceless onsets. The quality of /h/ varies depending on the nature of the previous vowel. It has the following allophones: [h] after [a], [ç] after [i], [x] after [ɨ], and voiceless glide [w̥] after [o]; in onset position, /h/ only appears word-initially and surfaces as [h], where it is phonemic, as the following minimal pairs illustrate (Parker 1994:96-7):

(20)

há.naʔ	'tongue'
á.noʔ	'paca rodent'
ká.naʔ	'macaw'

Following Parker (1994, 1998) and Elías-Ulloa (2003), I do not show the allophones of /h/ in the Huariapano data discussed here.

Epenthetic /h/ occurs word-internally in coda position before voiceless consonants. Epenthesis does not occur initially if the syllable has main stress; neither does it occur if a syllable already has a coda.

Huariapano /h/ insertion occurs in the left syllable of a disyllabic foot. Elías-Ulloa (2003) schematizes the epenthesis in the following way:

(21)

    #(σh.σ)(σh.σ)(σh.σ)…

Quite conspicuously, the scheme above does not show the position of stress, though it does show the foot structure needed to correctly predict the location of the coda [h]-insertion. The foot structure shown does not always correspond with the position of stress, which is certainly not assigned in a syllabic trochee left-to-right fashion, but rather obeys a set of complex requirements outlined above.

The following examples of rhythmic /h/-insertion are all from Parker (1998). The inserted [h]s are underlined and in bold face for visibility:

(22)

a.	no**h**.póʂ	'snail'
	tʃɨ**h**.kɨ.na.mán	'corner'
	jò.mɨ.rà**h**.ka.tí**h**.kajn	'they hunted'[6]
	kɨ**h**.pĩn	'I open'
	βɨ**h**.tsa.káŋ.ki	'they laughed'
	pa**h**.tsá.kɨ	'we washed'
	i**h**.kàʂ.tʃan.ká.ti	'they will shake with fear'
b.	ì ʃ.to.kí.ra	'although he may run'
	ná.kaʔ	'flea'
	βoʂ.káʔ	'head'
	pí.kɨ	'he ate'

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[6] In this example, *jò.mɨ.rà**h**.ka.tí**h**.kajn* (hunt-PAST-3RD PL), the suffix /-ka.'ti/ has a lexical stress so that it prevents the next closed syllable from attracting stress.

ma.níʃ	'jungle'
ka.nó.ti	'bow'
pa.já.ti	'hand-held fan'
pà.ja.tí.ra	'hand-held fan (topic)'
ní.tɨ	'day'
nɨ**h**.tí.no	'day (locative)'

As noted above, the insertion has some restrictions, one of which is that the onset of the following syllable has to be voiceless. This restriction accounts for the absence of epenthesis in such forms as ĭʃ.to.kǐ.ra 'although he may run'. The form with /h/-insertion in the initial syllable of the second foot is ungrammatical: * ĭʃ.to.kǐ**h**.ra. The absence of insertion in the first syllable of the form is due to the already present onset [ʃ]. The same explanation applies to the form βoʂ.káʔ 'head': the initial syllable has a coda, hence there is no /h/ epenthesis.

An additional restriction prevents epenthesis in initial syllables: the insertion does not apply in the first syllable of the word if that syllable carries primary stress. This additional condition accounts for the absence of /h/-insertion in forms like ná.kaʔ 'flea' and ní.tɨ 'day' in (22b) above. The minimal contrast is with the form nɨ**h**.tí.no 'day (locative)': the main stress in this form is shifted onto the second syllable, thus leaving the initial one be available for the epenthesis. With other conditions on /h/-epenthesis satisfied, the first syllable surfaces with a coda.

According to Parker (1994), coda /h/ epenthesis is quite regular. Out of 115 morphemes, only 9 are exceptional and do not undergo epenthesis even if all the conditions we discussed above are met. The following morphemes are exceptional in that they show no /h/ epenthesis in the initial unstressed syllable before a voiceless consonant:

(23)

kɨ.pú.ki	* kɨ**h**.pú.ki	'he/it closed'
tʃu.ʂí.kɨ	*tʃu**h**.ʂí.kɨ	'he/it dried (up)'
hi.kí.ki	*hi**h**.kí.ki	'he/it entered'

Apart from additional conditions on /h/-epenthesis, like the voicelessness of the following onset, the situation in Huariapano is similar to what we have hypothesized is the diachronic source of Alutiiq degemination: both phenomena are related to promoting optional foot structure, rather than to a segmental process that is restricted by foot structure.

Several more detailed case studies are presented in this chapter. First, we will present two cases of vowel harmony, especially useful here as we can compare the properties of foot-dependent vowel harmony with those cases of vowel harmony presented in the previous chapter, i.e. cases that involve reference to stress.

Mwotlap vowel harmony will be investigated first. The pattern shows that the domain for the harmony is both morphological and prosodic, i.e. it depends on foot boundaries as well as difference between roots and affixes, in addition to underlying representations of two classes of prefixes. It is crucial that, synchronically, stress plays no role in determining whether or not certain vowels surface as harmonic.

The next case study presented here is from the language Kera, where there is a vowel-sonority alternation that, I argue, shows where prominence is placed in the language. Secondly, Kera has [±front] vowel harmony that is restricted by foot structure.

Next, we turn to Ibibio that has voiceless stop lenition also dependent on the foot structure of the language.

4.2 Case Study: Mwotlap Vowel Harmony

Mwotlap, or Motlav, is described as having a phonological phenomenon of 'vowel shifting' (Codrington (1885), Kasarhérou (1962), François (2000)), where a number of prefixes change their vowel to agree with that of the following root. This process, however, applies only to one type of root, namely CV roots, but is blocked in roots of

CCV shape. Given historical facts and synchronic phonotactics of the language, the 'vowel shifting' alternation seems to depend on prosody.

Mwotlap is an Oceanic language spoken in Northern Vanuatu (Banks Is.), on the island of Mwotlap/Motalava, by approximately 1800 speakers. It is geographically and historically close to Mota, a more conservative (François (2000)) language, which was first described in detail by Reverend Codrington (1885).

4.2.1 Relevant Basics

Mwotlap has 16 consonants: /^{k}p^w, ^{ŋ}m^w,^{m}b, w, p, m, t, ^{n}d, s, n, l, j, k, ɣ, ŋ, h/. Underlying /p/ surfaces as [v] in the onset position, and as [p] in the coda[7]:

(24)

a.　　/pnʊ/　　　　vʊnú　　　　'country'
　　　/na/-/pnʊ/　　napnʊ́　　　'the/a country'
　　　DEF/INDEF-country

b.　　/wjit/　　　　wiɟ́it　　　　'octopus'
　　　/na/-/wjit/　　nawɟ́it　　　'the/an octopus'
　　　DEF/INDEF-octopus

The vowel system has no long vowels or diphthongs and it contains the following elements: /i, u, ɪ, ʊ, e, o, a/. The language's syllable structure is (C)V(C), i.e. both codas and onsetless syllables are allowed; however, there are no complex codas or onsets in the language. Restrictions on complex onsets are responsible for several alternations in the language such as **epenthesis**:

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[7] François (2000) has /v/ in the consonant inventory, and [p] is derived on the surface in the coda position. Given that this segment is reconstructed as *p for Proto-Oceanic, I set up /p/ as underlying. Phonotactically, however, it does not seem to make any difference.

(25)

a.	/mtij/	mitij	'sleep!' (imperative)
  cf.	/ni/-/mtij/	nimtij	'he/she sleeps' 3sg

b.	/mtiɣ/	mitiɣ	'coconut'
  cf.	/le/-/mtiɣ/	lemtiɣ	'in the coconut'

c.	/pnʊ/	vʊnʊ	'country'
  cf.	/le-pnʊ/	lepnʊ	'in the country'

In first examples in (25), we see epenthesis that breaks up onset clusters if the first of the two consonants cannot be syllabified to the previous syllable like in the second examples in (25)[8], where the root is preceded by a prefix of the shape CV. Note the quality of the epenthetic segments: it is not a particular vowel that epenthesizes to break up the banned complex onsets; rather, the epenthetic vowel is fully harmonized with the vowel that follows it in the next syllable. This observation will become important when we discuss vowel harmony in certain prefixes later in this case study.

4.2.2 Stress

Synchronically, Mwotlap has only one stress per word, always on the last syllable. It is essential, however, to sketch the historical stress system of the language, since it is the key to understanding some aspects of the 'vowel shifting' phenomenon that concerns us in this chapter.

Former linguistic stages of Mwotlap followed Proto-Oceanic in having mainly open syllables of the form (C)V (Ross (1998)). The closed CVC syllables of Mwotlap are obviously an innovation, and were evidently formed through unstressed vowel syncope (François (2000)).

The basic stress rules of pre-Mwotlap included a primary stress on the penultimate syllable of the phonological word, and 'secondary stresses on every second syllable

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[8] An alternative explanation could be some sort of Minimal Word requirement here, but see the examples below.

towards the left of the word' (François (2000)). In other words, the pattern can be described as right-to-left syllabic trochee. On the way to its modern stage, all post-tonic vowels in the language were deleted, causing closed (CVC) syllables to appear word-finally. Below are some examples of pre-Mwotlap and modern language place names and nouns as reconstructed in Ross (1998):

(26)

	Pre-Mwotlap	**Mwotlap**	**Gloss**
a.	*mʷòtaláva	ᵑmʷotlap	'Mwotlap island'
	*àlakóna	alkon	'Gaua island'
	*àravéŋa	ajveŋ	'Ravenga islet'
	*àmʷosína	aᵑmʷsin	'Mosina village'
	*àvalúwa	apluʊ	'Valuwa village'
b.	*àvanùaláva	apnʊlap	'Vanua Lava island'
c.	*vanúa	vʊnʊ (/pnʊ/)	'country'
	*wuríta	wiɟit (/wɟit/)	'octopus'
d.	*ᵏpʷóe	ᵏpʷo	'pig'
	*ɣáu	ɣe	'fish-hook'

As can be seen from the above examples, not only post-tonic, but all the pre-tonic vowels were lost in the language. In other words, all unstressed vowels fell out, creating closed syllables in many cases. Words with four open (CV) syllables were eventually reduced to two closed (CVC) syllables (26a), or from six to three (26b). Yet other words shortened from three syllables to one (open or closed) syllable with complex onset (26c); disyllabic words were shortened to monosyllables (26d). In all of the examples, only stressed syllables were retained in the language, while unstressed vowels were lost.

The evolution of stress from the penultimate to the final syllable is easy to understand from the deletion rules outlined here; it is very similar to the evolution of stress from Latin to French. More important, for out present purposes, is that syncope of unstressed syllables seems to have **preserved** the foot structure: a disyllabic and bimoraic CVCV

foot, for example, would be turned into monosyllabic, but still bimoraic CVC foot, where the second mora would dominate the coda consonant, for example:

(27)

a. *(àva)(lúwa)   (ap)(lʊw)   'Valuwa village'
b. *(àva)(nùa)(láva)   (ap)nʊ(lap)   'Vanua Lava island'

It is not entirely clear from these data, however, whether the light syllable in (27b), which resulted from the loss of an unstressed onsetless vowel, is footed with one of the closed syllables or left unparsed. I will argue that there are no degenerate feet in Mwotlap, since it is essential for our understanding of vowel harmony.

4.2.3 Vowel Harmony

Vowel harmony has traditionally been called 'vowel shifting' in the literature, perhaps to emphasize the fact that vowels harmonize in all features, producing vowels identical to their triggers. The phenomenon has customarily been presented (Codrington 1885, Kasarhérou 1962) as involving a series of prefixes, e.g. the definite/indefinite determiner /nA-/, verbal prefix /nA-/, the perfect marker /mE-/, and 'numeralizer' /pE-/. These prefixes surface as single consonants with vowel-initial roots, and 'borrow' the vowel features from the stems that are consonant-initial[9]:

(28)

a. /nA/-/ulsi/   [nulsi]   'the/a summit'
    /nA/-/ᵐbɪ/   [nɪᵐbɪ]   'the water'
    /nA/-/ɣit/   [niɣit]   'the/a louse'
    /nA/-/ɣom/   [noɣom]   'the/a disease'
    /nA/-/laŋ/   [nalaŋ]   'the/a fly'

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[9] The underlying forms of the prefixes, with a capitalized vowel, are the ones François (2000), among others, gives to distinguish these prefixes from non-alternating ones. Essentially, these underlying forms indicate that there is some diacritic feature [variable] on the vowels of these prefixes. I preserve this notation in the forms in (28), but argue that the underlying forms of these prefixes are set up incorrectly, and discuss the underlying forms of varying prefixes that do not need to refer to a diacritic specification later in this section.

/nA/-/sɪm/	[nɪsɪm]	'the money'
/nA/-/ᵏpʷo/	[noᵏpʷo]	'the/a pig'
/nA/-/pʊj/	[nʊvʊj]	'the/a volcano'
/nA/-/wis/	[niwis]	'the/an owl'
/nA/-/ᵏpʷti/	[niᵏpʷti]	'the/a head'
/nA/-/lɪt/	[nɪlɪt]	'the/a pudding'
/nA/-/ᵏpʷet/	[neᵏpʷet]	'the/a taro'
/nA/-/hij/	[nihij]	'the/a bone'
/nA/-/ɣe/	[neɣe]	'the/a fish hook'
/nA/-/kumaj/	[nukumaj]	'the/a sweet potato'
/nA/-/ⁿdokta/	[noⁿdokta]	'the/a doctor'

b.			
	/pE/-/jʊ/	[vʊjʊ]	'two'
	/pE/-/pet/	[vevet]	'four'
	/pE/-/pɪh/	[vɪvɪh]	'how many'

The prefixes in Mwotlap are divided into 'shifting' and 'non-shifting' in traditional terminology, i.e. those that harmonize to the first vowel of the stem and those that do not. Among the non-shifting prefixes is the following 3ʳᵈ person singular prefix *ni-*:

(29)

ni-in	'he/she/it drinks'
ni-et	'he/she/it sees'
ni-van	'he/she/it goes'
ni-ɣen	'he/she/it eats'
ni-ᵏpʷʊŋ	'it becomes night'
ni-siseg	'he/she/it plays'
ni-vɪjtitit	'he/she/it fights'
ni-vap	'he/she/it says'

As we can observe, the roots in the data above contain four different vowels, but the 3ʳᵈ singular prefix that is concatenated with all of these roots stays *ni-* no matter what vowel follows it in the root. In addition, the prefix does not show up without its vowel when it is concatenated with a root that is vowel-initial (29a). The same pattern can be detected with one of the Locative prefixes, *-a*, a nominal prefix *na-,* and prefix *le-* (that is considered Locative in the sources, but is glossed as 'in' as opposed to 'at'): the above prefixes keep their quality regardless of what root follows it:

(30)

a. Locative prefix *a-* (shows up mostly with place names):

a-pnʊlap	'at Vanua Lava'
a-ɣʊ	'at Gaua'
a-ŋmʷew	'at Maewo'
a-ŋmʷsɪn	'at Mosina'
a-ŋmʷot	'at Mota'

b. Nominal article[10] *na-*

na-naw	'the sea'
na-hij	'the bone'
na-ɣe	'the fish hook'
na-sŋmʷal	'the rain'
na-ᵏpʷo	'the pig'
na-he-k	'my name'
na-lɪt	'the pudding'
na-ɣmel	'men's house'
na-wis	'owl'
na-lo	'the sun'
na-ⁿdokta	'the doctor'
na-pnʊ	'the country, island'

c.   Locative prefix *le-*

le-naw	'in the sea'
le-sŋmʷal	'in the rain'
le-he-k	'in my name'
le-ɣmel	'in the men's house'
le-lo	'in the sun'
le-pnʊ	'in the country'
le-lɪt	'in the pudding'

It is unclear, at least synchronically, why there are two sets of prefixes in the language (the harmonizing ones and the non-harmonizing ones), but it is possible that, historically, the non-harmonizing prefixes used to be prepositions. Assuming that prepositions can in some cases at least be not a part of a prosodic word, those prepositions were outside the

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[10] This prefix is glossed as 'nominal article' in François (2000) and Kasarhérou (1962), but it is unclear what the function of the prefix is. It is, however, obviously distinct from the harmonizing prefix that is glossed as definite/indefinite determiner here.

domain of stress assignment and vowel elisions that followed. It is not true, however, that we can analyze these prefixes as prepositions synchronically: the difference between prefixes, on the one hand, and prepositions and clitics, on the other hand, are clearly visible from the presence or absence of root-internal epenthesis:

(31)

a. /le/-/pnʊ/ le-pnʊ 'in the country'
/le/-/mtiɣ/ le-mtiɣ 'in the coconut'

b. /ne/-/pnʊ/ ne-vʊnʊ 'of the country'
/ne/-/mtiɣ/ ne-mitiɣ 'of the coconut'

The examples in (31a) show that one of the Locative prefixes *le-*, as part of the prosodic word, syllabifies together with the first consonant of the roots, thus creating two CVC syllables in each case. The examples in (31b), on the other hand, show that *ne-* is not part of the prosodic word since the prefix cannot syllabify with the first consonant of the root and break up an ungrammatical complex onset. The onset consequently has to be resolved through epenthesis.

The prefixes listed in (30) above, therefore, cannot be analyzed as prepositions that are outside the prosodic word synchronically. Descriptively, we have three types of prefix-like morphemes in the language, varying, non-varying, and clitic-like. Below is a summary of the morphemes mentioned in this chapter, with their meanings and the types of stems they attach to:

(32)

	Morpheme	Function	Attaches to
varying	nA- bE-	determiner ('a'/'the') indicates purpose ('for')	nouns
	mE- nE- tE-	perfect stative future	verbs, adjectives, some nouns
	tE-	Ablative	locatives
	vE-	numeralizer	numbers
non- varying	a- na- le-	Locative 'at' definite determiner Locative 'in'	nouns
clitic	ne	Genitive 'of'	nouns

In fact, there seems to be no phonological or morphosyntactic property that would separate harmonizing prefixes from non-harmonizing ones, as far as I can see. Since the explanation that the non-harmonizing prefixes do not harmonize because of some predictable property seems to be untenable, we are left with the conclusion that the prefixes in the language are divided by having different underlying representations. One of the restrictions on the vowel harmony that concerns us in this section, therefore, is what the underlying forms of alternating vs. non-alternating prefixes are. Proceeding on our hypothesis that the alternating prefixes used to be (and still are synchronically) parts of phonological words, it stands to reason to suggest that the prefixes would be tonic or non-tonic, depending on the length of the following root. The non-alternating prefixes, on the other hand, are diachronically not parts of phonological word (former prepositions). The alternating prefixes, therefore, would surface in Pre-Mwotlap as either (for the definite/indefinite determiner prefix) a single consonant [n], when stress fell on the first syllable of the root, or as [na], when stress fell on the second syllable of the root, and, consequently, on the vowel of the prefix. Because of this distribution in Pre-Mwotlap, I propose that alternating prefixes have two allomorphs, one that is a single consonant, and the other with a vowel following that consonant:

(33)

Definite/Indefinite Determiner	/n-/ ~ /na-/
Purpose 'for'	/b-/ ~ /be-/
Perfect	/m-/ ~ /me-/
Stative	/n-/ ~ /ne-/
Future	/t-/ ~ /te-/
Numeralizer	/v-/ ~ /ve-/
Ablative	/t-/ ~ /te-/

Below are examples with some of the varying suffixes attached to the root /^{k}p^{w}ʊŋ/ 'night':

(34)

a.   bare root: ^{k}p^{w}ʊŋ   'night'
     /na/ ~ /n/-/^{k}p^{w}ʊŋ/   nʊ-^{k}p^{w}ʊŋ   'night' (definite/indefinite)
     /be/ ~ /b/-/^{k}p^{w}ʊŋ/   bʊ-^{k}p^{w}ʊŋ   'night' (purpose)
     /ne/ ~ /n/-/^{k}p^{w}ʊŋ/   nʊ-^{k}p^{w}ʊŋ   'night' (stative)
     /me/ ~ /m/-/^{k}p^{w}ʊŋ/   mʊ-^{k}p^{w}ʊŋ   'night' (perfect)

b.   bare root: momjij   'cold'
     /na/ ~ /n/-/momjij/   no-momjij   'cold' (definite/indefinite)
     /be/ ~ /b/-/momjij/   bo-momjij   'cold' (purpose)
     /ne/ ~ /n/-/momjij/   no-momjij   'cold' (stative)
     /me/ ~ /m/-/momjij/   mo-momjij   'cold' (perfect)

c.   bare root: ^{n}dɪm^{n}dɪm   'think'
     /na/ ~ /n/-/^{n}dɪm^{n}dɪm/   nɪ-^{n}dɪm^{n}dɪm   'think' (definite/indefinite)
     /be/ ~ /b/-/^{n}dɪm^{n}dɪm/   bɪ-^{n}dɪm^{n}dɪm   'think' (purpose)
     /ne/ ~ /n/-/^{n}dɪm^{n}dɪm/   nɪ-^{n}dɪm^{n}dɪm   'think' (stative)
     /me/ ~ /m/-/^{n}dɪm^{n}dɪm/   mɪ-^{n}dɪm^{n}dɪm   'think' (perfect)

Underlying representations of non-varying prefixes would have just single allomorph each, e.g. /le-/ for the Locative prefix with the meaning 'at'.

With the underlying forms of varying prefixes as we have determined them in (33) above, the analysis of the 'vowel shifting' becomes much clearer: first, there is no diacritic property that sets 'shifting' prefixes apart from 'non-shifting' ones; the difference between the two types is the difference (synchronically) between having two allomorphs or one. Secondly, the 'shifting' itself would be analyzed as allomorph selection with epenthesis and vowel harmony. Note that the two phenomena, 'vowel shifting' and

epenthesis in roots, previously analyzed as separate processes, are reduced to one phenomenon, epenthesis with vowel harmony determining the quality of the epenthetic vowel, under the present analysis. Vowel harmony, therefore, is a DEP-violating harmony, in that only epenthetic vowels harmonize with the first vowel of the root, regardless of whether the epenthetic vowel is root-internal or not. Vowels that are underlyingly specified for vocalic features do not alternate to harmonize with the root-internal vowel, hence neither non-initial root vowels nor vowels in non-varying prefixes surface as harmonic (no IDENT-violating harmony).

The question we have to ask ourselves now, however, is why have two allomorphs for varying prefixes, one with a single consonant and one with a consonant and a (specific!) vowel. Apart from historical reasons, we have seen no indication so far that varying prefixes surface with anything but a vowel harmonic with the first vowel of the root. The situation, however, is more difficult, since there are roots where these prefixes surface with non-harmonic vowels. Consider the following data with the varying Stative prefix:

(35)

a. bare root: /djɪ/   'wait'
    /ne/ ~ /n/-/djɪ/   me-djɪ (*mɪ-djɪ)   'wait' (stative)

b. bare root: /twojiɣ/   'easy'
    /ne/ ~ /n/-/twojiɣ/   ne-twojiɣ (*no-twojiɣ)   'is easy' (stative)

c. bare root: /hjo/   'long'
    /ne/ ~ /n/-/hjo/   ne-hjo (*no-hjo)   'is long' (stative)

Note that the forms in (35) above show up with disharmonic prefix vowel [e], even though the Stative prefix is among the varying prefixes. In fact, with certain roots, none of the varying prefixes surface with a harmonic vowel:

(36)

a. bare root: /mgumgu/   'work'
    /na/ ~ /n/-/mgumgu/   na-mgumgu   'work' (definite/indefinite)
    /be/ ~ /b/-/mgumgu/   be-mgumgu   'work' (purpose)
    /ne/ ~ /n/-/mgumgu/   ne-mgumgu   'work' (stative)
    /me/ ~ /m/-/mgumgu/   me-mgumgu   'work' (perfect)

b.	bare root:	/mtimtij/	'sleep'
	/na/ ~ /n/-/mtimtij/	na-mtimtij	'sleep' (definite/indefinite)
	/be/ ~ /b/-/mtimtij/	be-mtimtij	'sleep' (purpose)
	/ne/ ~ /n/-/mtimtij/	ne-mtimtij	'sleep' (stative)
	/me/ ~ /m/-/mtimtij/	me-mtimtij	'sleep' (perfect)

c.	bare root:	/mjʊs/	'want'
	/na/ ~ /n/-/mjʊs/	na-mjʊs	'want' (definite/indefinite)
	/be/ ~ /b/-/mjʊs/	be-mjʊs	'want' (pupose)
	/ne/ ~ /n/-/mjʊs/	ne-mjʊs	'want' (stative)
	/me/ ~ /m/-/mjʊs/	me-mjʊs	'want' (perfect)

d.	bare root:	/blekat/	'play cards'
	/na/ ~ /n/-/blekat/	na-blekat	'play cards' (definite/indefinite)
	/be/ ~ /b/-/blekat/	be-blekat	'play cards' (pupose)
	/ne/ ~ /n/-/blekat/	ne-blekat	'play cards' (stative)
	/me/ ~ /m/-/blekat/	me-blekat	'play cards' (perfect)

Note that all the roots concatenated with the varying prefixes above start with two consonants[11], instead of one consonant in roots that cause the vowels in varying prefixes to harmonize. Below are more examples with the varying prefixes /be-/~/b-/ 'for' (Purpose) and /na-/ ~ /n-/ (Definite/Indefinite determiner) that attach to nouns:

(37)

| a. | /ghʊw/ | gʊhʊw | | 'rat' |
| | /be/~/b/-/ghʊw/ | be-ghʊw | *bʊ-ghʊw | 'for the rat' |

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[11] There are a few roots in Mwotlap that contradict this generalization, because even though they start with a single consonant, they do not cause varying prefixes to surface with harmonic vowels. Historically, however, there is something particular about these exceptional roots: they used to be reduplicated, and left with geminates after the unstressed vowels between identical consonants had been lost (Kasarhérou (1962)), for example:

Pre-Mwotlap	Mwotlap	Gloss
lolo > llo	lo	'sun'
rereŋa > rreŋ	jeŋ	'turmeric'
sasa > sse	se	'name'

Synchronically, we either have to say that the roots are exceptional when it comes to vowel harmony, or have underlying representations that start with two consonants, one of which is not audible because of lack of length contrast in consonants.

b.   /ᵏpʷlismen/   ᵏpʷilismen   'policeman'
         /be/~/b/-/ᵏpʷlismen/   be-ᵏpʷlismen *bi-ᵏpʷlismen   'for the policeman'

c.   /tᵏpʷe/   tᵏepwe   'bell'
         /na/~/n/-/tᵏpʷe/   na-tᵏpʷe   *ne-tᵏpʷe   'a/the bell'

d.   /nje/   neje   'blood'
         /na/~/n/-/nje/   na-nje   *na-nje   'blood/the blood'

Both the Purpose prefix (37 a, b) and the Definite/Indefinite determiner prefix (37 c, d) show up with their respective non-harmonic vowels [e] and [a], even though the prefixes do harmonize with the first vowel of roots that do not start with two consonants.

Recalling our discussion of the stress evolution in Mwotlap, we can see how the root-initial double vs. singular consonant distinction can play a role: when prefixed to single-consonant roots (38a), prefixes can be parsed into a moraic binary foot with the first syllable of the root; when, on the other hand, these prefixes are attached to a root that starts with two consonants (38b), the first consonant of the root is syllabified into the coda of the word-initial syllable, so the prefix and the initial root of the consonant comprise a singular bimoraic foot:

(38)

a.   /me/~/m/-/vɪjtitit/   (mɪ-vɪj)(titit) [12]   'fight' (perfect)
        /te/ ~ /t/-/momjij/   (to-mom)(jij)   'cold' (future)

b.   /be/~/b/-/ghʊw/   (be-g)(hʊw)   'for the rat'
        /na/~/n/-/ᵏpʷlismen/   (na-ᵏpʷ)(lis)(men)   'a/the policeman'

In (38a), where the prefix is footed with the first syllable of the root, the vowel of the varying prefix shows up as harmonic with the second vowel in the same foot. In (39b), on the other hand, the vowel of the prefix is parsed, together with the first consonant of the root, into a separate foot, and does not harmonize with the vowel outside the foot. It seems clear, therefore, that there is a **prosodic restriction** on the vowel harmony: the target must be in the same foot as the trigger. Otherwise, the vowel-final allomorph is

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[12] Footing might or might not be persistent, it is only the initial foot that affects vowel harmony/allomorph selection in the language.

selected, and a vowel that has underlying specifications does not change them on the surface (no IDENT violations). While François (2000) is forced to say that two consonants is a 'blocking boundary' and a single consonant is not, we can analyze the phenomenon as being restricted by the **domain** of a bimoraic foot.

Our alternative analysis, therefore, takes into account several factors: the foot structure of the language; allomorph selection; and whether or not there is a single-consonant allomorph of a prefix (varying vs. non-varying prefixes). Below is an account of the pattern with the varying prefix /na-/~/n-/ (definite/indefinite determiner):

Tableau 1

/na/~/n/-/ᵏpʷʊŋ/ 'the/a night'	*COMPONS	IDENT [±high] [±front] [±round] [±ATR]	AGREE (V[±high] FT) [±front] [±round] [±ATR]	DEP(V)
☞ a. (nʊ-ᵏpʷʊŋ)				*
b. (n-ᵏpʷʊŋ)	*!			
c. (na-ᵏpʷʊŋ)			*!	
d. (nʊ-ᵏpʷʊŋ)		*!		

There are two constraints in the tableau above that cannot be violated: a markedness constraint against complex onsets, and a faithfulness constraint that bans any vocalic features that are changed from the output to input. The two constraints are unranked with respect to each other. Candidate (b) fatally violates one of these constraints, *COMPONS, and is eliminated. Candidate (c), that has the longer allomorph of the prefix, violates the AGREE constraint that requires that all vowels within a foot agree with respect to all vocalic features. Candidate (d), though identical to candidate (a) on the surface, is a candidate that also chooses the longer allomorph of the prefix, but changes the quality of the prefix vowel to agree with the root-initial vowel within the same foot, thus violating the IDENT constraint. The remaining candidate (a), which appears with the shorter allomorph of the prefix and epenthesis, violates only the DEP(V) constraint, but none of the others, therefore emerging as the winning candidate.

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Let us now contrast the situation above, where the root starts with a single consonant, with the situation, where the same Definite/Indefinite prefix /na-/~/n/ is concatenated with a root that has two initial consonants in the underlying representation:

Tableau 2

/na/~/n/-/^{k}p^{w}lismen/ 'a/the policeman'	*COMPONS	IDENT [±high] [±front] [±round] [±ATR]	AGREE (V[±high] FT) [±front] [±round] [±ATR]	DEP$_{(V)}$
☞ a. (na-^{k}p^w)(lis)(men)				
b. (n-^{k}p^w)(lis)(men)	*!			
c. (ni-^{k}p^w)(lis)(men)				*!
d. (ni-^{k}p^w)(lis)(men)		*!		

The tableau 3 above models how the longer allomorph of the Definite/Indefinite prefix is selected when the prefix is footed separately from the initial vowel of the root. Candidate (b) with the short allomorph and no epenthesis violates the highest-ranking *COMPONS constraint; candidate (d), which chooses the longer allomorph of the prefix but surfaces with a vowel different from the underlying specifications of the prefix vowel, fatally violates the IDENT constraint. The remaining two candidates, (a) and (c), surface with different allomorphs: (c) has the shorter allomorph of the prefix, with epenthetic [i]; candidate (a), on the other hand, chooses the longer allomorph /na-/. Neither candidate (a) nor candidate (c) violate any of the three higher-ranking constraints, but candidate (c) has an epenthetic vowel that candidate (a) does not. It is the DEP$_{(V)}$ constraint, therefore, that is responsible for the choice of the candidate (a) in this situation: even though syllable structure and agreement of vowels within a foot are more important requirements, given the choice between a candidate with epenthesis and a candidate without, it is a candidate that is more faithful to the underlying representation that is chosen (candidate (a) in our example above).

Note how the model we have established accounts for cases where there is only one allomorph of the prefix (i.e. concatenation with so-called 'non-shifting' prefixes):

Tableau 3

/le/-/naw/ 'in the sea'	*CompOns	Ident [±high][±front][±round][±ATR]	Agree (V[±high] Ft) [±front][±round][±ATR]	Dep$_{(V)}$
☞ a. (le-naw)			*	
b. (l-naw)	*!			
d. (la-naw)		*!		

When the prefix is of the non-varying type, i.e. has only one allomorph that ends in a vowel under the present analysis, there is no need for epenthesis as the prefix is vowel-final. Candidate (b) in tableau 3 above is ruled out by the *CompOns constraint since it surfaces without the vowel of the prefix. In fact, this candidate could also be ruled out by a Max$_{(segment)}$ constraint that does not seem to be violated anywhere in the language. Candidate (d), even though it has the surface correspondent of the underlying vowel in the prefix, fatally violates the Ident constraint, because the features of the vowel on the surface do not correspond to the features of the underlying vowel. Hence, candidate (a), despite its prefix vowel being disharmonic with the vowel in the same foot, is optimal here.

To summarize, there are several factors that determine vowel quality of prefix vowels in Mwotlap:

(39)

  a. Absence or presence of a consonant-only allomorph of a given prefix;

  b. Syllable structure that excludes complex onsets;

  c. Stronger prohibition (= higher-ranking constraint) against changing features specifications than adding features to an epenthetic vowel;

  d. Quality of the initial vowel of the root; and finally

  e. **Domain** of vowel harmony that is a **bimoraic foot**, where coda consonants contribute to weight.

Note that the role of prosody here is to restrict, or limit the domain of a phenomenon, total vowel harmony in the case under discussion, rather than to trigger vowel harmony, or add a condition on the trigger of vowel harmony, as in cases we discussed previously in this chapter. Note also that the prosodic condition on the vowel harmony in Mwotlap cannot be stress, since stress is always on the ultimate syllable synchronically, so the triggering vowel may or may not be stressed, depending on how many syllables a root has. There is, therefore, binary foot structure, with which stress does not coincide, and the effect of the foot structure on the segmental alternations in the language is to **restrict the domain** of the alternation.

It is also important to note that all the prefixes in the language are footed to account for the pattern of vowel harmony. The harmony shows us that there is at least one bimoraic foot at the left edge of a Phonological Word. Recall that stress, on the other hand, is always word-final, i.e. its assignment is due to a constraint that aligns prominence with the right edge of a Phonological Word, creating a misalignment of stress and foot boundaries, either if footing is not persistent, or if there is an unparsed final syllable, as in the example below:

Tableau 4

/be/ ~ /b/-/mgumgu/ 'work' (purpose)	ALIGN-R (ó, PWD)	ALIGN-L[13] (GRID$_2$, FT)
☞ a. (be-m)(gum)gú		*
b. (bé-m)(gum)gu	*!	

If, on the other hand, footing is persistent in the language **and** degenerate feet are allowed, it is the second type of Prominence Alignment constraint, the one that requires that a foot edge must be aligned with prominence, that is violated by the optimal candidate:

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[13] I chose ALIGN-L as a Prominence Alignment constraint here more for historical reasons, since the language used to have trochaic pattern rather than because it is possible to show that the foot type of trochee synchronically. ALIGN-R would be equally violated by the optimal candidate.

Tableau 5

/be/ ~ /b/-/mgumgu/ 'work' (purpose)	ALIGN-R (ǿ, PWD)	ALIGN-L[14] (FT, GRID$_2$)
☞ a. (be-m)(gum)(gú)		**
b. (bé-m)(gum)(gu)	*!*	

Mwotlap vowel harmony, therefore, shows us that there is at least one bimoraic foot at the left edge of the word, but stress assignment is not matching the foot structure, due to the ALIGN-R (ǿ, PWD) constraint outranking one of the Prominence Alignment constraints.

4.3 Case Study: Kera Vowel Sonority Distribution and [±high] Vowel Harmony

Kera, an East Chadic language of Afroasiatic language family, has several types of harmony, some of which must be accounted for with reference to foot structure. There are four overlapping types of vowel harmony:

(40)

a. Complete harmony that applies within roots only; final light syllables are not subject to complete harmony;

b. Between root and affix, there is height harmony;

c. Rounding harmony that is triggered by suffixes with the vowel [u] and affects only the high central vowel [ɨ]; and

d. Fronting harmony that affects central vowels.

4.3.1 Relevant Basics

Kera is very unusual in that it apparently has no detectable stress[15] (Pearce (2003)); vowel harmony patterns in the language, however, require reference to foot structure, namely to

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[14] See previous footnote.

[15] It is difficult to evaluate what this statement really means: it could mean that no prominence detected impressionistically or instrumentally, or it could mean that speakers are unable to pick out more prominent

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bimoraic feet. Evidence for postulating foot structure, apart from [±front] harmony to be discussed momentarily, comes from phonotactics involving three non-high vowels [ɛ, a, ɔ]. The lower-sonority vowels [e, ə, o] are found only in a particular metrical environment that can only be defined as a trough syllable of an iambic foot.

The Kera vowel inventory is listed below:

(41)

<div align="center">

i   ɨ   u

ɛ/e   ɔ/o

a/ə

</div>

Vowel length is phonemic in the language, and each of the short vowels has a long counterpart, with the same set of features as short vowels, as is illustrated by the minimal pairs below:

(42)

cerɛ 'libation'	cɛ:rɛ 'rip open'
ɗerɛ 'gathering fruit'	ɗɛ:rɛ 'pour liquid'
hamɛ 'eat'	ha:mɛ 'bend metal'
holɛ 'skin of animal'	ho:lɛ 'rewarm'
ɗɛ 'go' (imperfective)	ɗɛ: 'go' (perfective)
diri 'in them'	di:ri 'with them'
duru 'in him'	du:ru 'with him'
dɨrɨ 'in her'	dɨ:rɨ 'with her'
kəsaw 'sauce'	ka:saw 'millet'

There are no diphthongs in Kera. The three non-high vowels have alternates: ɛ/e, a/ə, ɔ/o. According to Pearce's (2003) analysis, in each case, the second vowel differs from the first with respect to specification for the [ATR] feature, but they also differ in sonority, the [-ATR] vowels being more sonorous than the [+ATR] ones. I see the distribution of non-high vowels as one marking the position of accent, rather than [ATR] alternations.

syllable(s). I will maintain that accent in Kera has vowel sonority as phonetic correlate, rather than duration or pitch.

4.3.2 Non-high Vowel Sonority Distribution

Pearce (2003) finds the following distribution of vowels correlating with particular types of syllable sequences:

(43) In CVCV or CVCVC

a. [i] [i]   miɗi   'miracle'
    [ɨ] [ɨ]   kɨkɨw   'flies'
    [u] [u]   tukur   'plate'

b. [e] [ɛ]   begɛ   'cattle'
    [ə] [a]   kəram   'women'
    [o] [ɔ]   solɔj   'money'

Note that in words with two open syllables or an open syllable followed by a closed syllable we either see only two identical high vowels (43a), or two vowels differing only in sonority if the vowels are non-high (43b). In the latter case, it is the second vowel in the sequence that has to be of higher sonority: sequences like CɛCe(C), CaCə(C), and CɔCo(C) are prohibited.

In trisyllabic (or trimoraic) words, however, the situation is different:

(44) In CVCV(C).CV
a. [ɨ] [ɨ] [a]   gɨdɨwa   'stick'
    [i] [i] [u]   a-tifinku[16]   'aubergine'
    [ə] [a:] [ɔ]   gəda:mɔ   'horse'
    [a:] [a] [ɔ]   ba:sajmɔ   '(sp. of) bird'
    [ɨ] [ɨ] [i]   a-mɨnɨli   'chameleon'
    [a:] [ɛ] ka:ɗɛ   'hair'
    [a] [ɔ] kaskɔ   'bird'

b.   [a:] [a]   sa:ma   'rope'
     [ɛ] [ɛ]   lɛntɛ   'lost'
    [a:] [a] [a]   ka:lajna   'regret'
    [o] [ɔ] [ɔ]   molɔrɔ   'saliva'

---

[16] Prefix *a-*, which obligatorily appears with some nouns, is not parsed into feet, and is not subject to sonority alternations or vowel harmony.

As we can see, the 'stray' final light syllable might, as in (44a), or might not (44b) be harmonic with the vowels that precede it in the root. We might consider that harmonic vowels in (44b) are simply accidental. However, it seems that there is another interesting property of final light syllables: they are always of higher sonority, i.e. the same vowels that are allowed in heads of feet, but disallowed in feet's troughs. A distribution like that suggests that the final syllables footed by themselves are accented.

Below are more examples of sonority distribution that can be seen in underived (at least synchronically) roots consisting of up to four syllables:

(45)

a. monosyllabic

(kaw)	'milk'
(si)	'cow'
(ja:)	'friend'
(ka:)	'people'
(ca:)	'poor'

b. bisyllabic

(cəwa)	'sun'
(ka:)(saw)	'millet'
(dəmal)	'drum'
(belɛ)	'love'
(tosɔ)	'sore'

c. trisyllabic

(kətar)(taw)	'boats'
(sa:)(təraw)	'cat'
(godɔr)(mɔj)	'leach'
(ta:)(məka)	'sheep'
(kesɛr)(ɗɛŋ)	'traditional skirt'

d. quadrisyllabic

(gədar)(gəɗaw)	'granaries'
(tiwir)(nini)	'electric fish'

If prominence and foot structure of the language match, sonority distribution shows us the binary iambic left-to-right foot structure, in addition to the location of prominence in

the language. It appears that the choice between higher-sonority and lower-sonority non-high vowels is subject to sonority constraints on stressed vowels: accented vowels have to be of higher sonority than their respective unaccented counterparts. I believe that the distribution of non-high vowels in the language, therefore, is a consequence of the relative sonority of stressed vowels, rather than the assignment of the feature [±ATR] *per se[17]*. If the position of prominence and foot structure of the language are perfectly aligned, the distribution of non-high vowels also gives us the inventory of possible feet in Kera:

(46)

LH	CV.CV: or CV.CVC	(dəmal) 'drum'
H	CV: or CVC	(ka:)(saw) 'millet'
LL	CV.CV	(belɛ) 'love'
L	CV	(sa:)(ma) 'rope'

The [±ATR] distribution, or, rather, sonority of non-high vowels distribution, though a static generalization in Kera, is, I believe, the basis of sonority considerations in allomorph selection in Maŋʂi and Shipibo, which we discuss in the following chapter in detail.

With the foot inventory and foot structure principles established, we now turn to vowel harmony alternations that show influence of the foot structure.

4.3.3 Fronting Harmony

There are two types of fronting harmony in Kera. In **Type 1**, suffixes containing a high vowel cause fronting and/or rounding of the high central vowel [ɨ] within the Prosodic Word:

(47)

/cɨ:r/-/i/	ci:ri	'your (f) head'
/cɨ:r/-/u/	cu:ru	'his head'

---

[17] Pearce (2006) also proposes an analysis in these terms observing that the open vowels are c. 20 ms. longer than the closed ones.

Type 2 harmony is more interesting for the purposes of this dissertation: suffixes containing any front vowel, e.g. Imperfective /-ɛ/ (48a and 49a) and the 2nd person possessive feminine /-i/[18] (48b and 49b), cause central vowels [ɨ, a] **in the same foot** to front:

(48)
a.	/bal/-/ɛ/	(belɛ)	'love' (Imperf)
	/bɨŋ/-/ɛ/	(biŋi)	'open' (Imperf)
	/ɨs/-/ɛ/	(ʔisi)	'sit down' (Imperf)
	/fal/-/ɛ/	(felɛ)	'find' (Imperf)
	/wɨt/-/ɛ/	(witi)	'hit' (Imperf)
	/ham/-/ɛ/	(hemɛ)	'eat' (Imperf)

b.	/mar/-/i/	(miri)	'your (f) wife'
	/dɨr/-/i/	(diri)	'your (f) eye'
	/bar/-/i/	(biri)	'your (f) father, master'

If, however, the front vowel of the suffix is footed separately from the root vowel, fronting does not apply:

(49)
a.	/vɨːg/-/ɛ/	(vɨː)(gi)	*(viː)(gi)	'empty' (Imperf)
	/baːd/-/ɛ/	(baː)(dɛ)	*(bɛː)dɛ	'wash' (Imperf)
	/ɨsk/-/ɛ/	(ʔis)(ki)	*(ʔis)(ki)	'understand' (Imperf)
	/haːm/-/ɛ/	(haː)(mɛ)	*(hɛː)(mɛ)	'mend metal' (Imperf)

b.	/kaːs/-/i/[19]	(kɨː)(si)[20]	*(kiː)(si)	'your (f) hand'
	/daːr/-/i/	(dɨː)(ri)	*(diː)(ri)	'your (f) friend'
	/naːr/-/i/	(nɨː)(ri)	*(niː)(ri)	'your (f) aunt'
	/gɨgɨːr/-/i/	(gɨgɨː)(ri)	*(gigiː)(ri)	'your (f) knee'
	/nawr/-/i/	(nɨw)(ri)	*(niw)(ri)	'your (f) sister'
	/tarm/-/i/	(tɨr)(mi)	*(tir)(mi)	'your (f) heart'

---

[18] Used only with inalianable nouns, it seems, or nouns that can be interpreted as such.

[19] cf.

/kaːs/-/u/	kɨːsu	'his hand'
/kaːs/-/a/	kaːsa	'her hand'

[20] Raising in this root is due to another type of vowel harmony, [±high], that is not restricted by foot structure.

The fronting harmony in Kera, therefore, is clearly dependent on foot boundaries: whereas most vowel harmony systems have the Prosodic Word as a domain, the fronting harmony in the language has foot as its domain. Given the distribution of non-high vowel pairs ɛ/e, ɔ/o, and a/ə, which we take as marking prominent vs. non-prominent syllables, we conclude that foot boundaries and position of prominence coincide in Kera, with prominence assigned to the rightmost syllable of a foot.

4.4 Case Study: Ibibio Verbs

There are three phenomena in Ibibio that are of interest to us in this dissertations: vowel distribution; voiceless stop lenition; and finally, verbal suffixation.

Ibibio is spoken in Akwa Ibom State in the Niger-Delta region of Nigeria. Essien (2001) puts the number of speakers at 4 million. Greenberg (1963) classifies Ibibio under the Benue-Congo branch of the Niger-Congo family. It is subclassified as a Lower-Cross language of the Cross-River subfamily.

The data in this case study is from Akinlabi and Urua (2002), Essien (1990), and Kaufman (1968). Ibibio itself has a fair amount of dialect variation. The dialect Akinlabi and Urua (2002) discuss is the Uruan dialect, as spoken in Mbaya, about eight miles from Uyo, the location of the state headquarters.

4.4.1 Relevant Basics

In Ibibio, monosyllabic verb roots may take one of three shapes: they may be CVVC, CVC, or just CV[21]:

(50)

a.	waak	'tear'	deep	'scratch'	kɔɔŋ	'hang up (a dress)'
b.	wat	'paddle'	dep	'buy'	kɔŋ	'knock (on the head)'
c.	wa	'sacrifice'	se	'look'	kpɔ	'carry'

---

[21] here and throughout, tones are omitted

Each of the items above may be used in isolation (i.e. without any affix), as, for example, in imperatives.

Aside from the monosyllabic verb roots above, Ibibio also has synchronically underived disyllabic verbs, which can take the form of CVCCV (51a), CVVCV (51b), or CVCV (51c):

(51)

a. dappa   'dream' (verb)
    damma   'be mad'
    dɔkkɔ   'tell'
    temme   'explain'

b. faaŋa   'argue'
    yɔɔŋɔ   'plaster a wall (surface)'
    yeeme   'wilt'
    daara   'rinse'

c. saŋa   'walk'
    kɔŋɔ   'choke'
    feɣe   'run'
    bɔɣɔ   'overtake'
   kere   'think'
    saɾa   'comb'

Note that in disyllabic roots, when the first syllable is closed, it is closed by the first part of a geminate. All the vowels in roots are harmonic.

With this background, we turn to specific alternations in Ibibio verbs. We will first consider the distribution of vowels in the language.

4.4.2 Vowel Distribution

Below is the vowel system of Ibibio, with allophones circled:

(63)
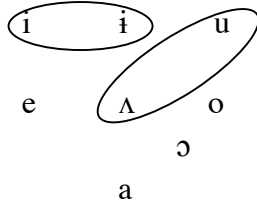
The high vowels [i] and [u] have centralized allophones [ɨ] and [ʌ]. According to Akinlabi and Urua (2002) and Essien (1990), [ɨ] is also lower than [i], and, of course [ʌ] is lower than [u]. It seems, therefore, that the alternations of the high vowels could be interpreted as alternations driven by sonority considerations, central lower vowels [ɨ] and [ʌ] being more sonorous than high [i] and [u], respectively. The alternations, consequently, are very similar to the ones in Kera, discussed in the previous section, and also possibly indicate prominence, about which we have no information available otherwise.

In disyllabic CVCV roots, the lower central vowels appear in the first syllable, and the high vowels, or non-alternating vowels, in the second syllable:

(64)

a.	niɣe	'tickle'	b.	tʌnɔ	'discipline'
	bɨme	'scramble for'		tʌnɔ	'chastise'
	tɨɾe	'stop'			
	sɨne	'put on dress'			

Similarly, when the Agentless Passive/Reflexive suffix is added to CVC roots, the initial vowel of the resulting form has the higher sonority allophone of [i] and [u], while the second vowel does not:

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(65)

a. /dip/-/kV/   diβe   'hide oneself'
    /jit/-/kV/   jiɾe   'be fastened/fasten on oneself'
    /bit/-/kV/   biɾe   'spread oneself'
    /sin/-/kV/   sine   'put dress on (or by) oneself'

b. /fuk/-/kV/   fʌɣɔ   'cover oneself'
    /kuk/-/kV/   kʌɣɔ   'be shut'
    /dut/-/kV/   dʌɾɔ   'drag oneself'
    /mum/-/kV/   mʌmɔ   'catch oneself'
    /kup/-/kV/   kʌβɔ   'be covered'

CVC roots in isolation also have the more sonorous [i] and [ʌ], and never the less sonorous [ɨ] and [u]:

(66)

a. /dip/   dɨp   'hide'
    /jit/   jɨt   'fasten'
    /bit/   bɨt   'spread'
    /sin/   sɨn   'put on (dress)'

b. /fuk/   fʌk   'cover'
    /kuk/   kʌk   'shut (door)'
    /dut/   dʌt   'drag'
    /mum/   mʌm   'catch'
    /kup/   kʌp   'cover (with lid)'

Roots of the form CVVC, which are shortened to CVC when the Agentless Passive/Reflexive suffix is added, must also contain only [ɨ] and [ʌ], and cannot surface with [i] or [u]:

(67)

a. siit   'seal/block an opening'   siɾe   'be sealed/blocked'
    fiik   'press down'   fiɣe   'be piled up'
    fiip   'suck'   fiβe   'have an object stick out of
                                                the mouth'

b.   wuuk   'drive something in'   wʌɣɔ   'be driven in'
        buuk   'bury'   bʌɣɔ   'be buried'

Given the facts in (64 – 67) above, it is reasonable to say that the more sonorous vowels appear in initial position of a (disyllabic or bimoraic) foot, and the less sonorous [i] and [u] appear otherwise. The only counterexamples to this generalization Ibibio presents are CVV or CVVC roots, i.e. high long vowels do not lower or centralize even in word-initial position:

(68)

a. Negative forms

        /siit/-/kV/   …siiɾe   'not sealing an opening'
        /fiik/-/kV/   …fiiɣe   'not pressing down'
        /fiip/-/kV/   …fiiβe   'not sucking'
        /wuuk/-/kV/   …wuuɣɔ   'not driving something in'
        /buuk/-/kV/   …buuɣɔ   'not burying'

b. Reversive forms

        /siit/-/kV/   sɨtte   'unseal/unblock an opening'
        /wuuk/-/kV/   wʌkkɔ   'driving something out'

In (68a), where the Prosodic Word-initial syllable contains a long vowel, the high vowels appear without lowering/centralization, while when the underlying long vowel is shortened due to some suffixation conditions to be discussed shortly, only more sonorous [ɨ] and [ʌ] appear. If, indeed, the alternation of sonority between the vowels indicates the position of prominence, we can argue that long vowel are not only more sonorous than their short counterparts, but are also more sonorous than short lower/centralized more sonorous alternates [ɨ] and [ʌ]. The prominent position, hence, is the initial syllable of a Prosodic Word.[22]

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[22] Prosodic Word excludes some verbal prefixes.

Another interesting property of Ibibio vowels can be seen if we consider verbal suffixation: certain (homophonous) suffixes in the language consist of an underlying /k/ followed by a copy of the root vowel:

(69)

se	'look'	n-see-ɣe	'I am not looking'
nɔ	'give'	n-nɔɔ-ɣɔ	'I am not giving'
do	'be' (copula)	n-doo-ɣo	'I am not giving'
da	'stand'	n-daa-ɣa	'I am not standing'

The same Negative suffix, however, appears with either [e] after root [i]/[ɨ] or [ɔ] after root [u]/[ʌ] (see, for example, (68a) above). Outside roots, therefore, the vowels are neutralized to central vowels, possibly indicating that only prominent vowels, that are root-initial vowels, can appear with their underlying [+high] feature. If the alternation between [i, u] and [ɨ, ɔ], respectively, indicated the foot structure rather than prominence, we would expect at least some suffix vowels (foot-initial or foot-final) to appear as (variants of) high vowels. It appears, therefore, that, similar to Kera vowel alternations, the high vowels mark the location of prominence (the initial syllable of a Prosodic Word), rather than foot structure. With this hypothesis in mind, we will now discuss voiceless stop lenition, which is analyzed as foot structure-dependent in Akinlabi and Urua (2002).

4.4.3 Voiceless Stop Lenition

The following consonants occur in Ibibio in Prosodic Word-initial position (Urua (2000)):

(70)

p t k kp
b d
m n ɲ ŋ
f s
w   j

Syllable-finally, the set of consonants above is reduced:

(71)

     p t k
     m n ŋ

As we can see, the syllable-final consonants are reduced to stops (oral or nasal), and to labials, coronals and dorsals.

Ibibio also shows voiceless stop lenition, where [p t k] lenite to [β ɾ ɣ] respectively, but the lenition is prosodically restricted: weakening does not apply Prosodic Word-initially:

(72)

a. Prosodic Word-internal

    dɨp   'hide'   /dip/-/kV/   [diβe]_{PWD}   'hide oneself'
    wet   'write'   /wet/-/kV/   [weɾe]_{PWD}   'be written'
    fʌk   'cover'   /fuk/-/kV/   [fʌɣɔ]_{PWD}   'cover oneself'

b. Prosodic Word-initial

    /u/-/taŋ/   u-[taŋ]_{PWD}   *[uɾaŋ]_{PWD}   'plaiting'
    /u/-/kup/   u-[kʌp]_{PWD}   *[uɣʌp]_{PWD}   'covering'

The failure of lenition in (72b) above is due to the fact that the Ibibio nominalizing prefix /u-/ lies outside the Prosodic Word domain. Within a root, the generalization holds:

(73)

    /topo/   [toβo]_{PWD}   *[topo]_{PWD}   'make an order'
    /sata/   [saɾa]_{PWD}   *[sata]_{PWD}   'comb'
    /feke/   [feɣe]_{PWD}   *[feke]_{PWD}   'run'

Note that if our hypothesis that the initial syllable, whether heavy or light, of the Prosodic word is the prominent one, we can formulate the lenition condition as prominence dependent: a voiceless stop lenites after a prominent syllable. One apparent counterexample to lenition would show up with geminate voiceless stops that do not lenite despite following the initial syllable:

(74)

kʌp	'hear'	i-[kʌp-pɔ]_{PWD}	'he/she is not hearing'
jet	'wash'	i-[jet-tɛ]_{PWD}	'he/she is not washing'
bot	'mould'	i-[bot-to]_{PWD}	'he/she is not molding'
dat	'take/pick up'	i-[dat-ta]_{PWD}	'he/she is not taking/picking up'
kɔk	'vomit'	i-[kɔk-kɔ]_{PWD}	'he/she is not vomiting'

Geminates in the language do not lenite, even though they follow Prosodic Word-initial syllables. This counterexample, however, just seems to be an instance of 'geminate inalterability' (see Kirchner (2000) and references therein) and the voiceless stops do not lenite just by virtue of being geminates.

Even though Akinlabi and Urua (2002) consider the lenition of voiceless stops as restricted to onsets of troughs of trochaic feet, rather than to consonants following prominent syllables, such an analysis would have to consider trochaic feet of the form (HL) not only possible, but **optimal** with certain types of verb forms, as Akinlabi and Urua (2002) claim. Only under their analysis of foot structure in the language the 'trough of a foot' environment for voiceless stops is sustainable. In the next subsection, I argue that such an analysis is misguided, and that even though an uneven trochee is a possible foot form in Ibibio, it is never the optimal one. The environment of voiceless consonant lenition, consequently, is better defined with reference to prominence rather than foot structure.

4.4.4 Verbal Suffixation

Essien (1990) refers to Ibibio morphemes that mark verb negation, reversion or action, and relativization as verbal extensions. These morphemes are homophonous, and have the underlying form /kV/, where the vowel of the suffix is a copy of the root vowel, with exceptions mentioned above.

When the Negative suffix is concatenated with a root of the form /CVC/, the consonant of the suffix is fully assimilated to the last consonant of the root, and the root itself is unchanged:

(75)

dep	'buy'	i-dep-pe	'he/she is not buying'
kʌp	'hear'	i-kʌp-po	'he/she is not hearing'
yet	'wash'	i-yet-te	'he/she is not washing'
bot	'mould'	i-bot-to	'he/she is not moulding'
dat	'take/pick up'	i-dat-ta	'he/she is not taking/picking up'
ɲek	'shake'	i-ɲek-ke	'he/she is not shaking'
kɔk	'vomit'	i-kɔk-kɔ	'he/she is not vomiting'
dom	'bite'	n-dom-mo	'I am not biting'
nam	'do/perform'	n-nam-ma	'I am not performing'
bon	'father a child'	m-bon-no	'I am not fathering a child'
saŋ	'go'	n-saŋ-ŋa	'I am not going'
kɔŋ	'knock'	ŋ-kɔŋ-ŋɔ	'I am not knocking'

As is evident from the forms above, the Negative suffix surfaces with the same consonant as the final consonant of a CVC root, and with the vowel of the root as well. Person prefixes have to be added to form the negative form, but they do not seem to affect the shape of the root + suffix complex. In fact, person and other prefixes in Ibibio are not a part of prosodic structure of the roots. The same pattern can be observed with CVC roots with the Reversive suffix. This suffix is homophonous with the negative one, but its distribution is restricted to less roots. The Reversive forms do not need a prefix to be well-formed:

(76)

kɔp	'lock (door)'	kɔp-pɔ	'unlock'
sɔt	'squat'	sɔt-tɔ	'move from squatting position'
tem	'cook'	tem-me	'remove cooked foof from fire'
bjom	'carry load on head'	bjom-mo	'remove load from the head'

After CV verb roots, the Negative suffix takes the form of a dorsal continuant [ɣ] and a vowel identical to the preceding vowel, but the /CV/ roots now become CVV:

(77)

se	'look'	n-see-ɣe	'I am not looking'
nɔ	'give'	n-nɔɔ-ɣɔ	'I am not giving'
do	'be' (copula)	n-doo-ɣo	'I am not giving'
da	'stand'	n-daa-ɣa	'I am not standing'

According to our generalization in the previous subsection, [ɣ] is the reflex of lenited underlying /k/, with lenition appearing after the prominent Prosodic Word-initial syllable.

After CVVC roots, there is a distinction between the Negative and Reversive forms. The Negative takes the form of a vowel identical to the preceding vowel, while the reversive takes the form of a CV as in the CVC roots, but the CVVC root is not shortened to CVC:

(78)
a.   Negative forms

    faak   'wedge between two objects' …faa-ɣa   '…not wedged'
    kɔɔŋ   'hand on hook'   …kɔɔ-ŋɔ   '…not hanging on hook'
    ɲɔɔn   'crawl'   …ɲɔɔ-nɔ   '…not crawling'
    weem 'flowing'   …wee-me   '…not flowing'
    koot   'read/call'   …koo-ro   '…not reading/calling'
    deep   'scratch'   …dee-βe   '…not scratching'

b.   Reversive forms

    faak   'wedge between two objects'   fak-ka 'remove wedged object'
    kɔɔŋ   'hang on hook'   kɔŋ-ŋɔ 'remove from hook'

Finally, the negative suffix takes the form [ke], without the lenition of the underlying voiceless stop of the suffix after disyllabic verbs, no matter the segmental melody of the verb. Consider the negated forms of disyllabic verbs below:

(79)

a. /CVCCV/ roots
    dappa 'dream' (verb)   …dappa-ke   '…not dreaming'
    damma 'be mad'   …damma-ke   '…not being mad'
    dɔkkɔ   'tell'   …dɔkkɔ-ke   '…not telling'

b. /CVCV/ roots
    /topo/ 'make an order'   …toβo   '…not making an order'
    /sata/ 'comb'   …saɾa   '…not combing'
    /feke/ 'run'   …feɣe   '…not running'
    /saŋa/ 'walk'   …saŋa-ke   '…not walking'
    /kɔŋɔ/ 'choke'   … kɔŋɔ-ke   '…not choking'

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Yet another suffix that has a similar effect on roots is the Relative suffix. Below are examples with CVC (80a), CV (80b) and CVVC (80c) roots:

(80)

a.　dep　'buy'　　　　　　dep-pe　　'one who has bought'
　　wat　'drive'　　　　　wat-ta　　'one who has driven'
　　wot　'kill'　　　　　　wot-to　　'one who has killed'
　　tem　'cook'　　　　　…tem-me　'…which is cooking'
　　bom　'break'　　　　…bom-mo　'…who has broken'

b.　ma　'love'　　　　　　maa-ɣa　　'one who loves'
　　bo　'say'　　　　　　…boo-ɣo　'…who is saying'
　　kpe　'judge a case'　…kpee-ɣe　'…who is judging'

c.　waak　'tear'　　　　…waa-ɣa　'…which is torn'
　　kpeep　'teach'　　　…kpee-βe　'…who is teaching'
　　koot　'read'　　　　…koo-ro　'…who is reading'
　　kɔɔŋ　'hang on hook'　…kɔɔ-ŋɔ　'…which is hung'
　　soon　'mock'　　　　…soo-no　'who is mocking'
　　weem　'flowing'　　…wee-me　'which is flowing'

As the data above shows, the Relative suffix behaves more like the Negative than the Reversive suffix with respect to treatment of CVVC roots: the first consonant of the suffix is deleted, and the final consonant of the root is syllabified into the onset of the final syllable.

There are two generalizations to be made from the patterns of Negative/Reversive suffixation: first, the input root form to the Negative/Reversive suffixation has to have one of the following shapes:

(81)

a.　CVCCV　　HL
b.　CVCV　　　LL
c.　CVV　　　　H
d.　CVC　　　　H

Leaving the shape in (80a) aside for a moment, the three remaining shapes above pattern together. It stands to reason to hypothesize that codas are moraic in the language, so CVC syllables are heavy, and trimoraic syllables are not allowed in derived roots.

The second generalization that we can make from the Negative/Reversive suffixation is that in order to reach one of the desired prosodic targets, different roots are manipulated in different ways; in one instance, with roots of the shape CVVC, *-ke* negative suffix behaves differently from the reversive suffix with respect to its effect on the roots: while both inflectional stems surface as bimoraic (heavy) syllable, CVV or CVC, the results are achieved in disparate ways.

Akinlabi and Urua (2002) propose that the root + inflectional suffix complex (a constituent they dubb 'inflectional stem') has a templatic target of its own; the target is a **disyllabic unbalanced** foot, and the relevant templatic constraint is stated as follows:

(82)
        Inflectional Stem = [σμμ σμ] (INFLST)   (A&U 2002:127)
        The Inflectional Stem is a heavy-light trochee

According to Akinlabi and Urua (2002)'s analysis, ideally, the right edge of this trochaic foot is aligned with the right edge of the inflectional affix; the left edge of the foot is aligned with the left edge of the root; and the inflectional stem matches the template.

I believe this analysis to be undesirable because, first, there is a constituent 'inflectional stem' that is different from Prosodic Word; secondly, the template for the constituent is defined not only as a foot, but a foot containing particular types of syllables; and finally, the template identifies as optimal an uneven trochaic foot, where the first syllable has to be heavy, whereas this type of trochee has repeatedly been shown to be the least optimal, if at all possible (see Hayes (1989), (1995), McCarthy and Prince (1986), (1996)).

An alternative analysis I propose here is based on the notion of Minimal Word, a requirement that disallows (content) words of less-than-a-foot size. I propose that the type of suffixation we have been discussing has the Minimal Stem requirement, i.e. the

suffixes in question are subcategorized to attach to stem of (minimally) a foot. The requirement can be enforced by Alignment constraints that make the foot edges correspond to the right and left edges of the root, respectively, and Foot Binarity$_{(\mu)}$ minimum constraint that would disallow degenerate feet.

Abstracting away from particular changes to roots for each of the suffixes we have discussed above, we can analyze the Ibibio suffixation as a phenomenon where the suffixes have to be attached to Minimal Stem, regardless of the underlying shape of the root. Hence, even though a heavy-light trochee **is** a possible foot type in Ibibio, as in formations with the underlying /CVCCV/ roots, e.g. …*(damma)-ke* '…not being mad', this foot shape is definitely not the target shape, but rather arises as a result of subcategorization and the Alignment and Binarity constraints mentioned above.

While the suffixes we have mentioned above subcategorize for stems with a particular prosodic shape (moraic trochee), this is not true for all verbal suffixation in Ibibio. We will now turn to the suffixation that creates "reflexive" or the "agentless passive" forms of verbs (i.e. verbs with suppressed external argument according to Essien (1990) or Urua (1990)). Below we see the suffixed forms of CVC (83a) and CVVC (83b) roots:

(83)

a.	jat	'wear a hat'	jara	'wear a hat on oneself'
	dot	'place on top of'	doro	'place on top of oneself/be on top'
	wet	'write'	were	'be written'
	kɔp	'lock'	kɔβɔ	'be locked'
	bot	'create/mold'	boro	'be shaped'
	man	'give birth'	mana	'be born'
	bɔp	'tie'	bɔβɔ	'tie on oneself'
	tat	'loosen'	tara	'be loosened'
	dɔŋ	'put in'	dɔŋɔ	'be put in'
	waŋ	'wrap around'	waŋa	'be wrapped around/wrap around oneself'
	fɔp	'roast'	fɔβɔ	'be roasted'

b.	dɔɔn	'talk smoothly'	dɔnɔ	'be smooth'
	kɔɔk	'stack'	kɔɣɔ	'be stacked'
	beek	'remove corn'	beɣe	'be removed (of corn)'
	waak	'tear'	waɣa	'be torn to pieces'
	kɔɔŋ	'hang'	kɔŋɔ	'be hung/hang on oneself'

The Agentless Passive forms of CV verbs have a different mechanism of formation: high-tone prefixation is required, and the root remains unchanged. Since there is not enough data to determine how the prefixation and the suffixation methods can be related to foot structure of the language, I will not discuss the prefixation method here.

As we can see, the data in (83) above shows that roots that are underlyingly larger than /CV/ get shortened to CV when subject to this type of suffixation. In other words, the whole derived Prosodic Word has to be a bimoraic foot, and there is no subcategorization for any particular shape of the stem. I believe that this type of suffixation provides additional support to the proposal that a heavy-light trochee is not a target shape in Ibibio: there is shortening of the underlyingly long vowels in (83b), creating a light-light trochee. We saw that shortening of the root vowel is one of the mechanisms to arrive at a target root shape, so an even trochee emerges whenever possible. In fact, the only type of uneven trochee that we saw would be with the underlying /CVCCV/ roots, where a syllable cannot be deleted even to achieve the desirable form of bimoraic trochee. It is unfortunate that there are no examples of concatenation of such roots with the Agentless Passive/Reflexive suffix, since the prediction under the present analysis would be that the suffixed forms surface as (CVC)(CV-CV), with two even feet that the suffixed form is parsed into.

The difference between the two types of suffixation, therefore, boils down to subcategorization: type one suffixation, with the Negative, Relative and Reversive suffixes has a subcategorization requirement, where the suffixes have to be concatenated with a stem that is minimally a (bimoraic) foot, whereas the type two suffixation, with the Agentless Passive/Reflexive suffix does not have such a requirement. The latter type of suffixation also shows that there is a requirement on the whole Prosodic Word to be footed. Note that it is not necessary to say that the first type of suffixation does not have the requirement on the whole Prosodic Word to be parsed into feet, just that the subcategorization requirement on the root shape supercedes the constraint on exhaustive parsing of the Prosodic Word.

To summarize, we discussed several phenomena that are related to prosody in Ibibio: the distribution of high vowels that indicates the position of the prominent syllable (Prosodic Word-initial); voiceless stop lenition that applies to onsets of post-tonic syllables; and finally, the two types of suffixation that help us define the foot structure in the language.

Since the voiceless stop lenition, previously analyzed as depending on foot structure, is recast here as sensitivity to prominence, it is not surprising that lenition in Ibibio shows signs of prominence-driven alternation, at least in that it is triggered by prosody rather than restricted by it and in that the alternation produces allophones like [β], [ɾ], and [ɣ] that are not present in the underlying inventory of the language.

4.5 Local Conclusions

In sum, there appear to be several points of typological dissimilarity between segmental alternations that are dependent on prominence and the ones that depend on foot structure of a language:

(84)

Prominence-dependent alternations	Foot structure-dependent alternations
triggered by position of prominence	restricted by foot structure
can produce allophonic alternates	produce contrastive alternates
optional in whether the alternation occurs; optional alternates	obligatory alternations; no optionality in reflexes of alternations
strictly local, segment-to-segment adjacency plays an important part	locality only in terms of position of the target within the structural unit (foot)

While none of the typological differences between the two types of alternations are exceptionless, the tendencies do exist in languages. This fact suggests that the notion of unbounded feet is not tenable, as cases of segmental alternation do not single out any such constituent in the same way they mark bounded feet.

We will take up the exceptionality of the typological differences outlined above and how they should be viewed in the context of synchronic grammar in the conclusions to this thesis. In the next chapter we will deal with cases of prosody/morphology interaction as it relates to segmental alternations.

In the case studies we have presented in this dissertation, there is no segmental alternation that depends on an unbounded foot when prominence assignment relies on different constraints. A hypothetical case below illustrates what such a language would look like:

(85) A non-existing language (schematic)

/melinə/-/-/daru/-/to/-/le/	mélinə-(dara-ta-la)
/ate/-/-/daru/-/to/-/le/	áte-da(ru-tu-lu)
/ri/-/-/daru/-/to/-/le/	rí-daru-(to-lo)
/porameni/-/-/daru/-/to/-/le/	pórame(ni-diri-ti-li)

The language above has uniformly initial stress and total vowel harmony that is triggered by the unbounded-foot initial syllable, where all the vocalic features are spread from the fourth vowel in the word throughout unbounded foot. In essence, the pattern is similar to vowel harmony in Mwotlap, where vowels within a foot harmonize, except in the hypothetical pattern in (85), the foot would have to be unbounded. Such a pattern, to the best of my knowledge, does not exist, which leads us to conclude that the notion of 'unbounded foot' is not part of grammar and should therefore be abandoned.