CHAPTER 3

Umlaut in Chamorro

3.1 Introduction

Umlaut in Chamorro involves the fronting of stressed stem-initial vowels as a result of spreading backness features from certain prefix/particle vowels (almost all of which are *i*). This is illustrated in (1) with the definite determiner *i*.[1]

(1)	nánɑ	'mother'	i nǽnɑ	'the mother'
	gúmɑʔ	'house'	i gím̀ɑʔ	'the house'
	cúpɑ	'cigarettes'	i cí̀pɑ	'the cigarettes'
	sóŋsuŋ	'village'	i séŋsuŋ	'the village'
	hágɑ	'daughter'	i hǽgɑ	'the daughter'
	átcuʔ	'rock'	i ǽtcuʔ	'the rock'
	dáŋkulu	'big one'	i dǽŋkulu	'the big one'
	láhe	'male'	i lǽhe	'the male'
	tómo	'knee'	i témo	'the knee'

Of interest here is the fact that umlaut appears noniterative. When stress is not stem-initial, umlaut can neither spread through the intervening vowels to

[1] All Chamorro data are from the following sources: Chung (1983), Conant (1911), Crosswhite (1996), Klein (2000), Topping (1968, 1969, 1973), Topping et al. (1975), von Preissig (1918). I follow Chung's transcription system except that *æ* is used in place of Chung's *ä*, and *ɲ* is used instead of *ñ*. Primary stress is marked with an acute accent, and secondary stress is marked with a grave accent. I abstract away from certain alternations in the low vowels, showing only the front/back distinction as it relates to umlaut.

reach the stressed vowel, nor can it skip over these unstressed vowels. Instead, umlaut does not occur at all in this situation:[2]

(2)	pulónnun	'trigger fish'	i pulónnun	'the trigger fish'
	mundóŋgu	'cow's stomach'	i mundóŋgu	'the cow's stomach'

This pattern contrasts with Spanish metaphony, which exhibits either spreading through intervening vowels or skipping intervening vowels depending on the dialect (Walker 2004). It seems as though Chamorro umlaut is truly noniterative in the sense that if the target (stress) cannot be reached with one iteration of spreading, then umlaut is not permitted. This is roughly the characterization of umlaut that Klein (2000) adopts. Since the central claim of this dissertation is that truly noniterative phenomena are nonexistent, I argue in this chapter that the preceding characterization of Chamorro umlaut is incorrect. Rather than treating stress as the target of umlaut (i.e., the position to which [–back] is attracted), the analysis below argues that stress triggers spreading to the root: immediately pretonic prefixes/particles must spread their [–back] features to the root. When stress is not root-initial, as in (2), the prefix/particle is not immediately pretonic, and umlaut does not occur because its prerequisites are not met. Stress appears to be the target simply because it falls in the root-initial syllable, but in actuality [–back] targets the root. Thus there is no reason to expect spreading to seek out a non-initial stressed syllable.

[2]But see §3.5 for cases of stress-insensitive umlaut.

3.2 The Facts and the Problem

3.2.1 Noniterativity in Chamorro

Other morphemes that trigger umlaut are shown in (3). Affix-root boundaries are marked with a hyphen, and particles are separated from roots by a space.[3]

(3)				
	kátta	'letter'	ni kǽtta	'the letter (obl.)'
	húŋuk	'to hear'	in-híŋuk	'we (excl.) heard'
	fógon	'stove'	ni fégon	'the stove'
	óksoʔ	'hill'	gi éksoʔ	'at the hill'
	túŋoʔ	'to know'	en tíŋoʔ	'you (pl.) know'
	góde	'to tie'	g-in-éde	'thing tied'
	lágu	'north'	sæn-lǽgu	'towards north'
	ótdot	'ant'	mi-étdot	'lots of ants'

Two properties distinguish this phenomenon from standard cases of umlaut such as that found in German (Klein 2000, McCormick 1981, van Coetsem & McCormick 1982). The first is the sensitivity to stress mentioned above. Second, whereas German umlaut occurs at the right edge of the stem with regressive spreading onto stem-final vowels from suffixes, Chamorro umlaut has progressive spreading at the left edge.

[3]Glosses for affixes and particles: *ni* 'oblique case,' *in-* '1pl. exclusive,' *-in-* 'passive,' *-in-* 'nominalizer,' *gi-* 'local case,' *en* '2pl.,' *sæn-* 'in the direction of,' and *mi-* 'abounding in.'

Chung (1983:45) notes that umlaut is partly morphologized in that "[t]he particles and affixes that trigger the fronting must be listed, and each is associated with a slightly different set of conditions." Most of the literature on umlaut focus on cases in which the trigger is the definite article *i*. I do the same here, and I make the simplifying assumption that all umlaut triggers behave like *i*. See §3.2.2.2 for more discussion of the range of patterns.

One immediate question, and the one that is central to this chapter, is why doesn't [–back] spread through the unstressed syllables to the stressed syllable in (2)? If the impetus for umlaut is the desire to have the prefix or particle's [–back] feature appear on the stressed vowel, why aren't forms like **i pilénnun* and **i mindéŋgu* attested? Or, if, as I argue below, umlaut is better characterized as spreading to the root, why is it acceptable to alter a stressed vowel but not an unstressed vowel?

These questions are especially puzzling in light of standard conceptions of faithfulness within OT. Beckman's (1999) Positional Faithfulness model asserts that prominent positions are subject to stricter faithfulness requirements that are formalized in the form of position-specific faithfulness constraints. For example, IDENT[back]-$\acute{\sigma}$ militates against changes to the backness features of segments in stressed syllables. This constraint exists alongside the more general IDENT[back], which prevents changes to any backness feature, regardless of its host segment's position in the larger phonological structure. These two constraints rule out grammars in which only stressed syllables' backness features can be changed. Since changes to a stressed vowel incur violations of both the stress-specific and generic IDENT constraints, candidates that change an unstressed vowel harmonically bound candidates that change a stressed vowel, as (4) shows.

(4)

dúpu	IDENT[back]-$\acute{\sigma}$	IDENT[back]
a. dípu	*	*
☞ b. dúpi		*

For Chamorro specifically, the fact that umlaut changes stressed vowels entails the ranking UMLAUT ≫ IDENT[back]-$\acute{\sigma}$, where UMLAUT is the constraint that triggers umlaut. But since unstressed vowels block spreading of [–back], we must also have the ranking IDENT[back] ≫ UMLAUT. As (5) shows, the combined rankings incorrectly block spreading to stressed vowels as well as unstressed vowels, as indicated by ☹:

(5)

i gúmɑʔ	IDENT[back]	UMLAUT	IDENT[back]-$\acute{\sigma}$
☹ a. i gúmɑʔ		*	
(☞) b. i gímɑʔ	*!		*

This is not a defect of Positional Faithfulness. This is exactly what the theory is designed to do: Crosslinguistically, prominent positions are not targeted by processes unless their non-prominent counterparts are also targeted. Chamorro seems to be an exception. Umlaut spreads [–back] to stressed vowels, but spreading is blocked by unstressed vowels in exactly the way Positional Faithfulness predicts to be impossible.

An important claim of this chapter is that the noniterative characterization of umlaut is incorrect. Chamorro's umlaut is not truly noniterative. This chapter develops an analysis in which the (apparent) unstressed-vowel blocking effects and noniterativity are the result of a fixed constraint subhierarchy derived from a prominence hierarchy. The argument advanced here is that umlaut reflects a requirement that a subset of prefix/particle [–back] features must be linked to the root, just like suffixal ATR features in Lango. The prefix/particle features that must be root-licensed in Chamorro are those that are pretonic. As in Lango,

spreading to the root enhances the prominence of these affixes'/particles' features, and licensing is required only of immediately pretonic affixes/particles because, as argued below, pretonic syllables are particularly weak in Chamorro. Umlaut therefore involves spreading [–back] from a weak position to a stronger one just as we saw in Lango's harmony in the previous chapter. In fact, the analysis below, like the one developed for Lango, calls on Positional Licensing to produce umlaut. But whereas Lango's Licensing constraint required all ATR features to be root-licensed, Chamorro's Licensing constraint holds only for [–back] features in syllables that immediately precede primary stress.

By requiring only immediately pretonic [–back] features to be licensed, the interaction with stress is produced. Umlaut occurs only with root-initial stress because only in this context are prefixes immediately pretonic and thus subject to the Positional Licensing constraint.

The failure of umlaut in *i pulónnun* is not the result of blocking by unstressed vowels or a locality restriction. Instead, since the definite article is not immediately pretonic in this form, the Licensing constraint does not motivate spreading. In general, when the prefix/particle is separated from the stressed syllable by unstressed syllables, the Licensing constraint is not violated to begin with, and no repair strategy (i.e. spreading) is necessary. This analysis is developed in §3.3.1, but first I discuss some other properties of Chamorro umlaut that complete the empirical picture.

3.2.2 Other Properties of Umlaut

3.2.2.1 Optional Umlaut on Secondary Stress

An important factor that complicates the picture is secondary stress, which arises under two conditions in Chamorro. First, primary stress can move under affixation. When this happens, secondary stress appears where primary stress would have appeared had their been no affixation. Chung (1983) uses this fact to argue for the cycle (although she later argues that the cycle alone is insufficient to account for umlaut): Primary stress is assigned to the bare root on one cycle, and on a later cycle, affixation triggers the placement of a different primary stress. The original primary stress is demoted to secondary status. (6) shows words of this sort, with suffixes in (6a) and prefixes in (6b). The syllable that immediately precedes the primary stressed syllable cannot bear stress at all, hence the loss of stress in the last form in (6a). Notice that the first form in (6b) shows that the ban on adjacent stresses does not apply when the second stress is secondary.

(6) a.

swéddu	swèddunmámi
'salary'	*'your (sg.) salary'*
inéŋŋulu?	inèŋŋuló?ɲa
'peeping'	*'his peeping'*
mímantìka	mìmantikáŋa
'abounding in fat'	*'more abounding in fat'*

b.

néŋkanu?	mínèŋkanu?
'food'	*'abounding in food'*

ɑdǽhi	gófɑdàhi
'be careful'	*'be very careful'*
kwentúsi	ǽkwentùsi
'to speak to'	*'to speak to one another'*

When a stem-initial vowel acquires this kind of secondary stress (*cyclic* secondary stress), it may optionally undergo umlaut:[4]

(7)	púgɑs	'uncooked rice'	mí̀pìgɑs,	'abounding in uncooked rice'
			mí̀pùgɑs	
	gúmɑʔ	'house'	i gì̀mɑʔní̀hɑ,	'their house'
			i gùmɑʔní̀hɑ	
	kóbbli	'cash, money'	i kèbblinmámi,	'our (excl.) cash'
			i kòbblinmámi	

Interestingly, this holds also for vowels whose stress has been deleted due to the clash prohibition:

(8)	cúpɑ	'cigarettes'	i cupáɲɑ,	'his cigarettes'
			i cipáɲɑ	
	sóŋsuŋ	'village'	i suŋsóŋŋɑ,	'his village'
			i siŋsóŋŋɑ	

Chung (1983) accounts for umlaut in these cases by appealing to transderivational relationships. In a way that is remarkably reminiscent of more recent transderivational frameworks developed for OT (e.g. Benua 1997), her analysis permits

[4]According to Chung (1983), this optionality appears only in the Saipan dialect. Umlaut in with cyclic secondary stress may be obligatory in the Guam and Rota dialects.

umlaut to occur on a non-primary stressed syllable if this syllable bears primary stress in a transderiviationally related, morphologically simpler form. Crosswhite (1996) develops an Output-Output Faithfulness (Benua 1997) analysis that is similar to Chung's approach. Based on arguments against the OO-Faith approach by Klein (2000),[5] I turn away from this line of reasoning and adopt an analysis of optional umlaut grounded in Stratal OT (Kiparsky 2000, Rubach 1997) in §3.6.

Alongside the *cyclic* secondary stress shown in (6), *rhythmic* secondary stress is also assigned to alternating syllables to the left of primary stress:

(9)	àtmaygósu	'vegetable sp.'		
	kì̀masón	'to burn'		
	magágu	'clothes'	màgagúŋa	'his clothes'
	bapót	'ship'	bàpotníha	'their ship'

Umlaut cannot target vowels in secondary stressed syllables of this sort:

(10)	pùtamunéda	'wallet'	i pùtamunéda,	'the wallet'
			*i pì̀tamunéda	

In light of the transderivational condition on umlaut on secondary stress noted above, the failure of umlaut here is simply a product of the lack of a suitable transderivational relative of *i pùtamunéda* in which the initial syllable has primary stress. Umlaut can target secondary stress only when a related form has primary stress on the root-initial syllable, so umlaut is impossible in (10). Under the Stratal OT approach developed below, umlaut cannot occur in (10) because

[5]There is not always a base that undergoes umlaut and can provide motivation for umlaut in a complex form. E.g., *mí-ì̀can* 'lots of rain' (from *úcan* 'rain') has no base **í̀can*.

rhythmic secondary stress (but not cyclic stress) is assigned in a stratum after the one in which umlaut occurs.

3.2.2.2 Exceptions

There are a number of cases that do not adhere to the above generalizations. Throughout this chapter I ignore these exceptions to keep the discussion focused.

Umlaut sometimes occurs when the prefix/particle lacks a front vowel:

(11)	dónniʔ	'hot pepper'	fɑʔ-dénniʔ	'to make hot sauce'
	hánom	'water'	fɑʔ-hánom	'melt, cause to liquify'

Perhaps morphemes like *faʔ-* are diachronically related to morphemes with front vowels and therefore were formerly ordinary participants in umlaut. I assume that these morphemes are genuine exceptions in modern Chamorro, and I will not analyze them here.[6]

There are also front-voweled prefixes that unexpectedly do not trigger umlaut. For example, *géʔ-*[7] 'about to, try,' when affixed to *túngoʔ* creates *géʔ-tùngoʔ*, and there is unexpectedly no optional variant **géʔ-tìngoʔ*. It is tempting to say that umlaut fails here because the prefix bears greater stress than the root-initial vowel (so spreading wouldn't increase the feature's prominence), but umlaut in fact can occur under such conditions, as (7) shows. Prefixes like *géʔ-* and *faʔ-* are simply exceptional, and an account similar to the one Klein (2000) adopts for these exceptions seems most appropriate; see §3.4.2.

[6] An obvious analysis involves positing a floating [–back] feature on *faʔ-*. The challenge for that approach is in ensuring that this floating feature only surfaces in umlaut contexts.

[7] I follow Chung (1983) in transcribing this morpheme as *géʔ-* rather than Klein's (2000) *gé-*.

Additionally, Chung (1983) notes that some loanwords do not undergo umlaut: *i bóti* 'the boat.' Umlaut may also occur without an obvious overt trigger: *tája?ci?có?ɲa* 'He has no work/His work does not exist' (cf. *có?cu?* 'work'). Umlaut is also occasionally insensitive to stress, a point which is addressed in §3.5 below.

3.3 Canonical Umlaut in Chamorro

3.3.1 The One-Syllable Spreading Limit

The data in (1) and (2) suggest that umlaut in Chamorro is limited to spreading by a single syllable. If spreading rightward exactly once does not place the prefix's/particle's [–back] feature in the stressed syllable, no spreading happens at all. Viewed this way, umlaut is a restricted version of an attraction-to-stress (e.g. Walker 2004) or vowel harmony process. This is in fact the position that Conant (1911:146) takes in comparing Chamorro to languages like Turkish, Hungarian, and Finnish. He speculates on

> the analogies that may be found to exist between the phenomena produced by a limited operation of the [vowel harmony] law, as in Chamorro, and those produced by its more general and vigorous activity in languages of the purely agglutinative type.

This section develops an analysis of this property that uses Positional Licensing (Crosswhite 2000, 2001, Itô 1988, Itô & Mester 1994, 1999, Steriade 1994a,b, 1995a, Walker 2001, 2004, Zoll 1997, 1998a,b) and constraint subhierarchies (Padgett 2002a, Prince & Smolensky 1993[2004]). The analysis argues for the position

that Chamorro's umlaut is neither attraction-to-stress nor vowel harmony. Instead, it involves, like Lango, simply spreading to the root (which is a prominent position, so umlaut is in that regard related to attraction-to-stress phenomena) triggered by root-initial stress. Conant's comparison is certainly instructive in terms of the typological range of assimilatory processes it highlights, but the close kinship he sees between Chamorro and vowel harmony in "languages of the purely agglutinative type" is formally inaccurate.

I discuss constraint subhierarchies in §3.3.1.1, drawing significantly on Padgett (2002a), and then turn to their application in a Positional Licensing analysis in §3.3.1.2.

3.3.1.1 Constraint Subhierarchies: Metrical and Morphological Prominence

Universal constraint subhierarchies can be derived through what Prince & Smolensky (1993[2004]:141) call *Prominence Alignment,* "in which scales of prominence along two phonological dimensions are harmonically aligned." In their example, the preference for sonorous syllable nuclei and nonsonorous syllable margins is derived from the two prominence hierarchies in (12), where '>' means "is more prominent than." The first hierarchy indicates that peaks are more prominent than margins, and the second hierarchy reflects the sonority scale.

(12) a. Peak > Margin

b. $a > i > \ldots > d > t$

The scales can be "merged" as in (13). As Padgett (2002a:5) explains, "[t]he intuition here is that the most prominent syllable position (nucleus) is best associated with the most prominent kind of sound," as indicated by '$\succ$,' and the least prominent syllable position (margin) is best associated with the least prominent kind of sound.

(13) a. $P/a \succ P/i \succ \ldots P/d \succ P/t$

b. $M/t \succ M/d \succ \ldots M/i \succ M/a$

These aligned hierarchies motivate a fixed constraint ranking expressing universal peak and margin preferences:

(14) a. *P/t $\gg$ *P/d $\gg \ldots$ *P/i $\gg$ *P/a

b. *M/a $\gg$ *M/i $\gg \ldots$ *M/d $\gg$ *M/t

Padgett (2002a) argues for a more general understanding of constraint subhierarchies in which they reflect scales of universal articulatory, perceptual, or processing factors. He further proposes a method for projecting constraint subhierarchies:

(15) *Projection of Universal Constraint Subhierarchies*

a. Given a scale of articulatory/perceptual/processing difficulty D:
$D_n > D_{n-1} > D_1$
(where '$>$' means 'more difficult than')

b. Project a universal constraint subhierarchy: $C_n \gg C_{n-1} \gg C_1$
(where $C_i = {}^*D_i$)

To use an example that Padgett (2002a:5) cites from Walker (2000), the subhierarchy in (16b) can be projected "based on the principle that nasality is aerodynamically incompatible with increasing stricture." This incompatibility is expressed by the scale in (16a).

(16) a. Nas/Obst-stop > Nas/Fric > Nas/Liq > Nas/Glide > Nas/Vowel

b. *Nas/Obst-stop ≫ *Nas/Fric ≫ *Nas/Liq ≫ *Nas/Glide ≫ *Nas/Vowel

I adopt Padgett's broadened view of constraint subhierarchies here. (See below for a demonstration that, as I understand it, Prince & Smolensky's algorithm yields incorrect results for Chamorro.) These subhierarchies let us ban the "worst of the worst" (WOW; Padgett 2002a, Smolensky 2006): Nasalization is articulatorily marked, and obstruent stops are particularly poor candidates for nasalization, so *Nas/Obst-stop, the highest-ranking constraint from (16b), bans the worst kind of nasalized consonant.

Chamorro exhibits a WOW effect: Umlaut only targets the especially weak position of an immediately pretonic (henceforth simply "pretonic") prefix/particle. Pretonic syllables on the one hand, and prefixes/particles on the other, are perceptually or cognitively weak elements, and, in WOW-like fashion, umlaut appears where these two dimensions of weakness converge. Evidence that pretonic position is weak, at least in Chamorro, comes from the fact that syllables in this position are destressed, as was shown in (6a). Furthermore, there is evidence that unstressed vowels in general are reduced in Chamorro. Unstressed *a* and *æ* reduce (in the sense of Crosswhite (2001)) to *a*. As there is already pressure to-

ward reduction of unstressed vowels generally, it is not unreasonable to think that there may be "extra" pressure on vowels in certain positions (crucially pretonic position).

One possible explanation for pretonic reduction is that Chamorro requires stressed syllables to contrast as much as possible with surrounding (and specifically pretonic) syllables, and therefore the pretonic syllables themselves must not be prominent. Rachel Walker (p.c.) suggests that Chamorro wants a sharp rise in intensity, etc., at the onset of primary stress, rather than the more gradual rise that a sequence of secondary stress followed by primary stress would entail. Perhaps this is motivated by a desire for the locus of primary stress to be clearly recoverable. In any case, I take metrical weakness (i.e. the perceptual differences between syllables in various prosodic contexts) to be a form of "articulatory/perceptual/processing difficulty" as required in (15a). The scale that instantiates this dimension of difficulty is given in (17). The term "non-pretonic" is used here to refer to unstressed syllables that do not immediately precede primary or secondary stress. Although distinctions among non-pretonic positions are possible (for example, post-tonic syllables may be crosslinguistically weaker than other non-pretonic syllables because they often reduce (Hyman to appear)), such distinctions are irrelevant to the current analysis.

(17) Pretonic > Pre-Secondary > Non-Pretonic > Secondary Stress > Primary Stress

Some dialects of Russian have vowel reduction patterns that treat (immediately) pretonic vowels differently from other unstressed vowels (Crosswhite 2001).

In these cases, though, pretonic vowels undergo less drastic reduction than other vowels. But Crosswhite's (2001) analysis takes Russian to be iambic, and therefore the pretonic vowel is footed, whereas other unstressed vowels are not. In a trochaic language like Chamorro (Flemming 1994), pretonic vowels are not footed, and consequently they should not be protected from (extreme) reduction in the way pretonic vowels in Russian are. Instead, concerns like creating a sharp contrast between stressed and unstressed syllables are free to encourage greater pretonic reduction in Chamorro.

Other cases of vowel reduction before prominent syllables can be found cross-linguistically. In Irish, "a short vowel immediately before the accented syllable may be elided" (Ó Siadhail 1989:23). In Chi-Mwiːni, syllables to the left of the phrasal antepenultimate syllable are shortened (Kenstowicz & Kisseberth 1977): *nuːmba* 'house' → *numbaː ŋkʰuɬu* 'large house.' One possible interpretation of this fact is that the antepenultimate syllable is prominent (perhaps stressed). Like Chamorro, Chi-Mwiːni reduces the prominence of syllables that precede the word or phrase's prominent position.

Similarly, Nevins & Vaux (2008a), citing personal communication with José Olímpio Magalhães, characterize the optional raising of vowels to the left of stress in Brazilian Portuguese as vowel reduction. One consequence of the optional nature of raising is that vowels farther away from the stressed syllable raise only if all the vowels closer to stress also raise. This fact lends support to the claim above that immediately pretonic vowels may be especially weak: Other vowels may reduce only if the immediately pretonic vowel reduces.

Various Italian dialects have reduction phenomena that specifically target pretonic vowels (Maiden 1995). For example, in some dialects, all vowels to the left of stress reduce to ə, except that /a/ remains unreduced.

A final example comes from Shimakonde (Liphola 2001). Here, unstressed mid vowels to the left of the (penultimate) stressed syllable optionally reduce to *a*. The optionality is similar to that of Brazilian Portuguese except that a vowel may reduce only if every vowel to its *left* also reduces.

Of course, there are many other languages with post-tonic reduction. Either (17) is not a universal scale (which does not affect its utility for Chamorro), or languages that seem to contradict the scale possess other factors (such as Russian's iambs) that suppress the relationships expressed by the scale. (15) is intended to generate universal hierarchies, but in case (17) proves to be specific to Chamorro, it seems reasonable to expect (15) to be employed on a parochial basis as well in areas where articulatory, perceptual, or processing difficulty can vary across languages.

Turning to the second prominence scale in Chamorro's WOW effect, prefixes, and affixes more generally, are morphologically weak compared to roots. Roots are "prominent positions which license more contrasts than other non-prominent positions" (Urbanczyk 2006:194; see also Beckman 1999, Kaplan 2008a, McCarthy & Prince 1995, Steriade 1995b). As phonemic and prosodic contrasts are keys to correct identification of lexemes by hearers, affixes are at a disadvantage compared to roots. See Ussishkin & Wedel (2002) for an overview of the issues at hand.

Beckman (1999:192) cites three lines of psycholinguistic evidence pointing to the conclusion that roots are more prominent than affixes. First, affixed forms

prime their roots as effectively as the roots prime themselves (Fowler et al. 1985, Kempley & Morton 1982, Stanners et al. 1970). Fowler et al. (1985) show that when subjects are asked to decide whether a visually-presented string of letters is a word, they respond faster when they have already seen the same word or an inflected version of the word. They argue that this must be lexical priming and not simply recognition of a repeated stimulus ("lexical" vs. "episodic" priming) because non-words do not show the same priming effect. The priming effect even holds for orthographically and phonologically dissimilar members of a paradigm (*clear* vs. *clarify*; *heal* vs. *health*). Furthermore, their experiments reveal no statistically significant difference between the priming effects of inflectional and derivational affixes. They also argue against the view that their results reflect semantic rather than morphological priming. (E.g., derived words may be semantically distant from their roots.) A version of one of their experiments that uses auditory rather than visual stimuli confirms their results.

The particles that trigger umlaut in Chamorro share relevant properties with prefixes. They are function morphemes, and, as clitics, they are not phonologically independent units. With respect to the definite morpheme in particular, Chung (1983:50) says, "*i* gives no evidence of being a separate phonological word, despite the fact that it is traditionally written as such." It therefore seems safe to treat these particles as prefixes for present purposes, keeping in mind that they are in fact morphosyntactically distinct from prefixes.

The research cited above offers various explanations for the weakness of affixes, and I take this weakness to reflect the "articulatory/perceptual/processing difficulty" from (15a). The scale for this dimension is shown in (18).

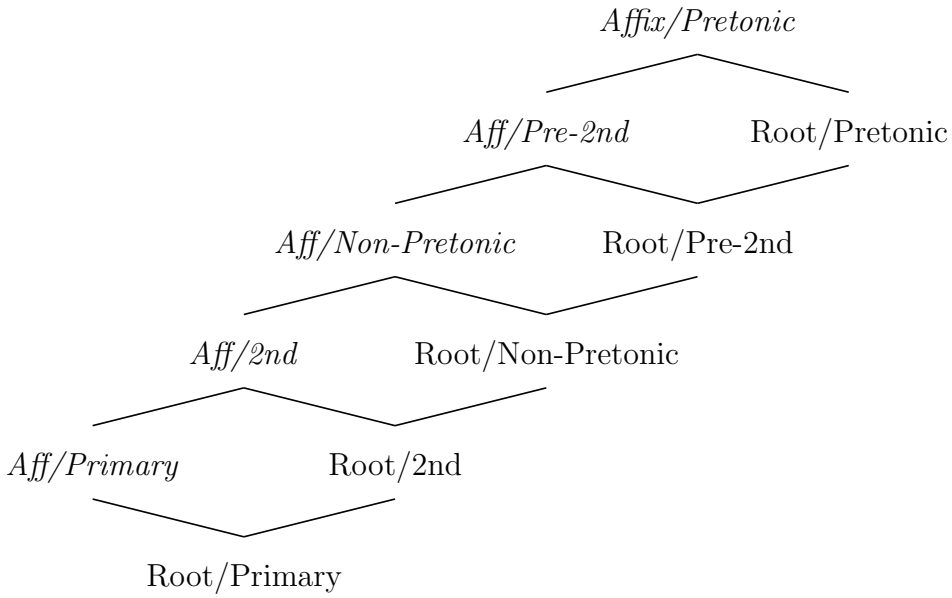
(18) Affix > Root

This scale assumes that prefixes and suffixes are treated the same, whereas Chamorro has umlaut only from prefixes. The analysis developed below accounts for this asymmetry independently, so I will not refine (18). However, it may be possible to assign prefixes and suffixes to different positions in the prominence scale, with the former being weaker than the latter. This would permit constraints that hold only for prefixes to be projected. Hyman (2008, to appear) points out that suffixes are crosslinguistically more common than prefixes, and there are few if any cases of prefix-controlled vowel harmony. In contrast, root-controlled harmony is very common, as is regressive harmony from suffixes.

In sum, prefixes and particles are weak positions, and pretonic prefixes and particles are weak along both prosodic and morphological dimensions and therefore especially weak. We need a scale that captures this two-dimensional weakness, and we can generate such a scale by merging the scales in (17) and (18) to produce (19). Diagonal lines in this lattice show prominence/weakness relationships that follow from the simple scales, with higher items being weaker or less prominent than lower items. For example, pretonic affixes are weaker than both affixes that immediately precede secondary stress (because pretonic syllables are weaker than pre-secondary syllables) and pretonic roots (because affixes are weaker than roots). Also, this scale shows that pretonic affixes are the weakest elements (of those considered here) and primary stressed roots are the strongest elements. Transitive relationships hold in this lattice, too, so pretonic affixes, for example, are necessarily weaker than pre-secondary roots because pre-secondary affixes and pretonic roots are stronger than the former but weaker than the lat-

ter. But no *a priori* relationship holds between items on the same row. There is no way to determine whether pre-secondary affixes are stronger or weaker than pretonic roots, for example.

(19)



Subhierarchies can be extracted from the lattice. The one relevant to the analysis below consists of the italicized items in (19). This subhierarchy is given in (20), where '>' again means "more difficult than." This hierarchy indicates that an affix's position with respect to the metrical structure of a word affects the affix's prominence.

(20) Affix/Pretonic > Affix/Pre-Secondary > Affix/Non-Pretonic > Affix/Secondary Stress > Affix/Primary Stress

We now have a prominence scale that, like (16a), expresses a relationship between two linguistic dimensions. The constraint families that scales like (20) can motivate come in two varieties. In Prince & Smolensky (1993[2004]), Smolensky

(1995), Zoll (1998b), and Padgett (2002a), Positional Markedness[8] constraints like the ones in (21) are generated. Since pretonic prefixes are the least prominent elements in (20), a constraint banning pretonic affixes is projected at the top of the subhierarchy. Non-pretonic affixes are the next least prominent elements on the hierarchy, so a constraint banning them is second on the constraint subhierarchy, and so on.

(21) *Affix/Pretonic ≫ *Affix/Pre-Secondary ≫
*Affix/Non-Pretonic ≫ *Affix/Secondary Stress ≫
*Affix/Primary Stress

But we can instead adopt constraints that recognize the markedness of weak positions by requiring elements to be licensed by strong positions. This is the style of constraint adopted by, e.g., Itô & Mester (1994), Walker (2001, 2004) and Crosswhite (2001), although their constraints are not explicitly derived from scales like (20). (Zoll (1997, 1998b) frames her constraints in terms of licensing, but her constrains are formally more similar to those in (21).)

Walker (2001) analyzes spreading of [+high] in Veneto Italian from suffixes to stressed syllables as spreading to a prominent position under pressure from Positional Licensing. I propose the same thing here. Front vowels are not banned from pretonic affixes in Chamorro. [–back] features in this position are simply required to spread to a more prominent position, namely the root. This is much

[8] I use the term *Positional Markedness* to refer specifically to constraints that categorically ban elements from marked positions. This contrasts with *Positional Licensing* constraints, which state that elements must appear in unmarked positions but do not ban them outright from marked positions. This terminological distinction departs from the practice of others (e.g. Walker (2001), Zoll (1998b)), where both kinds of constraints are categorized as Positional Markedness.

like Lango (see Chapter 2), where suffixes' ATR features spread to the root so as to be linked to a more prominent position. In order to enhance their salience, affix features in Lango, Chamorro, and Veneto Italian must spread to a more prominent position, although what feature spreads and the conditions in which spreading occurs are different for each language. For all three, though, spreading is produced by Positional Licensing.

Both Crosswhite (1996) and Klein (2000) account for Chamorro umlaut with similar constraints. Crosswhite's constraint requires (some part of) the definite morpheme to align with primary stress, and Klein (2000) adopts a constraint requiring bases (i.e. roots) to begin with a front vowel. Although neither analysis is explicitly grounded in either Positional Licensing or markedness facts, either one can be viewed in this light. The key insight in these analyses is that umlaut is driven by a desire to place [–back] in a prominent position—either the stressed syllable or the root—rather than by, say, a desire to spread one syllable to the right. That is, umlaut's goal is to spread to a target rather than to simply spread. The analysis proposed here exploits this insight, but it departs from Crosswhite (1996) and Klein (2000) in a way which, we will see shortly, is very advantageous: It takes stress to be part of the trigger for umlaut rather than the target (cf. Crosswhite) or an irrelevant distraction (cf. Klein). See §3.4 for more about these alternatives.

Positional Licensing constraints can require segments and features to meet certain conditions that enhance their prominence. In Lango, suffix ATR features are licensed if they are also associated to a root segment. A similar statement can be made for Chamorro: Pretonic affix backness features are licensed if they are also

linked to a root segment. Rather than projecting the constraint subhierarchy in (21) from (20), we can project the constraint subhierarchy in (22) from (20). The principles are the same, except that instead of projecting constraints that ban non-prominent configurations, we project constraints that impose requirements that these non-prominent configurations must meet to be acceptable. Licensing constraints let us encode markedness desiderata in the constraint formalism without banning marked elements altogether.[9]

(22) License-Pretonic ≫ License-Non-Pretonic ≫ License-Secondary ≫ License-Primary

These constraints are defined in (23), and each is relativized to [–back] since this is the feature that spreads in Chamorro. Following Walker (2001), I assume that [–back] and [+back] are subject to distinct Licensing constraints.[10] Each constraint requires a backness feature in a position of greater or lesser (metrical) prominence to be also linked to a position of greater (morphological) prominence, namely the root.

(23) a. License-Pretonic: Pretonic [–back] features must be linked to root segments.

b. License-Pre-Secondary: [–back] features that immediately precede secondary stress must be linked to root segments.

[9]It is possible that is hierarchy—and thus the prominence scales it is based on—could be formulated as a stringency scale in the style of de Lacy (2002a). Such a reformulation would have no practical consequence for the current analysis, so I will not attempt it here.

[10]In the analysis of Lango in Chapter 2, I argued for a single License-ATR constraint that holds for both [+ATR] and [–ATR]. In that analysis, both values of [±ATR] spread, so the simplest analysis uses just one Licensing constraint. An equally plausible approach uses both License-[+ATR] and License-[–ATR] and ranks them adjacently.

c. LICENSE-Non-Pretonic: Non-pretonic [–back] features must be linked to root segments.

d. LICENSE-$\grave{\sigma}$: Secondary stressed [–back] features must be linked to root segments.

e. LICENSE-$\acute{\sigma}$: Primary stressed [–back] features must be linked to root segments.

The same word of caution from Chapter 2, p. 75, holds here: Unlike Crosswhite's (2001)'s licensing constraints, these do not require [–back] to be wholly contained within the licensing category.

We now have constraints that, in combination with other constraints, can motivate umlaut just when stress is root-initial. The next section constructs an analysis of umlaut around these constraints.

3.3.1.2 Positional Licensing in Chamorro

When IDENT[back] is ranked between LICENSE-Pretonic and LICENSE-Pre-Secondary, only LICENSE-Pretonic can motivate spreading. Prefix backness features that are non-pretonic or stressed will not spread to the root because the Licensing constraints that would trigger spreading are outranked by IDENT[back].

Walker (2001), following Zoll (1998a,b), argues for a universal principle according to which Licensing constraints for marked values of features necessarily outrank their counterparts that refer to unmarked feature values. The idea is that marked elements are subject to greater restrictions than unmarked elements. In the present case, this would mean, e.g., that LICENSE-Pretonic[–back] (23a) is outranked by LICENSE-Pretonic[+back], predicting that both values of [±back]

undergo umlaut. The existence of languages like Chamorro and Veneto Italian (which Walker analyzes; [+high] but not [–high] spreads from suffixes to the stressed syllable) in which only the unmarked feature value spreads seems to call this principle into question, and I do not adopt it here. (However, see Walker (2001) for a strategy that renders the higher-ranked Licensing constraint for the marked feature inert when ranked under a constraint that essentially penalizes new specifications of the marked feature. This permits spreading of only the unmarked feature.)

(24) shows how LICENSE-Pretonic motivates umlaut in words such as *i gíma'*. (I won't address other irrelevant segmental changes that affect this and other forms. See Chung (1983) for these phenomena.) The [–back] feature of the definite article *i* violates LICENSE-Pretonic because this vowel is immediately pretonic, and the [–back] feature is not linked to any root segment. Umlaut corrects this, as the winning candidate shows, and just the lower-ranked IDENT constraint is violated. For space, all Licensing constraints below IDENT[back] are subsumed under LICENSE-Elsewhere.

(24)

/i gúma'/	LIC-Pretonic	IDENT[back]	LIC-Elsewhere
a. i gúma'	*!		
☞ b. i gíma'		*	

Umlaut does not occur in *i pulónnun* because the prefix segment is not pretonic, and therefore, as shown in (25), LICENSE-Pretonic is not violated. This form violates LICENSE-Non-Pretonic, but this violation is unavoidable: Spreading necessarily violates the higher-ranked IDENT[back]. Furthermore, spreading

through the root-initial unstressed syllable to the stressed syllable only exacerbates the problem by adding another IDENT[back] violation.

(25)

/i pulónnun/	LIC-Pretonic	IDENT[back]	LIC-Elsewhere
☞ a. i pulónnun			*
b. i pilónnun		*!	
c. i pilénnun		*!*	

The ranking used here ensures that only pretonic backness features will spread. The Licensing constraints motivate spreading from other positions, but IDENT prevents spreading from all but the pretonic position.

Notice that the constraint definitions in (23) do not make explicit reference to prefixes. That is, LICENSE-Pretonic does not require *prefix* pretonic features to be licensed. It requires *all* pretonic backness features to be licensed. This is not inconsistent with the claim that umlaut occurs because the relevant prefix/particle segments are both pretonic and prefixal. By requiring segments to be linked to the root, these constraints capture the fact that roots are more prominent than affixes.

If LICENSE-Pretonic requires all pretonic segments to be licensed, why don't we see spreading from all pretonic segments? For example, why doesn't *mə̀mantikáŋa* 'more abounding in fat' (6a) surface as **mə̀mantikǽŋa*, with spreading from the antepenultimate vowel to the penultimate (stressed) vowel? The answer is that the actual form does not violate LICENSE-Pretonic because the [–back] feature of the pretonic vowel is already linked to a root segment. No spreading is necessary. This is shown in (26). This also explains why no other Licensing constraints

are violated in (24) and (25). While there are non-pretonic and stressed vowels in these forms, they're all root segments, and they therefore don't violate the Licensing constraints.

In other words, umlaut targets the root, not the stressed syllable. The fact that the source of spreading is always an affix follows from this. The fact that only prefixes—and not suffixes—trigger umlaut is addressed below. (In the case of (26), the suffix doesn't trigger umlaut because it lacks a front vowel.)

(26)

/mɨ̀mɑntiká-ɲɑ/	LIC-Pretonic	IDENT[back]	LIC-Elsewhere
☞ a. mɨ̀mɑntikáɲɑ			
b. mɨ̀mɑntikǽɲɑ		*!	

Umlaut is motivated only when the pretonic prefix contains a front vowel. For example, *man-liʔof* 'they dove' and *naʔ-liʔof* 'cause to dive' do not surface as **man-luʔof* and **naʔ-luʔof*, with [+back] spreading from the plural subject marker *man-* and the causative prefix *naʔ-* to the verb root *liʔof* 'dive.' Spreading in these cases only creates gratuitous violations of IDENT[back] because LICENSE-Pretonic only requires [–back] to be licensed. The Tableau in (27) illustrates this.

(27)

/man-liʔof/	LIC-Pretonic	IDENT[back]	LIC-Elsewhere
☞ a. man-liʔof			
b. man-luʔof		*!	
c. mæn-liʔof		*!	

However, regressive spreading in /i gúmɑʔ/ to create **u gúmaʔ* is still a

possibility and must be ruled out. Both the correct *i gíma?* and **u gúma?* avoid the violation of LICENSE-Pretonic that is incurred by the fully faithful candidate, so we need some way to choose between progressive and regressive spreading. Though incorrect, **u gúma?* is superior to the correct output in that root faithfulness is satisfied at the expense of affix faithfulness, so this candidate better observes the Root-Faith ≫ Affix-Faith metaranking proposed by McCarthy & Prince (1994, 1995). What makes **u gúma?* ultimately suboptimal?

In umlaut, [–back] overwrites [+back] specifications, not *vice versa*. Splitting IDENT[back] into IDENT[+back] and IDENT[–back] (Hall 2006, McCarthy & Prince 1995, Pater 1999) and ranking IDENT[–back] over LICENSE eliminates **u gúma?* but still permits *i gíma?*:

(28)

/i gúmaʔ/	ID[–back]	LIC-Pretonic	ID[+back]	LIC-Else
☞ a. i gímaʔ			*	
b. u gúmaʔ	*!			
c. i gúmaʔ		*!		

Next, why is umlaut limited to prefixes? The scale in (18) and the constraints projected from it treat all affixes equally. This means that suffixes' [–back] features must be licensed just like prefixes' features. Klein (2000) provides the form *kwentús-i* 'to speak to' (cf. *kwéntus* 'to speak'). Why don't we find **kwentís-i*? The answer is that the suffix vowel is not pretonic, so LICENSE-Pretonic does not affect it. It violates only the low-ranked LICENSE-Non-Pretonic, and IDENT prevents satisfaction of this constraint:

(29)

/kwentús-i/	ID[–back]	LIC-Pretonic	ID[+back]	LIC-Else
☞ a. kwentús-i				*
b. kwentís-i			*!	

This is not quite the whole story; the issue of suffix-triggered umlaut is addressed in more detail in §3.3.2.

Finally, yet another way to satisfy LICENSE-Pretonic is by deleting the offending vowel: *i gíma'* could be realized as **gúma'*. Placing MAX sufficiently high in the constraint ranking is sufficient to rule this option out. REALIZE MORPHEME (Kurisu 2001) might also account for this specific example, but it will not work when deleting the offending vowel does not erase the entire prefix.

Returning to the larger theoretical interest of Chamorro umlaut, the apparent noniterativity of this phenomenon is a byproduct of the Licensing constraints. Rather than enforcing spreading to the stressed syllable, LICENSE-Pretonic requires only spreading to the root. Because this spreading is only motivated in pretonic position, umlaut will always target the primary stressed syllable, not because it has primary stress, but because it is the first syllable in the root. Once spreading reaches the root-initial syllable, LICENSE-Pretonic is satisfied, and further spreading is ruled out by IDENT[+back]. This is illustrated in (30). In short, spreading by one syllable is all that is ever needed to satisfy Licensing, and this is why umlaut seems noniterative. We saw exactly the same thing in Chapter 2, where [+ATR] spread just one syllable leftward in Lango because that was all that was needed for this feature to reach the root.

(30)

/i gúmɑʔ/	Id[–back]	Lic-Pretonic	Id[+back]	Lic-Else
☞ a. i gímɑʔ			*	
b. i gímæʔ			**!	

Additionally, spreading through unstressed syllables to reach the stressed syllable (as in **i pilénnun*; see (25)) finds no motivation under the Licensing analysis. The target of spreading is the root, not the stressed syllable, so spreading to a non-root-initial stressed syllable accomplishes nothing. The puzzle that umlaut creates when viewed through the lens of Positional Faithfulness is straightforwardly solved here. The Positional Faithfulness approach seemed to require special faithfulness constraints for non-prominent syllables (see (4)). But under Licensing, spreading through unstressed syllables to reach the stressed syllable is unattested for two reasons. First, the conditions for spreading to occur simply aren't met. If the source of spreading isn't adjacent to the stressed syllable, License-Pretonic is not violated in the first place, so there is no reason to spread. It's not that unstressed syllables block umlaut; rather, they simply don't trigger it. Second, the target of umlaut is the root rather than the stressed syllable, so spreading never specifically seeks a stressed syllable under any circumstance. Viewing umlaut as (i) triggered by stress adjacency and (ii) targeting roots means we do not need additional machinery to rein in umlaut's reach. Noniterativity comes for free, as predicted by the Emergent Noniterativity Hypothesis.

The Positional Licensing analysis of Chamorro sheds light on the puzzling aspects of umlaut and obviates "reverse" Positional Faithfulness. Under Positional Licensing, spreading to the root and failure to spread to unstressed syllables are two sides of the same coin. A single constraint motivates spreading in exactly

the right contexts. Chamorro umlaut provides further evidence that Positional Licensing is an indispensable tool in phonological theory.

As a final note for this section, one question for phonological research to answer is whether or not both Positional Licensing and Positional Markedness (i.e. constraints like *Unstressed-[–back]) are necessary. Positional Markedness has been used to account for phenomena in which weak positions host a reduced range of contrasts compared to strong positions. I argued above that only Positional Licensing can account for umlaut-like spreading. If Positional Licensing can also account for the reduced-inventory facts, Positional Markedness may be superfluous. Although detailed argumentation would be tangential here, I believe this position is at least conceivable. Coupled with constraints banning spreading, such as (Positional) Faithfulness, Positional Licensing can eliminate marked features from weak positions. For example, if Ident[back]-Root were highly ranked in Chamorro, the only way to satisfy License would be to eliminate the prefix's [–back] feature altogether. If this approach is tenable for concrete cases, then Positional Markedness is applicable in a proper subset of the phenomena that Positional Licensing accounts for, and the former is therefore expendable.

3.3.2 Predictions of the Licensing Analysis

In this section I take up two salient predictions of the Positional Licensing analysis. Both concern the behavior of long affixes or strings of affixes. First, as noted above (see discussion surrounding (29)), pretonic vowels in suffixes are subject to License-Pretonic and should trigger umlaut on root-final vowels. The explanation given above for the absence of right-edge umlaut was that suffixes are never

pretonic. This point deserves more attention.

To my knowledge, all suffixes relocate primary stress to the word-penultimate syllable. Consequently, a pretonic (i.e. umlaut-triggering) suffix vowel must be in the antepenultimate syllable, and the Licensing analysis predicts umlaut from suffixes just when there is a suffix or string of suffixes three syllables long. The only instance of multiple suffixation in Chamorro that I am aware of appears in forms like *bidan-ɲíɲiha* 'their doing,' in which the first syllable of the third person plural possessive suffix *-ɲiha* is reduplicated. (The verb root is *bida* 'do, work, act,' and reduplication is a nominalizing process.) This would be the perfect form on which to test the Licensing analysis's predictions but for the fact that stress remains on the antepenultimate syllable and does not shift rightward with reduplication, so there is no pretonic suffix syllable.

As for trisyllabic suffixes, the longest suffix I have identified is *-ɲaihon* 'for a while' (Topping 1973:181), and according to Topping (p. 24), the sequence *ai* is a diphthong. The only other polysyllabic suffix I am aware of is the benefactive focus marker *-iyi* (with allomorphs *-yiyi* after vowels and *-guiyi* after the diphthong *ao*), which is also disyllabic. So it appears that suffixal configurations cannot create the environment necessary to trigger umlaut, and umlaut at the right edge of the word is effectively (and correctly) ruled out.

However, assuming the right suffixation context exists and does not trigger umlaut, it is simple enough to further decompose the morphological prominence scale in (18) so that prefixes and suffixes occupy distinct positions on the scale. Then the constraints that are projected from this scale will be specific to one or the other kind of affix. Using just the constraints that require prefixes to be

licensed will rule out suffixal umlaut.

Alternatively, perhaps some kind of macrostem that includes roots and suffixes is the target of spreading, not the root. In this case, suffixal [–back] features are already licensed, just as root-internal features are. The viability of this approach depends on the plausibility of the macrostem, which can only be determined with a large-scale survey of the morphophonology of Chamorro. As the issue is tangential to the question of noniterativity, I will not pursue it here.

The second prediction is that longer prefixes or strings of prefixes can trigger umlaut over greater distances. For example, the ordinal marker *mina?-* (Topping 1973) contains a front vowel in its first syllable. (The remarks in this and the following paragraph also hold for *pinat-* 'have more of.') If the second syllable of this prefix is stressed, we expect umlaut to be triggered, with [–back] spreading through the prefix's second syllable to the root-initial syllable. When affixed to *kuatro* 'four,' we should find **minæ?-kiatro* (or perhaps **minæ?-kuætro*, depending on the behavior of the *ua* sequence) if stress is peninitial. But the correct form is *mina?-kuatro* 'fourth,' with no spreading at all. Topping (1973), from whom this form is taken, says nothing about the stress pattern of this construction, so I can only speculate on the lack of umlaut.

One possibility is that stress in *mina?-kuatro* is not peninitial, in which case the Positional Licensing analysis correctly predicts no umlaut at all. Alternatively *mina?-* may be an exceptional prefix like *ke?-*. Also relevant is the fact that Conant (1911:145) states (without elaboration) that only monosyllabic morphemes trigger umlaut. More satisfying explanations are these: *mina?-* affixes to words of Spanish origin, which belong to a lexical stratum that is not subject to um-

laut. See §3.4.2.2 below. (Conant (1911:144), though, says Spanish loans are not categorically exempt from umlaut.) The stratified-lexicon tactic will not extend to *pinat-*, which does affix to native Chamorro roots. (But Topping (1973:179) notes that *pinat-* may be separate word, not an affix, in which case umlaut is not expected to begin with.)

Alternatively, umlaut for *mina?-* involves spreading through another affix syllable, and this has the danger of causing homophony. So perhaps umlaut is blocked by affix faithfulness. See Ussishkin & Wedel (2002) for a discussion of the latter point. Of course, all these explanations are moot if the stress pattern isn't conducive to umlaut in the first place.

3.3.3 The Failure of Prominence Alignment

If I understand Prince & Smolensky's (1993[2004]) prominence alignment correctly, it cannot produce the desired outcome for Chamorro. I explain why here. First, we set up the prominence hierarchies (in the notation of Prince & Smolensky (1993[2004]), '>' means "is more prominent than"):

(31) a. Primary Stress > Secondary Stress > Non-Pretonic > Pretonic

b. Root > Affix

These are aligned as in (13):

(32) a. Root/Primary Stress $\succ$ Root/Secondary Stress $\succ$ Root/Non-Pretonic $\succ$ Root/Pretonic

b. Affix/Pretonic $\succ$ Affix/Non-Pretonic $\succ$ Affix/Secondary Stress $\succ$ Affix/Primary Stress

From these hierarchies, the constraint subhierarchies in (33) are projected:

(33) a. *Root/Pretonic ≫ *Root/Non-Pretonic ≫
*Root/Secondary Stress ≫ *Root/Primary Stress

b. *Affix/Primary Stress ≫ *Affix/Secondary Stress ≫
*Affix/Non-Pretonic ≫ *Prefix/Pretonic

These subhierarchies successfully capture the generalization that, since they're already prominent, roots are better aligned with primary stress than with, say, pretonic positions. Likewise, since affixes are inherently weak, placing primary stress on an affix dampens the stress's salience. But these rankings fail to capture the generalization that since affixes are inherently weak, they will be more reliably perceived if they're assigned metrical prominence. Similarly, pretonic affixes are especially non-prominent, so they should be avoided. Hence the rankings in (33b) should be reversed for Chamorro. This is why the analysis above does not follow the prominence alignment procedure although it is inspired by prominence alignment.

In fact, I believe Prominence Alignment will fail to account for Chamorro regardless of the prominence hierarchies one selects. According to the current analysis, umlaut is a strategy for ameliorating non-prominence. Features in a weak position spread to a stronger position. But Prominence Alignment produces constraints that discourage prominence enhancement. As with the examples in (14) and (33), constraint hierarchies produced by Prominence Alignment always have at their top constraints banning weak elements in strong positions or strong elements in weak positions. The lowest-ranked constraints are those that ban

strong elements in strong positions and weak elements in weak positions. These hierarchies encode the fact that weak units (such as [p]) are most suitable for weak positions (such as syllable margins), and strong things (such as [a]) are most suitable for strong positions (such as syllable peaks). But what we need for Chamorro is a constraint discouraging weak elements from (exclusively) occupying weak positions: [–back] spreads from (weak) prefixes in the (weak) pretonic position, but this match of weak-and-weak is exactly what Prominence Alignment favors. To return to the terminology used in §3.3.1.1, Chamorro exhibits a WOW effect in that umlaut surfaces only when weak morphemes are prosodically weak, but Prominence Alignment produces anti-WOW constraints and encourages the intersection of different dimensions of weakness, such as low sonority and syllable margins or affixes and pretonic syllables.

3.4 Alternative Accounts of Umlaut

3.4.1 Crosswhite (1996)

Crosswhite (1996), whose analysis of Chamorro is primarily concerned with transderivational phenomena, presents an account of the noniterative nature of umlaut that rests on the two constraints defined in (34). ALIGN({Def}, Head) motivates spreading in the first place, and LEFTMOST{Def} is intended to confine umlaut to the left edge of the stem. These constraints refer specifically to the definite morpheme *i* because this is the morpheme Crosswhite uses to illustrate umlaut, but it is easy to see how other triggering morphemes can be accommodated, either by broadening the scope of these constraints or positing additional constraints for

each umlaut trigger.

(34) a. ALIGN({Def}, Head): The definite morpheme must align with the head of a prosodic word.

b. LEFTMOST{Def}: The definite marker must occur at the left edge of the stem.

The head of a prosodic word is the primary stressed syllable, so ALIGN({Def}, Head) instructs (some feature of) the definite morpheme to seek this syllable. This is much like the Licensing analysis in that umlaut is driven by a desire place [–back] in a more prominent position.

LEFTMOST{Def} penalizes forms that spread beyond the first stem syllable: **i pilénnun* (cf. *i pulónnun* 'the trigger fish') satisfies ALIGN because the [–back] feature of the definite morpheme has spread to the stressed syllable, but LEFTMOST penalizes this candidate because [–back] has spread beyond the left edge of the stem. Consequently, the ranking LEFTMOST ≫ ALIGN is required: spreading to the stressed syllable only occurs when LEFTMOST is satisfied.

In contrast, *i gíma?* 'the house' is acceptable because spreading does not stray from the left edge of the stem. Since primary stress is stem-initial, both constraints are satisfied.

These constraints may produce the correct surface forms, but they do not elucidate the principles behind umlaut. It is easy to view ALIGN({Def}, Head) as a Positional Licensing constraint requiring the definite article to appear in the main stressed syllable. But LEFTMOST{Def} is rather mysterious in that is sheds no light on why umlaut cannot spread beyond the first syllable.

Crosswhite's analysis therefore shares the problem that arises in any approach (including one based on Positional Faithfulness; see §3.1) that treats umlaut as targeting a specific syllable such as the one with primary stress. In contrast, the Licensing analysis developed above claims that umlaut is instead triggered by this particular syllable and targets the root more generally. Spreading beyond the root-initial syllable is ruled out by Faithfulness and the fact that the Licensing constraint does not require spreading to a particular syllable within the root. Positional Faithfulness and limiting the extent of spreading do not enter the discussion under Licensing, so the extra machinery that reins in spreading in other approaches is unnecessary.

3.4.2 Representation as Pure Markedness

Klein (2000) develops a lengthy analysis of German and Chamorro umlaut under the framework of Representation as Pure Markedness (RPM; Golston 1996, Golston & Wiese 1998). RPM, as implemented by Klein,[11] captures the morphological conditioning of phonological processes by augmenting lexical entries with constraint violation desiderata—specifications that certain constraints must be violated by the winning candidate. Since umlaut is partially morphologically conditioned (not all prefixes with front vowels trigger umlaut; some prefixes with back vowel trigger umlaut), Klein argues that RPM is an appropriate framework for an analysis of Chamorro. I summarize the RPM analysis in §3.4.2.1 and discuss reasons to favor the Licensing analysis over the RPM analysis in §§3.4.2.2–3.4.2.4.

[11] Golston (1996) and Golston & Wiese (1998) replaces entire underlying representations with constraint violation desiderata. Klein's use of RPM is significantly less drastic.

Even though I argue against it, Klein's analysis contains an important insight into how Chamorro's stress system can be captured in a parallel system. This insight has a place in my own analysis of optional umlaut in §3.6.

3.4.2.1 The RPM Analysis

For Klein, umlaut is the product of the Alignment constraint in (35).

(35) L-ALIGN(BASE, [Cor]): All bases must begin with a front vowel.

Front vowels for Klein are assumed to be specified for [Coronal], as opposed to [Dorsal] for back vowels. A base is the unit to which an affix (i.e. the umlaut-inducing prefix or particle) attaches. L-ALIGN(BASE,[Cor]) would trigger umlaut under affixation of all types were it not outranked by DEP[Cor]$_V$, which prevents insertion of coronal features on vowels. L-ALIGN(BASE, [Cor]) can trigger umlaut only when a [Cor] feature is already present on some non-base-initial segment. [Cor] spreads from the definite article in *i gíma'*, but [Cor] cannot be inserted in, say, *g-um-úpu* 'to fly (sg.)' (**g-um-ípu*), and L-ALIGN(BASE, [Cor]) goes unsatisfied.

To block umlaut in *i pulónnun*, Klein adopts the constraint in (36), which penalizes front vowels whose left edges don't coincide with the left edge of a foot. With the footing *i pu(lónnun)*, umlaut cannot occur without violating this constraint.

(36) L-ALIGN([Cor], Ft): The left edge of all front vowels coincides with the left edge of a foot.

Klein's explanation for why umlaut may occur in *i gimáʔ-ɲa* 'his house' but not *i pulónnun* also relies on foot structure. One of Klein's goals is to account for umlaut without invoking transderivational relationships, so he cannot exploit the fact that *i gimáʔ-ɲa* is related to *i gíma'* while *i pulónnun* has no such related form. Instead, he devises an analysis of stress that places the root-initial syllable within a foot in *i gimáʔ-ɲa* but not in *i pulónnun*.

I will not recapitulate the analysis in detail, but here are the basics: Chamorro has by default right-aligned trochees, but two constraints disrupt this system. Alignment constraints require all roots to be right-aligned with a foot and all prosodic words to begin with a foot. (In essence, Klein posits three stress-assignment systems: one that places word-penultimate stress, one that places root-penultimate stress, and one that places prosodic word-initial stress. This is an efficient way to account for what looks like cyclic stress assignment, and it may have a place in the analysis of optional umlaut sketched in §3.6.) The latter requirement produces initial dactyls in words such as *(pùta)mu(néda)* 'wallet.' The former requirement produces parsings such as *(gumáʔ)-ɲa* rather than the expected *gu(máʔ-ɲa)*. (A constraint requiring stress as close to the right edge of the word as possible rules out **(gúmaʔ)-ɲa*.)

Klein's analysis essentially requires that trochees be built from right to left with the algorithm starting over when the root is encountered (as encoded by the constraint requiring a foot at the right edge of the root). Thus the root-internal foot structure of morphologically complex words mirrors that of the bare roots, even though this is not always reflected in the stress pattern. Umlaut can target syllables that once bore primary stress because these syllables are footed

exactly as they are in unaffixed forms, and umlaut therefore does not run afoul of the constraint requiring left-alignment of [Cor] within a foot. This, according to Klein, eliminates the need for transderivational computational power.

Notice that there is no direct connection between umlaut and stress. Umlaut is simply required to target base-initial syllables, but this is blocked when it places a [Cor] feature in an unfooted position. Stress itself (as distinct from foot structure) plays no role.

Recall that some prefixes with front vowels, such as *ké?-* 'about to, try,' do not trigger umlaut, while other prefixes with no front vowels, like *fa?-* 'to make, to change to,' do induce umlaut. Morphemes such as these prompt the first use of RPM in Klein's analysis. Under the RPM model, morphological conditioning of phonological phenomena is formalized through desiderata in lexical entries that require certain constraint violations. For example, *ké?-*, which does not trigger umlaut, contains the specification in (37) in its lexical entry.

(37)

ké?-

L-ALIGN(BASE, [Cor])
*

The box with a constraint and an asterisk indicates a *distinctive constraint violation* that is required of this morpheme. Forms with *ké?-* must incur a violation of L-ALIGN(BASE, [Cor]). The constraint MORPHMAX monitors obeyance of distinctive constraint violations by assigning violations to candidates that do not respect their morphemes' desiderata. The Tableau for *ke?-tungo?* 'try to know' is:

(38)

/keʔ tungoʔ/	MorphMax	L-Align(Base, [Cor])
a. keʔ-tingoʔ	*!	<*>
☞ b. keʔ-tungoʔ		*

Candidate (a) does not violate L-Align(Base, [Cor]), and '<*>' records its failure to obey the desideratum in (37). This in turn triggers a fatal violation of MorphMax. Candidate (b), with no umlaut, wins because it satisfies (37).

Similarly, *faʔ-* has the desideratum in (39). L-Align(Base, [Dor]), which is very low-ranked in Chamorro, must be violated in words with this prefix. Roots in these words must not begin with back vowels; i.e., umlaut must occur, as shown in (40). (L-Align(Base, [Cor]) and L-Align(Base, [Dor]) are abbreviated as L-[Cor] and L-[Dor], respectively, for space.)

(39)

faʔ-

L-Align(Base, [Dor])
*

(40)

/fɑʔ hánom/	MorphMax	Dep[Cor]	L-[Cor]	L-[Dor]
a. fɑʔ-hánom	*!			<*>
☞ b. fɑʔ-hǽnom		*		*

Besides accounting for idiosyncratic triggering and blocking of umlaut, RPM is invoked to account for the failure of certain words with non-initial stress to undergo umlaut. For example, *lugát* 'place' is assigned the footing *(lugát)* via a distinctive constraint violation of Ft-Form(Troch), which mandates trochees. The form *i lugát* 'the place' does not show umlaut: **i ligát*. Under Klein's analysis, this is unexpected because the root-initial syllable is footed. This form should

therefore pattern with *i gimáʔ-ɲa*. The difference between these forms, of course, is that *i gimáʔ-ɲa* is transderivationally related to *gíma?* (which has initial stress), but there is no **lúgat* to which we can compare *i lugát*. Since he aims to eliminate transderivational relationships from his analysis, Klein cannot use this distinction. Instead he must posit a second distinctive constraint violation for *lugát*. This form requires a violation of the umlaut-inducing L-Align(Base, [Cor]).

The same approach is taken with respect to words with initial rhythmic secondary stress, such as *pùtamunéda* 'wallet.' Umlaut fails to target these words, as (10) shows. Again, the lack of umlaut is unexpected because the root-initial syllables are footed. Klein declares that all words long enough to have initial rhythmic stress are lexically marked with a distinctive constraint violation for L-Align(Base, [Cor]).

In summary, the analysis in Klein takes umlaut to essentially target roots, as in the Licensing analysis, but with constraints on where features can appear in a form's prosodic structure blocking umlaut in some cases. Other scenarios in which umlaut is impossible are treated as lexical exceptions through constraint violation desiderata. I turn now to the shortcomings of this analysis.

3.4.2.2 Generalizations Treated as Exceptions

The first reason to disfavor the RPM analysis is that it treats language-wide generalizations as lexeme-specific exceptions. Forms like *i lugát* don't undergo umlaut because they are lexically marked as exceptional. All disyllabic roots with final stress must be so marked, and the generalization concerning umlaut's sensitivity to stress becomes a mere happenstance of idiosyncratic lexical entries.

In contrast, the Licensing analysis needs no addition to explain *i lugát*: the clitic is not pretonic, so umlaut isn't motivated.

Similarly, by lexically marking all words long enough to have rhythmic secondary stress as unable to undergo umlaut, RPM misses the obvious generalization that these secondary stresses have no primary stress transderivational correspondent. The analysis predicts that a new word, say *lugád* or *pùgamunéda*, could be adopted by Chamorro speakers without the required lexical marking and therefore undergo umlaut. Since umlaut never targets this kind of word, such a prediction does not seem well-founded.

It seems reasonable to suggest that words that are long enough to have initial rhythmic stress belong to a separate cophonology (Inkelas & Zoll 2005, 2007). As Klein (2000) notes, most such words are Spanish loans. They may therefore be subject to a separate constraint ranking that prohibits umlaut, much as Itô & Mester (1995) argue that Japanese has multiple lexical strata based on etymological origin. Evidence for cophonologies comes from the fact that "loans syllabify somewhat differently from native words" (Chung 1983:39, fn. 3). This approach would differ from RPM by predicting uniform behavior within each stratum. Crucially, it would not rely on fortuitous lexical markings on every item in a stratum.

As we will see in §3.6, lexical tags and cophonologies are superfluous in the Licensing account's treatment of forms like *pùtamunéda*.

3.4.2.3 Foot Structure

The foot structures generated by the RPM analysis are highly unusual. Instead of the expected *(pùlu)(lón-ɲa)* 'his trigger fish,' we are given *(pù)(lulón)-ɲa* by the

requirement that the root coincide with a foot boundary. The sole reason to adopt this sort of structure is to account for forms like *i gimáʔ-ɲa* with transderivationally conditioned umlaut. Klein provides no evidence for the foot structure he posits for words like *i gimáʔ-ɲa*, and if we give up on the idea that syllables which were stressed on a previous cycle are still footed in the output, we can adopt more conventional foot structures for these words. Umlaut in *i gimáʔ-ɲa* can be produced either with the transderivational machinery of Chung (1983) and Crosswhite (1996) or the Stratal OT system adopted in §3.6.

3.4.2.4 Alignment is too Powerful

By now it should be clear that the RPM analysis does not capture the facts as elegantly as one might hope. I will point out one final reason not to adopt it. The Alignment constraints in the RPM analysis invite strategies that Klein does not rule out.

Recall that *i pulónnun* 'the trigger fish' does not show umlaut because [Cor] is banned from unfooted syllables, and the root-initial syllable is unfooted. Notice that the same goes for the definite article: *i* is unfooted, yet it is permitted to have a [Cor] feature in violation of L-ALIGN([Cor], Ft). The [Cor] feature on this vowel should be eliminated in the output. MAX, which penalizes feature deletion in the framework of Klein (2000), cannot prevent that deletion. It must be ranked below L-ALIGN([Cor], Ft) to allow umlaut in the first place.[12]

In fact, L-ALIGN([Cor], Ft) causes more widespread problems. This constraint

[12]More accurately, L-ALIGN([Cor], Ft) outranks the umlaut-triggering L-ALIGN(BASE, [Cor]) because the former blocks certain cases of umlaut, and L-ALIGN(BASE, [Cor]) itself must outrank MAX to generate umlaut at all. So by transitivity, we have the ranking L-ALIGN([Cor], Ft) ≫ MAX.

assigns a violation for each front vowel that is not leftmost in a foot. Actual outputs like *i gíma?* violate this constraint. **u gíma?* should be optimal because no features have been deleted or inserted. Rather, the first two vowels have simply exchanged features. Nor is **gíma?* (for the meaning 'the house') ruled out, again because of the low ranking of MAX, with deletion of the article altogether. Likewise, *kóbbli* 'money' should be realized as **kébblu*, with the vowels swapping backness features in compliance with L-ALIGN([Cor], Ft).

The umlaut-driving L-ALIGN(BASE, [Cor]) favors similar problematic candidates. Consider the form *t-um-óhge* 'to stand (sg.),' which lacks umlaut. The [Cor] feature on the final vowel should be able to spread to the root-initial vowel. The analysis based on L-ALIGN(BASE, [Cor]) predicts that affixation should trigger fronting of the root-initial vowel as long as some [Cor] specification exists elsewhere in the word:

(41)

/um tóhge/	DEP[Cor]$_V$	L-ALIGN(BASE, [Cor])
☹ a. t-um-éhge		
(☞) b. t-um-óhge		*!

Perhaps a high-ranking LINEARITY can rule out the feature-swapping candidates. But since MAX must be low-ranked to permit umlaut, forms that simply delete vowels to avoid Alignment violations cannot be eliminated.

The Licensing analysis encounters none of these problems. Since IDENT outranks LICENSE-Non-Pretonic, faithfulness to all backness features is favored for *i pulónnun*. Likewise, **u gíma?* is harmonically bounded by *i gíma?* because the former contains more IDENT violations than the latter, and each candidate fully

satisfies LICENSE. Finally, the front vowel in *t-um-óhge* is not penalized by the Licensing analysis because this vowel is root-internal and therefore its features are licensed; no spreading is motivated.

3.4.2.5 Summary

I have argued in this section that the RPM approach to Chamorro umlaut in Klein (2000) is inferior to the Licensing analysis proposed here. It relies heavily on lexeme-specific distinctive constraint violations to capture language-wide generalizations. In order to eliminate (or more accurately, reduce) the role of transderivational correspondence in the analysis of umlaut, the RPM model requires unusual metrical parses for various forms. The constraint L-ALIGN([Cor], Ft) seems to incorrectly predict deletion of vowels and movement of features to ensure that all [Cor] specifications are foot-initial. Finally, the RPM analysis posits only a tenuous connection between stress and umlaut. Even Klein admits that there is a very close relationship between stress and umlaut in Chamorro, and the Licensing analysis captures this relationship directly: the constraint that motivates umlaut only requires spreading from pretonic position. The RPM analysis, on the other hand, mandates umlaut in all stress configurations and therefore requires other constraints to block umlaut in certain cases.

3.4.3 Summary of Alternatives

This section has considered two alternatives to the Licensing-based approach to umlaut. Both alternatives revolve around constraints—ALIGN({Def}, Head) and L-ALIGN(BASE, [Cor])—that motivate umlaut regardless of the stress pattern.

These analyses therefore require additional constraints that block umlaut when stress is not root-initial, and these constraints create analytical problems. In contrast, the Licensing analysis relies on LICENSE-Pretonic, which motivates umlaut just when stress is root-initial. Consequently, it does not need extra machinery to rein in umlaut.

3.5 Stress-Insensitive Umlaut

Both Klein (2000) and Flemming (1994) mention the existence of stress-insensitive umlaut in Chamorro and give examples like those in (42). Klein explains that *i* triggers umlaut on unstressed syllables in the dialect spoke on Guam, but not on the dialect spoken on Saipan.

(42)	a.	kutsínu	'dirty person'	i kitsínu	'the dirty person'
	b.	kulépblɑ	'snake'	i kilépblɑ	'the snake'
	c.	kuttúra	'culture'	i kittúra	'the culture'
	d.	tɑsáhus	'dried meat'	i tæsáhus	'the dried meat'

Similarly, Sandra Chung (p.c.) explains (by way of (43) from Chung 1983:45; see her (31)) that the infix *-in-*, which marks the passive, produces stress-insensitive umlaut.

(43)	tulǽykɑ	'to exchange'
	t-ìn-ilǽykɑ	'to be exchanged; exchanging'

Flemming (1994) and Klein (2000) rightfully point out that examples like these show that umlaut is at least partially morphologized (i.e. conditioned by

specific morphemes). Flemming goes too far, in my opinion, by concluding that umlaut is entirely morphologized and therefore doesn't belong to the synchronic phonology. The existence of exceptions does not necessarily make an otherwise regular phenomenon unproductive.

Within his RPM framework, Klein assigns a distinctive constraint violation for *i* in the Guam dialect. Forms with this morpheme must include a violation of L-ALIGN(BASE, [Dor]), which means having a front vowel in root-initial position. Although he does not discuss it, one can imagine treating *-in-* the same way in all dialects. This seems reasonable if exceptional morphemes like *-in-* are isolated cases. But if stress-insensitive umlaut is more general (perhaps in the Guam dialect), a better approach might be to modify the constraint ranking, or at least adopt cophonologies that treat exceptional morphemes as a class.

I have no information about the extent of stress-insensitive umlaut in the Guam dialect, so I offer two analyses of the above data. Assuming that umlaut in the Guam dialect is never sensitive to stress, a simple demotion of IDENT[+back] in the Licensing analysis can produce umlaut with any front-voweled prefix. With the ranking in (44), every Licensing constraint outranks faithfulness, and therefore spreading to the root will occur in all situations.

(44) LICENSE-Pretonic ≫ LICENSE-Non-Pretonic ≫ LICENSE-Secondary ≫ LICENSE-Primary ≫ IDENT[+back]

On the other hand, if stress-insensitive umlaut is restricted to a few isolated morphemes, we can posit either cophonologies (Inkelas & Zoll 2005, 2007) or lexically indexed constraints (Pater 2006) that impose (44) on forms that contain

exceptional morphemes. This approach works for the Saipan dialect discussed in Chung (1983), with the exceptional *-in-*.

3.6 Optional Umlaut

3.6.1 Stratal OT and Multiple Grammars

As noted in §3.2, when affixation relocates a word's primary stress, the syllable that would have had primary stress if the stress-moving affix were not present surfaces with secondary stress. That is, stress assignment is cyclic: A syllable with primary stress on one cycle will surface with secondary stress if some later cycle repositions the primary stress.[13] Such syllables with secondary stress may optionally undergo umlaut, as may syllables that formerly had primary stress but are now stressless because they are immediately pretonic:

(45)	púgɑs	'uncooked rice'	mí̀pìgɑs, mí̀pùgɑs	'abounding in unc'd rice'
	gúmɑʔ	'house'	i gì̀mɑʔní̀hɑ, i gùmɑʔní̀hɑ	'their house'
	kóbbli	'cash, money'	i kèbblinmámi, i kòbblinmámi	'our (excl.) cash'

On the other hand, vowels with rhythmic secondary stress cannot undergo umlaut:

[13]The only exception to this generalization that I am aware of was mentioned above: immediately pretonic syllables must be unstressed, so a syllable that previously had primary stress will not surface with secondary stress if it is immediately pretonic.

(46) pùtɑmunédɑ 'wallet' i pùtɑmunédɑ, 'the wallet'
*i pìtɑmunédɑ

In Chung's (1983) analysis, these forms are accounted for via the condition in (47). According to Chung, the umlaut in *i gíma?* 'the house' permits umlaut to optionally occur in the morphologically complex *i gìma?níha* 'their house' because the root-initial vowel in the latter form corresponds to the umlauted vowel in the former, non-complex form. Chung argues explicitly for the necessity of this sort of transderivational power.

(47) Condition on Umlaut and Vowel Lowering: If a vowel V_x of a complex word bears m-stress (m≠1) and corresponds transderivationally to a vowel V_y bearing n-stress in the related non-complex word, then the rule can optionally apply to V_x as though it bore n-stress.

In this section I sketch an approach to optional umlaut grounded in Stratal OT.[14] I will not dwell on the details, as the correct approach to optional umlaut is not crucial to main goal of the current chapter, which is to assess the apparent noniterativity of umlaut.

As pointed out to me by Lev Blumenfeld, a simple way to account for umlaut on cyclic secondary-stressed and unstressed vowels is to perform cyclic stress assignment and umlaut before rhythmic stress assignment and clash resolution.

[14]See Klein (2000) for arguments against Crosswhite's (1996) Output-Output Correspondence (Benua 1997) approach to optional umlaut. In short, this approach fails because there is not always a free-standing base to which umlauted candidates can be faithful.

It may be possible to salvage the thrust of Crosswhite's proposal by recasting it in terms of Paradigm Uniformity (Downing et al. 2005, McCarthy 2005). With high-ranking LICENSE-Pretonic requiring umlaut under primary stress, other constraints (perhaps ranked stochastically to achieve optionality) can trigger umlaut on forms with the same root but different stress pattern to maintain uniformity across the paradigm.

This section develops an analysis along these lines.

The basic approach is this: Suppose all stress is assigned at one stage (call it Level 1) except for rhythmic secondary stress, which is assigned at a later level, Level 2. (Other phenomena discussed below are consistent with this ordering.) Also clash is only resolved at Level 2. This means Level 1 will contain only primary and cyclic secondary stress. LICENSE-Pretonic can then obligatorily trigger umlaut on the primary stress as in §3.3.1. Optional umlaut on secondary stress can be produced by optionally ranking LICENSE-Pre-Secondary over IDENT[back]. Subsequently, Level 2 enforces no umlaut but adds rhythmic secondary stress and removes stress from certain other syllables. With this order of events, cyclic—but not rhythmic—secondary stress will participate in umlaut. Pretonic syllables whose secondary stress is eliminated will participate in umlaut as well because their stress isn't eliminated until the Level 2, after umlaut has occurred.

Obviously a strictly parallel conception of OT cannot accommodate this approach, but a theory of Stratal OT (Kiparsky 2000, Rubach 1997, among others) in which inputs are passed through a series of Tableaux, with each Tableau providing the input for the next, might be successful. The number of derivational levels that are needed in such a theory is an important question that I will not address here. For present purposes, just three levels are necessary, which I assume are the stem, word, and postlexical levels.

Starting with the stem level, I assume that just the root morpheme is present here. Stress is generally penultimate, and constraints at this level assign primary stress to the root's penultimate syllable. See Prince & Smolensky (1993[2004]) and much subsequent research for treatments of this kind of stress system in OT.

If the root exceptionally has non-penultimate stress, that stress is assigned here, too.

The word level, where affixes are added, is responsible for assigning primary stress in accordance with these affixes. Suffixes always move stress to the penultimate syllable, and some prefixes attract stress of their own. Stress from the stem level is retained through faithfulness constraints, although it is demoted to secondary stress, perhaps through CULMINATIVITY (Hayes 1995, Liberman & Prince 1977), if affixes relocate the primary stress. Umlaut is produced here as described in more detail below. Thus the Level 1 identified above is actually two strata, the stem and word levels.

With the labeling of strata adopted here—and the division of labor among them—clitics like the definite article *i*, which are syntactically independent units, would be expected to appear at the postlexical level. This is obviously not a good result because the umlaut triggered by these particles occurs at the previous level. A simple repair is to reconsider what is meant by "word level" and "postlexical level." If we take the word level to apply to phonological words rather than morphological or syntactic words, then these elements will in fact appear at the word level because, as clitics, they are part of the phonological word on their right.

It may be possible to conflate the stem and word levels, at least in terms of their stress-assignment responsibilities. By adopting both a constraint system that assigns root-penultimate stress and one that assigns stem-penultimate stress, as in Klein (2000), we can simultaneously assign the root-level and stem-level stresses. By giving the stem-assignment system "priority" (i.e. higher ranking) over the root-assignment system, these constraints can produce the effect of cyclic

demotion of root stress.

In some cases, such as *mì-sapatós-ɲa* 'more abounding in shoes,' both a prefix and a suffix alter the stress pattern. Constraints at the word level are responsible for sorting out which affix gets the primary stress and which one must be content with secondary stress. This can be done either by ranking constraints pertaining to one affix over constraints pertaining to the other, or by assigning primary stress according to level of embedding, with the least embedded affixes receiving primary stress.

In short, the output of the word level contains the root's own (often demoted) stress plus any secondary and primary stresses added by affixes. In some cases, such as *swèddunmámi* 'your (sg.) salary' (see (6a)), the output of the word level contains the stress pattern of the final output form. For *i gimáʔ-ɲa*, the word-level output (umlaut aside; see immediately below) is *i gùmáʔ-ɲa*, with the root-penultimate stress retained for now as secondary stress. Clash resolution eliminates this stress at the postlexical level.

It is also at the word level where optional umlaut on secondary stress occurs. If the root-initial vowel has a secondary stress that was retained from primary stress assigned at the stem level, umlaut may occur. To produce this, the ranking adopted in §3.3.1 must be amended. Rather than the crucial ranking IDENT[+back] ≫ LICENSE-Pre-Secondary, we must allow the opposite ranking in some cases.

For simplicity, I assume that optionality is a product of non-crucial rankings between constraints, although other approaches (e.g. stochastic rankings (Boersma & Hayes 2001) or Markedness Suppression from Chapter 5) are equally

possible. IDENT[+back] and LICENSE-Pre-Secondary are not crucially ranked, and for each Tableau, either IDENT[+back] ≫ LICENSE-Pre-Secondary or LICENSE-Pre-Secondary ≫ IDENT[+back] is chosen at random. This is simply the multiple-grammars theory of variation proposed by Anttila (2006, 2007). When the first ranking occurs, no umlaut appears on secondary stress, and the latter ranking produces this umlaut. For other approaches to optionality, see Riggle & Wilson (2005) and Vaux (2003b).

Only cyclic stress is assigned at the word level. An analysis of the Chamorro stress system would take us too far from the goals of the current analysis, so the Tableaux below consider only candidates with correct stress. See Crosswhite (1996) and Klein (2000) for relevant OT analyses.

The Tableau in (48) and (49) show the word-level phonology for the (eventual) surface forms *i gimáʔ-ɲa* 'his house' and *i pùtamunéda* 'the wallet.' The stem-level phonology is trivial for our purposes (it just assigns penultimate stress), so I will not show Tableaux for that stage. The ranking LICENSE-Pre-Secondary ≫ IDENT[+back] is shown here; see below for the opposite ranking. Following Rubach (1997), I use double slashes to mark underlying forms and single slashes to mark intermediate forms.

(48) *Word Level: i gimáʔ-ɲa*

//i gùmáʔ-ɲa//	ID[−bk]	LIC-Pre	LIC-2nd	ID[+bk]	LIC-Else
a. /i gùmáʔ-ɲa/			*!		
☞ b. /i gì̀máʔ-ɲa/				*	

Here, the first syllable of the root has cyclic secondary stress. Because LICENSE-Pre-Secondary outranks IDENT[+back], umlaut is required.

In contrast, the secondary stress in *i pùtamunéda* is rhythmic, so it is not assigned at the word level. Consequently, the prefix does not immediately precede stress of any kind, and LICENSE-Pre-Secondary doesn't trigger umlaut:

(49) *Word Level: i pùtamunéda*

//i putamunéda//	ID[−bk]	LIC-Pre	LIC-2nd	ID[+bk]	LIC-Else
☞ a. /i putamunéda/					*
b. /i pitamunéda/				*!	

Postlexically, rhythmic stress is assigned, but umlaut doesn't occur. I model this by promoting IDENT[+back] above all the Licensing constraints (subsumed under LICENSE for space) at the postlexical level. I also adopt the cover constraint RHYTHM to assign rhythmic stress (again, see Crosswhite (1996) and Klein (2000)), and *CLASH penalizes stressed syllables that immediately precede primary stress. Both RHYTHM and *CLASH are high-ranked at the postlexical level.

The postlexical evaluation of *i gimáʔ-ŋa* is shown in (50). The input here is the optimal candidate from the word-level evaluation, so the input shows umlaut in this case. With high-ranking *CLASH, the candidates that preserve the cyclic secondary stress on the root-initial vowel are eliminated. This leaves a choice between *i gimáʔ-ŋa* and *i gumáʔ-ŋa*, and IDENT[+back] selects the former because this candidate is faithful to the backness specifications of the input. RHYTHM is inert in this Tableau because the form under consideration isn't long enough to

require rhythmic stress assignment. The winning candidate violates none of the constraints shown in the Tableau, although it presumably violates low-ranking constraints that encourage stress preservation.

(50) *Postlexical Level: i gimáʔ-ɲa*

/i gìmáʔ-ɲa/	Rhythm	*Clash	Id[+bk]	Id[–bk]	Lic
a. i gìmáʔ-ɲa		*!			
☞ b. i gimáʔ-ɲa					
c. i gùmáʔ-ɲa		*!	*!		*
d. i gumáʔ-ɲa			*!		*

Although each candidate with *u* in the root-initial syllable violates a Licensing constraint, this is not what rules them out. Had the output of the stem-level phonology supplied a form with Licensing violations, the word-level phonology would still have selected the most faithful candidate because Ident outranks the Licensing constraints at this level. In fact, this situation is exactly what we find in the postlexical Tableau for *i pùtamunéda*:

(51) *Postlexical Level: i pùtamunéda*

/i putamunéda/	Rhythm	*Clash	Id[+bk]	Id[–bk]	Lic
a. i putamunéda	*!				*
☞ b. i pùtamunéda					*
c. i pìtamunéda			*!		
d. i pitamunéda	*!		*!		

Rhythm eliminates any candidate that doesn't assign root-initial secondary stress. This means that the forms that survive this constraint but don't have umlaut will necessarily violate License-Pre-Secondary. But the window for umlaut

has closed: IDENT[+back] now ensures that the winning candidate will have the same backness configuration as the input. *i pùtamunéda* is the optimal form, and this state of affairs renders umlaut insensitive to rhythmic secondary stress.

Now let's consider what happens if the ranking IDENT[+back] ≫ LICENSE-Pre-Secondary is chosen at the word level. This is the ranking that gives us *i gumáʔ-ɲa*, with no umlaut. Once again, /i putamunédɑ/ is the optimal form, with no umlaut:

(52) *Word Level: i pùtamunéda*

//i putamunédɑ//	ID[–bk]	LIC-Pre	ID[+bk]	LIC-2nd	LIC-Else
☞ a. /i putamunédɑ/					*
b. /i pitamunédɑ/			*!		

But this time umlaut is blocked with the input //i gùmáʔ-ɲɑ//. This is because the constraint that triggers umlaut here is LICENSE-Pre-Secondary, and IDENT[+back] outranks it. Of course, a form like *i gíma* still obligatorily undergoes umlaut because the constraint that motivates umlaut in that case is LICENSE-Pretonic, which always outranks IDENT.

(53) *Word Level: i gimáʔ-ɲa*

//i gùmáʔ-ɲɑ//	ID[–bk]	LIC-Pre	ID[+bk]	LIC-2nd	LIC-Else
☞ a. /i gùmáʔ-ɲɑ/				*	
b. /i gìmáʔ-ɲɑ/			*!		

The postlexical Tableau for *i pùtamunéda* is identical to (51). The Tableau for *i gumáʔ-ɲa* is comparable to (50) in that the winning candidate preserves the underlying backness features, but the input (and therefore the faithful output) is different. Also unlike (50), the optimal candidate violates Licensing. But this is irrelevant at the postlexical level, where the overriding factor is preservation of input vowel quality:

(54) *Postlexical Level: i gimáʔ-ɲa*

/i gùmáʔ-ɲa/	Rhythm	*Clash	Id[+bk]	Id[–bk]	Lic
a. i gi̗máʔ-ɲa		*!	*!		
b. i gimáʔ-ɲa			*!		
c. i gùmáʔ-ɲa		*!			*
☞ d. i gumáʔ-ɲa					*

This analysis correctly accounts for the facts of optional umlaut by segregating different stress-related phenomena in different strata. Depending on whether or not umlaut may occur at a particular stratum, the stress assigned at that stratum may or may not interact with umlaut.

3.6.2 Arguments against a Cyclic Approach

Chung (1983) argues against a cyclic approach to optional umlaut within a rule-based framework. As the analysis developed here is similar to a cyclic account, her concerns must be addressed. The cyclic umlaut rule she considers is one that produces umlaut when primary stress is root-initial. Thus it can generate *i gimáʔɲa* by spreading [–back] at an early stage when the root-initial vowel still has primary stress. This rule must be optional, otherwise it can't generate *i*

gumáʔɲa as well. But if the rule is optional, there is no way to ensure that it applies on at least one cycle to produce *i gíma?*, which obligatorily undergoes umlaut because of the root-initial primary stress. An optional rule predicts **i gúma?* as well. We have a conflict: Either the rule is optional and we incorrectly predict **i gúma?*, or the rule is obligatory and we cannot produce *i gumáʔɲa*. Recognizing this conundrum, Chung rejects a cyclic account of optional umlaut.

Chung's argument holds only if a rule applies in exactly the same way at every cycle. Consequently, if umlaut is optional at one cycle, it must be optional at all other cycles as well. There is no way to mark the umlaut rule as both optional and obligatory. This predicament is what permits **i gúma?* if umlaut is optional.

It is tempting to produce optionality by permitting two different morphological bracketings for *i gumáʔɲa/i gimáʔɲa*. The former is produced when we have the bracketing [i [gumáʔɲɑ]]. Here, suffixation moves the primary stress before the prefix appears, and therefore the prefix has no root-initial stress for umlaut. The other form comes from the bracketing [[i gimáʔ]ɲɑ], where the prefix appears and triggers umlaut before the suffix relocates stress. Chung acknowledges the possibility that bracketing may be variable, and Crosswhite (1996) uses this variability to produce optional umlaut.

But Chung points out a problem with this approach. Vowel lowering (see §3.6.3.2) also optionally targets cyclic secondary stress, and the variable-bracketing analysis predicts that in words that can undergo both umlaut and vowel lowering, the two processes should be linked. For example, /i kupbli-hu/ 'my cash' permits two bracketings, [[i kupbli]hu] and [i [kupblihu]]. The first structure produces a form with both umlaut and vowel lowering (*i kebblékku*), and the

second one produces a form with neither (*i kubblékku*). The first bracketing entails a derivational stage where we have [i kúpbli]. The root-initial stressed vowel undergoes both umlaut and lowering because it is stressed. But in the second bracketing, stress never appears on the first root vowel because of the suffix, which is added on the first cycle and requires penultimate stress: [kupblíhu]. The root-initial vowel is never stressed and therefore undergoes neither umlaut nor vowel lowering. The variable-bracketing approach, then, predicts that where umlaut occurs vowel lowering must also occur, and *vice versa*.

But this prediction is false. Umlaut and vowel lowering are completely independent of each other. In addition to the surface forms given in the previous paragraph, *i kibblékku* (with only umlaut) and *i kobblekku* (with only vowel lowering) are also attested. Variable bracketing cannot save the cyclic approach.

The Stratal OT analysis does not encounter these defects and therefore doesn't inherit the problems of the cyclic analysis. The **i gúma?* pitfall is avoided, yet umlaut on secondary stress is optional. This is because closely related but different constraints trigger umlaut in these cases. **i gúma?* is impossible because LICENSE-Pretonic always outranks IDENT[+back], but variability in other cases is permitted by the non-crucial ranking between LICENSE-Pre-Secondary and IDENT[+back]. Furthermore, umlaut is independent of the morpheme attachment sequence, so even if it is joined with an analysis of vowel lowering that is tied to bracketing, the undergeneration problem will not arise.

By reevaluating the underlying mechanisms behind umlaut—Licensing in various contexts instead of general attraction to (primary) stress—within Stratal OT, the problems that Chung sees in a cyclic analysis are avoided.

3.6.3 Corroboration for Stratal OT

According to the Stratal OT approach, rhythmic stress assignment is a relatively late process. There is evidence, also pointed out to me by Lev Blumenfeld, that this claim is correct. Two other phenomena, gemination and vowel lowering (both analyzed by Chung (1983)), are sensitive to the difference between cyclic and rhythmic secondary stress.

3.6.3.1 Gemination

Gemination targets CV suffixes in words that meet the following conditions: (i) the syllable immediately before the suffix must be open, and (ii) there must be a closed stressed (or formerly stressed) syllable elsewhere in the word. Compare the words in (55a) with (55b). Stress on the initial syllable in each suffixed word is eliminated because it is pretonic. In (55b), gemination doesn't occur because the stressed syllable in the bare word is not heavy.

(55)	a.	kánta	'song'	kantákku	'my song'
		maléffa	'forgetting'	maleffámmu	'your forgetting'
		mǽypi	'hot'	mæypíŋŋa	'hotter'[15]
	b.	dúda	'doubting'	dudámu	'your doubting'
				**dudámmu*	

As Chung (1983) points out, the effect of gemination is to maintain the weight of the stressed syllable. If the stressed syllable elsewhere in the word is heavy, the stressed syllable created by suffixation must also be heavy. Since suffixes relo-

[15] *ŋŋ* dissimilates to *nŋ*.

cate stress to the penultimate syllable, gemination of the suffix-initial consonant provides a coda for the new stressed syllable. (Crosswhite's (1996) analysis of gemination follows this description closely.)

Secondary stress in a heavy syllable can also trigger gemination:

(56)	a.	mí̀bàtku	'abounding in ships'
		mì̀bɑtkónɲɑ	'more abounding in ships'
	b.	mí̀còddɑ	'abounding in green bananas'
		mì̀coddánɲɑ	'more abounding in green bananas'

But this only holds if the secondary stress is cyclic. Rhythmic secondary stress does not trigger gemination. Although all the suffixed words in (57) have heavy stressed syllables, gemination is not possible because the heavy stressed syllables have rhythmic stress.

(57)	a.	sitbésɑ	'beer'	sì̀tbesá	'his beer'
	b.	iskwélɑ	'school'	ì̀skweláɲɑ	'his school'
	c.	cincúlu	'fishing net'	cì̀nculúmu	'your fishing net'

These patterns are entirely expected if gemination is a word-level process and rhythmic stress assignment is a postlexical process. When gemination occurs, the heavy syllables in (57) don't have stress, so gemination fails in these forms. Once rhythmic stress is assigned, gemination—like umlaut—cannot reapply.

3.6.3.2 Vowel Lowering

Vowel lowering in Chamorro is a process whereby "[n]on-low vowels surface as mid in stressed closed syllables, and as high elsewhere" (Chung 1983:46). The forms in (58) illustrate this. Stress alternations yield changes in vowel height.

(58)	a.	lápis	'pencil'	lɑpéssu	'my pencils'
	b.	mɑlægúʔ	'wanting'	màlægóʔmu	'your (sg.) wanting'
	c.	hugándu	'playing'	hùgɑndónɲɑ	'his playing'

Like gemination, vowel lowering obligatorily targets cyclic secondary stress:

(59)	a.	éttigu	'short'	èttigónɲɑ	'shorter'
	b.	inéŋŋuluʔ	'peeping'	inèŋŋulóʔhu	'my peeping'
	c.	óttimu	'end'	òttimónɲɑ	'her end'
	d.	sénsin	'flesh'	mísènsin	'fleshy'

But it only optionally affects syllables with rhythmic secondary stress:

(60)	a.	tintáguʔ	'messenger'
		tìntɑgóʔta,	'our (incl.) messenger'
		tèntɑgóʔta	
	b.	mundóŋgu	'cow's stomach'
		mùnduŋgónɲɑ,	'its stomach'
		mònduŋgónɲɑ	
	c.	ispéyus	'mirror'
		ìspiyósɲɑ,	'his mirror'
		èspiyósɲɑ	

If vowel lowering is obligatory at the word level but optional at the postlexical level, these facts are accounted for. Cyclic stress is assigned at the word level, so vowels in heavy syllables with cyclic stress must lower. But rhythmic stress is assigned only postlexically, so vowels in syllables with rhythmic stress are subject to optional lowering.

3.7 Conclusion

An initial look at umlaut in Chamorro suggests that it is truly noniterative in nature: umlaut seeks the stressed syllable, but only if it can be reached with noniterative spreading. This chapter has shown that umlaut can be accounted for without assuming a noniterativity requirement. When the stressed syllable is not adjacent to the prefix/particle from which [–back] might spread, umlaut fails not because the target of spreading is too far away, but because the form fails to meet the conditions that trigger umlaut.

The analysis developed here makes no use of foot structure. This is because I assume that Flemming (1994) is correct in his claim that Chamorro has trochees. If we assume instead that Chamorro has iambs (as suggested by the fact that pretonic syllables must be unstressed), then umlaut becomes a case of spreading within a foot and is amenable to the sort of analysis that Flemming adopts for similar phenomena. Such an analysis is obviously unavailable under a trochaic analysis, where umlaut always crosses a foot boundary and is banned when it does not do so. I have been unable to implement an analysis in OT that requires feature spreading to cross a foot boundary, so I am left to conclude that if Chamorro

indeed has trochees, an analysis like the one presented here must be correct.

Like Lango's vowel harmony, umlaut is driven by Positional Licensing. Pretonic syllables are weak in Chamorro, and to compensate for this the grammar requires a [–back] feature in this position to be linked to a root segment. As a result, when stress is not root-initial, umlaut is not motivated because the pretonic syllable is already part of the root, and the prefix is not pretonic. This analysis can be extended to account for optional umlaut on secondary stress, and to account for the different behavior of cyclic and rhythmic secondary stress it was necessary to invoke Stratal OT.

What of Conant's (1911) comparison between Chamorro and languages with full-blown vowel harmony, like Finnish, Turkish, and Hungarian? It is clear from the analysis developed here that characterizing Chamorro's umlaut as vowel harmony is misleading. Like Lango's vowel assimilation, Chamorro's umlaut is similar to vowel harmony only in that (i) it involves vowel assimilation, and (ii) the feature that spreads is often the active feature in harmony systems. At a formal level, umlaut, which involves attraction to prominence and is driven by Positional Licensing constraints, is quite different from vowel harmony, which involves a push toward vocalic homogeneity and is driven by constraints like Align, Spread, Agree, etc.

Aside from its apparent noniterativity (which is the basis for Chung's (1983) preference for "umlaut" over "vowel harmony"), the assimilation seen in Chamorro is typologically unusual in an important way: vowel harmony systems are typically either root-controlled or have a right-to-left directionality (Hyman 2008, to appear). Chamorro fits neither pattern. Viewed as vowel harmony, umlaut is ei-

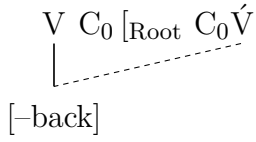
ther prefix-controlled or left-to-right (or both), making it a highly unusual system. This is further evidence that umlaut is formally distinct from vowel harmony.

It is worth applying the same scrutiny to the term "umlaut." Is there some common set of properties that unites the umlaut phenomena in Chamorro and Germanic languages? Perhaps, but just as it is a mistake to let our terminology blind us to important differences between Lango's vowel harmony and standard cases of vowel harmony, we should not expect—or force—Chamorro and German umlaut to submit to similar analyses simply because they're both called "umlaut." It is true that the analysis of Chamorro umlaut presented here will not easily be transferred to German, but this is only a drawback if these two cases of umlaut are demonstrably the same phenomenon. I am not convinced that they are.[16]

This chapter's investigation of Chamorro umlaut reveals that this phenomenon is not truly noniterative. The noniterative nature of umlaut is, like the noniterativity in Lango, a product of root-adjacency. LICENSE-Pretonic only requires [–back] to spread to the root, so spreading just one syllable rightward from a prefix is sufficient. Umlaut therefore shows emergent noniterativity in that the impetus for spreading is satisfied after the first iteration, not because of a stipulation for noniterativity. In fact, as was pointed out in Chapter 1, even a rule-based analysis of umlaut predicated on the rule in (61) claims that umlaut's noniterativity is emergent. This rule is not self-feeding, so the iterativity specification for this rule is inconsequential.

[16]Here are some ways in which German umlaut differs from Chamorro: In German, stress is clearly the target, and umlaut is triggered by suffixes. Unstressed vowels that fall between the stressed vowel and the triggering suffix are skipped over. See McCormick (1981), van Coetsem & McCormick (1982), and Klein (2000).

(61)



Lango's harmony and Chamorro's umlaut present the best non-tonal arguments for the reality of true noniterativity that I am aware of. Since these phenomena are amenable to analyses that do not invoke noniterativity, they do not constitute evidence against the Emergent Noniterativity Hypothesis. Moreover, the analyses developed in this chapter and the preceding one are more insightful than rule-based analyses that require noniterativity because they identify reasons besides an iterativity parameter that spreading stops after one iteration. This means that the analyses which support the ENH are an improvement on alternative rule-based analyses that would refute it. These OT analyses—and therefore the ENH—are therefore preferable to a theory of phonology that permits true noniterativity.

The results of the analyses of Lango and Chamorro lay the groundwork for the next chapter, in which noniterative tonal phenomena are considered. If true noniterativity outside of tone is unattested, it is worth investigating whether the same can be said for tone.