exactly as we would expect in a theory of grammar oriented towards conspiracies of violable constraints.

2.2.3. Infixation over rhyme

In segmental terms, the mirror image of the Akkadian phenomenon is found in Levantine Arabic (Broselow and McCarthy 1983), where a reduplicative (single consonant) affix appears just before the final rhyme of the base.

(79) Levantine Arabic Intensification

barad	barb̲ad	'shaved unevenly'
šaraħ	šarš̲aħ	'criticized severely'
ħalat	ħalħ̲at	'sheared unevenly'
daħal	daħd̲al	'rolled gradually'

As the status of the rhyme as a prosodic unit available to theories of syllable structure has been contested since McCarthy and Prince (1986), such phenomena—Broselow and McCarthy (1983) observe a similar case in Zuni (Newman 1965)—should constitute a complication for our theory of analogical infixation if no prosodically-inspired account of the phenomena is to be found.

Once again, however, we find a phonological markedness constraint at the ready predict the surface positioning of the morpheme. The syllable canon of Levantine Arabic includes CV, CVV, CVC, CVC and CVCC (Broselow et al. 1998, Moren 1999). Of those syllable types, the last four are maximally and minimally bimoraic, suggesting that a constraint against trimoraic syllables, $*(\mu\mu\mu)_\sigma$, is undominated in the language. Given a ranking of ANCHOR$_{OO}$ capable of forcing the exponence of the reduplicant within the base of affixation, we again find a simple conspiracy of $\mathbb{M}$ and $\mathbb{F}_{OO}$ to be the underlying cause of the alternation.

(80) Avoidance of a trimoraic σ conditions morpheme placement

- barba$^{\mu}$d$^{\mu}$ ≻ *bara$^{\mu}$d$^{\mu}$<u>b</u>$^{\mu}$, *bara$^{\mu}$ <u>b</u>$^{\mu}$d$^{\mu}$, *bara$^{\mu}$<u>a</u>$^{\mu}$b$^{\mu}$

	/barad + RED/	ANCHOR$_{OO}$	*(μμμ)$_{\sigma}$	LINEARITY
☞	a. bar<u>b</u>ad			**
	b. bara<u>bd</u>		*!	*
	c. barad<u>ba</u>	*!		

2.3. Infixation over foot

Perhaps more problematic for the current theory are cases of apparent infixation-over-foot, as such are superficially only accessible to analysis as prosodic-subcategorizational phenomena. In Ulwa—surely the most well-known case—a possessive marker affixes to the right edge of the initial root foot, no matter the length of the resulting word (McCarthy and Prince 1993a).

(81) Ulwa Infixation

a. <u>After Initial Syllable</u>
bas → bas-ka 'hair.POSS'
ki: → ki:-ka 'stone.POSS'
su:lu → su:-ka-lu 'dog.POSS'
asna → as-ka-na 'clothes.POSS'

b. <u>After Peninitial Syllable</u>
sana → sana-ka 'deer.POSS'
siwanak → siwa-ka-nak 'root.POSS'
ana:la:ka → ana:-ka-la:ka 'chin.POSS'
arakbus → arak-ka-bus 'gun.POSS'
karasmak → karas-ka-mak 'knee.POSS'

McCarthy and Prince (1993a) account for this fact with a constraint which encodes the raw surface generalization directly into the Ulwa grammar. Where an alignment constraint enforcing right-periphery affixation is dominated by a similar constraint requiring the left edge of the suffix to be adjacent to the right edge of the head foot of the output word, infixation will occur just in case the head foot is not the final foot of the surfacing form.

It is possible, however, to account for such cases in a manner anticipated by our treatments of Katu and Hua. Where ANCHOR is undominated and a constraint mitigating against any corruption of OO-base foot-contiguity dominates LINEARITY, infixation between feet must result.

(82) Anchor, Contig-Ft ⇒ infixation over foot

	mapping: /siwanak + ka/ →	CONTIG-FT$_{OO}$	ANCHOR$_{OO}$	LINEARITY
☞	a. (siwá)(-**ka**-nak)			***
	b. (síwa)(nak-**ka**)		*!	
	c. (siwá)(na-**ka**-k)	*! $\{a \not\prec k\}$		
	d. (si-**ká**-)(wanak)	*! $\{i \not\prec k\}$		*****

As a result, McCarthy and Prince 1993's original generalization must be considered in a slightly different light. ANCHOR forces infixation; CONTIG-Ft prevents breaking of feet present in the OO-base. As a result, the generalization should be that the infix will appear to the left of the OO-base's final foot, or as close as possible to the right edge otherwise. Where there is no final foot, ANCHOR and various structural constraints will force the infix to appear before the final syllable. This results in the following spectrum of mappings, where 'ϕ' denotes the site of infixation in various inflected construct forms of the noun, such as with the possessive *ka*, above. The fact that there exist no examples of infixation which hew monopodal forms in twain is an expected outcome given the ranking of CONTIG-Ft in tableau (82) above.

(83) Predicted infix patterns

OO-Base	*Construct State*	*Example*
(σσ)(σ)	a. (σσ)ϕσ	aransa → aranϕsa
(σσ)(σσ)	b. (σσ)ϕ(σσ)	siwanak → siwaϕnak
(σσ)(σσ)(σ)	c. (σσ)(σσ)ϕσ	bakantingka → bakantingϕka
(σσ)(σσ)(σσ)	d. (σσ)(σσ)ϕ(σσ)	*none*

These predictions were tested against an online Ulwa dictionary.[53] Not surprisingly, the vast majority of nouns in Ulwa are two feet or shorter, and conform to patterns (a-c) as expected (note, however, that a large number of nouns don't show any infixation at all,

[53] See: http://web.mit.edu/ling-phil/lex/misumalpan/ulwa/dict/html/.

regardless of shape). One instance of the predicted mapping in (c) was found, but it is glossed as a deverbal noun, and so might be morphologically complex. The apparent empirical gap in (d), we will attribute to a scarcity of relevant data, rather than a genuine mark against the proposed theory. Of the observed nouns that consist of more than 4 syllables, most are compounds in fairly obvious analogical relationships with other output forms, and tend to follow similar infixation patterns. Take the following, for example.

(84) Super-infixation by analogy[54]

Compound	*Noun Base*
asϕna#pahna 'clothespin'	asϕna 'garment'
di:ϕ#manlalah 'white crab'	di:ϕ 'animal'
panϕ#kirabu 'typewriter bird'	panϕ 'tree'
ya:ϕmak#bah 'abandoned plantation'	ya:ϕmak 'plantation'
yulϕ#kaspang 'poem; poetry'	yulϕ 'instruction; order; advice'
kungϕ#makyûh 'type of snook'; lit. 'long-lip'	kungϕmak 'lip'
wasϕ#makpah 'swamp; marsh'	wasϕ 'water'

In each case, the infix occurs in exactly the same location in the compound and base words. OO-correspondence among compounds and the externally surfacing stems of which they are composed has been proposed by Ito and Mester (1997), and may be put to good use here to predict exactly this form of 'hyperinfixation' in the compound noun. Taking the direction of derivation among the three morphologically related form to be {*noun* → *construct noun* → *compound noun*}, we arrive at the following picture of correspondence in the nominal paradigm.

(85) Correspondence in compound forms

/asna/	$\rightarrow_{IO}$	asna
		$\downarrow_{\text{OO: Stem-Construct}}$
/asna + ka/	$\rightarrow_{IO}$	as-ka-na
		$\downarrow_{\text{OO: Construct-Compound}}$
/$[\text{asna + ka}]_{Mwd}$ + $[\text{pahna}]_{Mwd}$/	$\rightarrow_{IO}$	as-ka-na#pahna

[54] While the dictionary did supply four exceptions to the rule, we will note that the dictionary was fairly small and, based on their meanings, it would be surprising if the recalcitrant forms weren't morphologically decomposable, as well.

Given these relationships, it is a relatively simple matter to preserve infixation in the compound form. LINEARITY, construed over the {construct noun → compound noun} relation prevents normal I-O LINEARITY from preserving the underlying syntactic ordering of morphemes.

(86) LinearityOO preserves infixation

/[asna + ka] + [pahna]/ →	LINEARITY_{OO}	LINEARITY_{IO}
as-ka-na#pahna ~ *asna-ka#pahna	W	L

The approach to Ulwa infixation promoted here generalizes to other cases of 'infixation-to-foot' which have been observed in the literature. The most well-known case is found in the Samoan Plural.

(87) Samoan Plural Reduplication (Marsack 1962, Mosel and Hovdhaugen 1992)

a. Prefixation
   táa   ta(táa) 'strike'
   nófo   no(nófo) 'sit'
b. Infixation over σ
   alófa   alo(lófa) 'love'
   saváli   sava(váli) 'walk'
   maná?o   mana(ná?o) 'desire'
c. Infixation over σσ
   ?anapógi   ?anapo(pógi) 'to be fast'
d. Infixation over σσσ
   fa?amalósi   fa?amalo(lósi) 'to encourage'
   maualúga   maualu(lúga) 'to be high'

Consideration of this data has led researchers to a unifying and obvious conclusion: the plural morpheme subcategorizes to prefix to the final (head) foot of the verbal stem. Note, however, that this conclusion is only confirmed by the data in ((87)d), where the reduplicant infixes over what is at first blush a *trisyllabic* sequence of segments—a sequence of segments not decomposable into multiple edgebound prosodic categories in any standard analysis of right-to-left trochaic Samoan metrical structure (Mosel and Hovdhaugen 1992). The forms in ((87)a-c), however, demonstrate a pattern of infixation that is perfectly mirrored in Ulwa, the only distinction being that here a prefix (rather than a suffix) infixes in between the head foot of the word and whatever prosodic category precedes it. If it can be demonstrated that, as in Ulwa, other circumstances conspire to produce the 'hyperinfixation' found in the (d) forms, the prosodic subcategorization approach is once again left without true justification. As it happens, such 'other circumstances' are thick upon the ground.

The forms in ((87)d) are archetypal of only two sets of reduplicative data which pose significant difficulty for the current theory. The first set of data is otherwise unified in the fact that all of its members begin with the string *faʔa*. Fortunately, this class of data turns out to be non-problematic, as *faʔa* is in fact a distinct, causative marking morpheme.

(88) Causative prefix + partial reduplication

ma(lósi) 'to be strong' → faʔa-ma-<u>lo</u>-(lósi) 'to encourage'
(máfa) 'to be heavy' → faʔa-<u>ma</u>-(máfa) 'to emphasize'
(líu) 'to change, alter' → faʔa-<u>li</u>-(líu) 'translate'

Explanation of examples like *faʔamal<u>o</u>lósi*, then, is simply a matter of faithfulness and correspondence with an appropriate OO-base. Consider the derivational relationships and resultant correspondence relations in the following paradigm. As the crucial rankings for each form's derivation show, the approach taken to analogical morpheme-order preservation in Ulwa accounts for the causative cases with equal ease.

(89) Correspondence and composition[55]

/malosi/	$\rightarrow_{IO}$	[ma(lósi)]
		$\downarrow_{OO}$ {L-ANCHOR$_{OO}$, CONTIG-Ft$_{OO}$ >> LINEARITY$_{IO}$}
/RED + malosi/	$\rightarrow_{IO}$	[ma-lo-(lósi)]
		$\downarrow_{OO}$ {LINEARITY$_{OO}$ >> LINEARITY$_{IO}$}
/faʔa + RED + malosi/	$\rightarrow_{IO}$	[faʔa-ma-lo-(lósi)]

The second category of reduplicated forms which pose a challenge for the current theory involve infixation over a string of vowels, as in /RED + maua(lúga)/ → [maualu(lúga)]. If the Samoan syllable is canonically (C)V (Broselow and McCarthy 1983), each syllable composed of a single mora, the triphthongal form should be prosodically structured *ma.u.a.lu(lúga)*, with infixation of the reduplicant over three syllables from the left edge. Such forms become inconsequential, however, when we consider Mosel's (1992) assertion that diphthongs $V_{[-high]}V_{[+high]}$ diphthongs are short, i.e., monomoraic, when in the head position of a foot. As a result, we may reasonably postulate the following footing of the reduplicated word, wherein the reduplicant infixes over but a single, edge-bound constituent—a foot.

(90) Monomoraic diphthongs: /ei, eu, ai, au, ou, oi/

/RED + maualuga/ → (mau.a)lu(lúga)

Given the straightforward manner in which the various phenomena are thus accounted for, we will conclude that there is insufficient evidence to support the prosodic subcategorization approach over the anchoring/contiguity approach advocated here, and that, given the arguments we have made throughout the chapter against prosodic subcategorization and parochial alignment more generally, that the current approach is superior on grounds of increased restrictiveness. Here it is not a morpheme-specific

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[55] Evidence of the underlying (syntactic) ordering of the morphemes, [CAUS + RED + *verb*], does exist here. We can infer this underlying structure from the behavior of a cognate morpheme in the language The reduplicative plural marker has a suppletive, fixed segment allomorph, *fe*, appearing on certain lexically determined forms (Mosel and Hovdhaugen 1992). When causative *faʔa* marks a verb pluralized with *fe*, the only available ording of the prefixes is [*faʔa* + *fe* + *verb*].

imperative to affix to a prosodic category which results in infixation, but rather a tension between the syntactic composition of morphemes (imposed in the phonology by LINEARITY) and the natural tendency for morphologically related forms to maintain structural similitude.

3. Reduplication and Visions of the Kager-Hamilton problem

As we have observed, the current approach predicts that there should be reduplicative anchoring of the same range of categories found in aprosodic infixation. This follows as long as the constraints we have argued for here are operative over the B-R correspondence ras well as the O-O. Consider a simple case of syllable copy (as found, for instance, in Rotuman (Churchward 1940)). Here CONTIG-σ prevents lower-ranked markedness from truncating segments copied from complete syllables of the base.[56]

(91) Syllable reduplication by domain-contiguity

	RED + CVCCV	CONTIG-σ_{BR}	*STRUC	MAX_{BR}
☞	a. (<u>cvc</u>)-(CVC)(CV)		***	**
	b. (<u>cv</u>)-(CVC)(CV)	*!	**	***
	c. (<u>cv</u>)(<u>c_iv</u>)-(CVC$_i$)(C$_i$V)	*!	****	*
	d. (<u>cvc</u>)(<u>cv</u>)-(CVC)(CV)		****!*	

(Reduplicant lowercase and <u>underlined</u>.)

Since CONTIG-σ only considers the adjacency relations of base segments *within the same syllable* and only among those segments that have correspondents in the reduplicant, it is not violated by failure to copy the entire second syllable of the base. Structurally unmarked and therefore typologically likely candidate (b), however, shows what happens when a portion of a syllable is not copied. CONTIG-σ rules out the candidate for its failure to copy the coda of the first base syllable. Candidate (c) is similarly bad, but shows contiguity failure in the second base syllable. Failed candidate (d), while

[56] We use *STRUC here only for purposes of demonstration; Gouskova (Gouskova 2003) makes a number of compelling arguments against the inclusion of the constraint in CON.

satisfying CONTIG-σ, is ruled out by markedness; while syllable contiguity is maintained, too much of the base is preserved relative to other syllable-contiguous candidates. A candidate (not shown) which simply fails to copy any base segmentism at all would satisfy CONTIG-σ vacuously, but would be ruled out by undominated MORPHREAL or even L-ANCHOR.

We anticipate reduplication of this nature for any possible edge-bound prosodic category or (through anchoring) segment. As we can see in (92) below, the typological range is borne out; examples are from Moravcsik (1978) unless otherwise noted.

(92) Attested reduplicant categories

Cat	*language*
C_1	Marshallese
C_{fin}	Chinanteco, Mayan, Semai (Hendricks 2002)
V_1	Quileute
V_{fin}	Tzeltal
σ_1	Tohono O'odham, Turkish, Hungarian, Rotuman (Churchward 1940)
σ_{fin}	Hopi, Mokilese
Ft_1	Fox
Ft_{fin}	Dyirbal
PrWd	English

It is observable, however, that this approach to reduplication has a distinct similarity to approaches using prosodic-template. Using anchoring and domain contiguity, it is possible to effectively proscribe a prosodically characterizable portion of the base and ensure its presence in the reduplicant against all outside pressures. As the crux of Generalized Template Theory (McCarthy and Prince 1994) is the understanding that prosodic templates are epiphenomenal—the consequence of constraint interaction—we must ask if the current theory undermines the claims and goals of that program of work to any degree.

We will contend here that in fact the proposed theory does not compromise GTT, and we make this claim on two counts. First, nothing in the present theory undermines the basic functioning of Emergence of the Unmarked (TETU henceforth, McCarthy and Prince 1994) effects in reduplicative copying. As the only constraints we implement in our 'templatic' approach to reduplication are faithfulness constraints, they may be subjugated to high-ranked markedness in a TETU ranking, as we can see in the more expanded hierarchy of (91) above.

(93) Syllable reduplication by domain-contiguity

	RED + CVCCV	MAX$_{IO}$	NOCODA	CONTIG-σ_{BR}	*STRUC	MAX$_{BR}$
☞	a. (cvc)-(CVC)(CV)				***	**
	b. (cv)-(CVC)(CV)			*!	**	***
	c. (cv)(c_iv)-(CVC_i)(C_iV)			*!	****	*
	d. (cvc)(cv)-(CVC)(CV)				****!*	

Second, the present theory doesn't allow the typological leakage inherent in a purely template-driven approach to prosodic morphology: it doesn't allow re-emergence of the much-discussed Kager-Hamilton problem (McCarthy and Prince 1995, Spaelti 1997). In the simplest case, the problem results from the use of templatic markedness which impose a size restriction on the reduplicant. Given the appropriate ranking of B-R and I-O faithfulness (the former over the latter), high-ranked templatic markedness can force perfect B-R identity by actually truncating the base; such is not known to occur cross-linguistically. We can see this in an example from Boumaa Fijian (Dixon 1988, Spaelti 1997) below, where this universally unattested back-truncation is predicted to occur in compliance with a templatic constraint requiring RED to be *exactly* one foot.

(94) The problem with template constraints; /RED + talanoa / → tala-talanoa, *tala-tala

	/RED + talanoa /	MAX$_{BR}$	RED=Ft	MAX$_{IO}$
☞	a. (tala)(tala)(noa)	***		
☛	b. (tala)(tala)			***
	c. (tala)(noa)(tala)(noa)		*	

Turning now to the ANCHOR/CONTIG approach, we find different results. Back truncation is not predicted by the current formulation of constraints because anchoring isn't a *negative* prohibition on S_2 (i.e., the reduplicant) in the manner of the above templatic markedness constraint. As long as RED contains the *Cat* in question, the constraint is satisfied; it doesn't care if RED contains other material, and so can never force violation of MAX$_{IO}$. We can see this in tableau (95) below, where CONTIG-Ft simply has no effect whatever on the outcome of competition between the same candidates shown in (49). Here we don't find the desired Fijian optimum (a) emerging as most-harmonic, but—crucially—neither do we find a ranking which will generate universally unattested candidate (b).

(95) D-Contig ⇒ total identity, but no back-truncation

	/RED + talanoa /	MAX$_{BR}$	CONTIG-Ft	MAX$_{IO}$	*attested?*
☞	a. (tala)(tala)(noa)	***			✓
	b. (tala)(tala)			***	✗
☛	c. (tala)(noa)(tala)(noa)				✓

We thus rule out the emergence of the Kager-Hamilton problem in factorial typology. As for the facts of Fijian itself, the present theory arrives at the desired optimum in a manner straightforwardly parallel to the syllable-reduplication account given above: here Max$_{IO}$ and CONTIG-Ft dominates *Struc, which in turn dominates Max$_{BR}$, resulting in exact preservation of a single base foot in the reduplicant.

(96) Anchoring, no back-truncation

/RED + talanoa / →	MAX$_{IO}$	CONTIG-Ft	*STRUC	MAX$_{BR}$
a. (tala)(tala)(noa) ~ *(tala)(tala)	W		L	
b. ~ *(tala)(noa)(tala)(noa)			W	L
c. ~ *ta(tala)(noa)		W	L	

Spaelti (1997) sidesteps the use of templatic markedness in his treatment of the Fijian by appealing to conflicting alignment constraints. An undominated constraint requiring the RED morpheme to be left-coincident with a left foot boundary, when ranked above

MAX$_{BR}$ and another aligment constraint requiring all feet to be rightmost in the prosodic word, will force RED to consist of one and only one foot. While we will pose no further objection to this account beyond those we have established for *any* theory which makes use of parochial alignment, we will note that the proposed $\mathbb{F}_{rel}$ account side-steps the back-truncation problem faced by any prosodic subcategoriztional approach to reduplication. Continuing with the Fijian theme, suppose there exists a Fijian′ in which the reduplicant is not only positioned leftmost in the word by an undominated alignment constraint, but at the same time selects for the category *final-σ*, a category argued by Yu (2003) to be subject to prosodic subcategorization in a number of cases of suffixal infixation. Where MAX$_{BR}$ and both alignment constraints dominate MAX$_{IO}$, all root-initial material leading up the final syllable will be truncated to match the conflicting alignment conditions on RED. Again, this problem does not obtain for a theory which makes use of 'templatic' faithfulness constraints.

(97) Back-truncation by prosodic subcategorization

- REDLEFT ≡ ALIGN(RED, L, PrWd, L)
- REDTOFINσ ≡ ALIGN(RED, R, σ_{final}, L)

	/RED + talanoa /	REDLEFT	Max-BR	REDTOFINσ	Max-IO
	a. (tala)(noa)(tala)(noa)			*	
	b. (tala)▪▪▪(tala)(noa)		***	*	
	c. (tala)(noa)(noa)	*!			
☞	d. (noa)▪▪▪▪(noa)				****

Before moving on, we will note that the current theory does imply a crucial dependency between the metrical structure of the language and the nature of the reduplicative process. Stress assignment in Fijian is right-to-left trochaic and mora-counting, with degenerate feet prohibited (Hayes 1995, Bakovic 1996). Thus, in even-parity forms, we anticipate regular copying of the leftmost foot of the base. We must ask, though, what happens with a σ(σσ) base. Spealti (1997) reports that trisyllabic base forms reduplicate in the following manner: /RED + buta?o/ → (<u>búta</u>)[bu(tá?o)], *(<u>bù</u>[bu)(tá?o)], *(<u>bùta</u>)(<u>?ò</u>[bu)(á?o)]. Spealti argues such mappings to result from a requirement that the base be a prosodic word. Another equally viable solution would be to argue that the unattested mono- and tri-syllabic reduplicant forms are ruled out by a prohibition against the breaking of a prosodic category (i.e., foot) with a morphological word boundary. Yet another solution would be to argue that some kind O-O identity of prosody rules out σ-parsing of *bu* in the reduplicated form (i.e., *bu* is unfooted in S1, therefore it must also be unfooted in S2 to maintain structural similarity).

4. Remark

In Chapter 1, we came to an important conclusion. We saw that, when morpheme-specific alignment constraints are used to position the output exponents of input morphological categories, there is a resulting overgeneration in factorial typology of possible morpheme orders in natural languages. We went on to show that a more explanatory theory of morpheme positioning in natural language is got with the interaction of normal markedness constraints with relational faithfulness constraints—specifically, of the LINEARITY type. We then went on in the current chapter to deal with a potential obstacle to this approach to PoE, aprosodic infixation, arguing it to be best analyzed with what we termed analogical faithfulness constraints, constraints of the ANCHOR and CONTIG variety construed over correspondence relations between surface forms of words.

At no point in this chapter have we needed constraints which merely stipulate the position of the root verb with respect to an edge. Instead, we *maintain* edge-orientation found elsewhere in the surface phonology of the derivational base. The anchoring constraints put to use in this chapter are thus crucially different from alignment constraints; because anchoring does not force a constellation of morphemes into competition with one another for edge-adjacency, but rather formalizes the linguistic imperative to reduce perceptual dissimilarity among related output words. Infixation as a process is thus reduced to two basic ranking schemas, as shown below, neither requiring any reference to alignment constraints.

(98) Prosodic infixation schema: {𝕄 >> LINEARITY}
Analogical infixation schema: {$\mathbb{F}_{OO}$ >> LINEARITY}

Most of the examples we have seen are really a commingling of the two rankings. In most of the cases of 'aprosodic' infixation we have considered, OO-F constraints forcing infixation over some prosodic constituent are interranked with constraints on the prosody. Thus, while the source of infixation is analogical in nature, its realization is grammar dependent in a manner anticipated by constraint interaction in OT.

The next chapter will shift focus somewhat. We will show ultimately that, through a natural extension of the 'homomorphemic' constraint formulation to relational faithfulness constraints other than LINEARITY, we can account for a considerable body of what have been referred to as morphological derived environment effects with a particular type of TETU ranking. We will begin with discussion of how this very same TETU ranking allows us to account for a form of morpheme positioning superficially problematic for the proposed theory.

Chapter Four – Relational Faith and MDEE

To see what is in front of one's nose needs a constant struggle.
– George Orwell

1. MDEE and Bitropic Morphology

We saw in Ch. 1 a fundamental distinction between the alignment and precedence faith approaches to PoE: a formal prediction of the alignment theory that we will refer to as *bitropic morpheme effects*. Where multiple alignment constraints operative on a particular morpheme are defined for opposite edges of P/MCat, the contents of an affix must appear simultaneously at both edges of some output category (Mwd, Stem, PrWd, etc.) or else not at all. Any of a number of undesireable effects may obtain under such a ranking, depending on which of the following faithfulness constraints is lowest ranked in the grammar. Low-ranking of CONTIG (or CONTIG_{afx}) will allow the segments of the affix to break across the segmentism of the root; MAX allows for the simple disappearance of the morpheme, since both alignment constraints are vacuously satisified if the affix simply vanished; with INTEGRITY, one or more segments of the affix will appear copied at the opposite edge of the word; and with UNIFORMITY, one or more segments of the affix will fuse with every base segment until opposite edge alignment is achieved.

(1) Potential bitropic effects

Undominated	*Lowest-ranked*	*Effect*	*Example mapping*
ALIGN-R_{AFX}, ALIGN-L_{AFX}	a. CONTIG	circumfixation	/base + afx/ → $[\text{afx-base-afx}]_{word}$
	b. MAX	deletion	/base + afx/ → $[\text{base}]_{word}$
	c. INTEGRITY	doubling	/base + afx/ → $[\text{afx}_i\text{-base-afx}_i]_{word}$
	d. UNIFORMITY	fusion	/base + afx/ → $\begin{bmatrix} \leftarrow \text{afx} \rightarrow \\ \text{base} \end{bmatrix}_{word}$

The precedence faith approach to PoE that we advocated in Chapter One does not predict inherently bitropic morphology in this way. Each morpheme has a unique position in the input, and perturbation of input precedence only comes through interaction with phonological constraints. Thus LINEARITY, by itself, will never force a morpheme to 'spread' over another morpheme. In the main, the loss of the predicted effects of rankings (a-c) does not seem particularly tragic for our theory of grammar. Circumfixation has always been a questionably accurate explanation of affix/suffix co-occurrence phenomena (Bauer, Lieber 1992), and its exclusion from the bag of tricks available to phonological theories of PoE is doubtfully a loss. A ranking of constraints that prevents an underlying affix from ever surfacing would, presumably, never be learnable; its exclusion from our theory of grammar only serves to narrow the gap between the factorially predicted and the linguistically viable. Case (c), where an affix copies itself at an opposed edge of the output word, amounts to a kind of affix-oriented reduplication that is, to my knowledge, unattested in natural language.

Cross-linguistically, however, we find a number of morphophonological alternations suggestive of the fourth type of bitropic morphology, where root and affix material fuse in the output. Akinlabi (Akinlabi 1996) discusses a number of cases, such as those found in the Arawakan language Terêna and the Edoid language Etsako, where a floating-feature morpheme spreads from what is taken to be its underlying affixal position to the opposite edge of the base of affixation. In Terêna (Bendor-Samuel 1960), the first-person singular (1SG) spreads from left to right over the stem; we know spreading in this case to be rightward because, where a medial obstruent blocks the spreading, nasality is unilaterally found on the left edge. Similarly in Etsako, a high tone morpheme spreads from right to left over low tones, but is blocked by an intervening stem high tone. Spreading in both cases occurs only in the morphological contexts shown.

(2) Terêna Nasal Spread (Bendor-Samuel 1960, Akinlabi 1996)
Left to right spread: /$_{[nas]}$ + arine/ → ãr̃ĩnẽ 'sickness.1SG'
Blocked by medial obstruent: /$_{[nas]}$ + owoku/ → õw̃õ^{ŋ}gu 'house.1SG'

(3) Etsako H-tone Spread (Elimelech 1976, Akinlabi 1996)
Right to left spread: /$a^{L}me^{L}$ + H/ → $a^{H}me^{H}$ 'water.ASSOC'
Blocked by root H: /$a^{L}ta^{H}sa^{L}$ + H/ → $a^{L}ta^{H}sa^{H}$ 'plate.ASSOC'

Akinlabi (1996) explains such phenomena with exactly the appeal to opposite edge alignment constraints observed above. In Terêna, for example, given a featural affix /[+nas]/ for the underlying 1SG morpheme, ALIGN-L and ALIGN-R for that morpheme effectively propel it to either end of the output string. Spreading proceeds from the undominated left-aligned feature to the first obstruent in the string, where undominated markedness constraints prevent its further migration.[57]

(4) Alignment-controlled spreading.

a. Morpheme alignment constraints
ALIGN-L(1SG, stem) := 'The 1SG is a prefix in stem.'
ALIGN-R(1SG, Pwd) := 'The 1SG must be right aligned with the prosodic word.'
*NASOBS := 'The release phase of an obstruent is not nasally articulated.'

b. Crucial rankings

	/[+nas] + owogu/	*NASOBS	ALIGN-L	ALIGN-R
☞	a. õw̃õ^{ŋ}gu			*
	b. õwogu			****
	c. owogũ		*!***	
	d. õw̃õg̃ũ	*!		

Akinlabi's theory has obvious appeal. It situates morpheme position in the larger formal context of Generalized Alignment (McCarthy and Prince 1993b) and requires no external impetus outside of the alignment constraints themselves to force propagation of the nasal morpheme across the rest of the word. If Occam's Razor were the only metric by which linguistic theories were judged, the alignment approach would best the LINEARITY approach above, which requires an external phonological force (SPREAD) to ensure harmony of the 1SG morpheme across the output word. Unfortunately, the alignment

[57] Surface forms such as nõ^{ŋ}gõnẽ, with gaps in the nasality, are prevented by an undominated NOGAP constraint.

approach also suffers a number of drawbacks—amd note that the Optimal Domains Theoretic account of the Terêna facts offered by Cole and Kisseberth (1994) as well as the featural licensing account of Piggott (1997, 2000) both suffer identical criticisms, inasmuch as they too hinge crucially on some formulation of gradient, morpheme-specific alignment to position the exponence of the 1SG morpheme.

I. We saw in Chapter One that a theory of morpheme positioning hinging on morpheme-specific alignment effectively renders any linguistic explanation of morpheme order universals impossible, effectively rendering any syntactic or semantic explanation of such a universal vacuous. The theory of 1SG nasal harmony proposed by Akinlabi takes such a theory of morpheme order as a point of departure—it is not the case that *any* morpheme in Terêna will align to opposed edges of the word, but that the 1SG *alone* will do so. While a descriptively adequate characterization of the problem, such a theory cannot exist without the tacit assumption that *any* particular morpheme may align to *any* edge of *any* phonological or morphological constituent. This is simply too powerful a theory of morpheme position in natural language. As LINEARITY will necessarily attract the exponence of a morpheme to a single underlying position (specified by the syntax), we explicitly espouse a theory in which the space of possible surface morpheme orders is constrained by the syntactic component of the grammar. LINEARITY can never force a morpheme to a position to which it is not affiliated in the input.

II. The theory relies crucially on *gradient* alignment. As is apparent from tableau (4) above, were Align-R only categorically violable—that is, violated only once, no matter the number of segments intervening between the 1SG and the right edge of the prosodic word—there would be no means of differentiating the harmonic worth of candidates (a) and (b). Unfortunately, as argued at length by McCarthy (McCarthy 2002b), such a construal of alignment theory leads to any of a number of undesirable formal consequences. The LINEARITY theory, on the other hand, is not gradiently violable in the sense argued against by McCarthy, who distinguishes *multiply-violable* constraints like LINEARITY from gradiently violable alignment.

III. Though numerous authors have proposed alignment constraints to be at work in a variety of nasal harmonies (Prince and Smolensky 1993, Pulleyblank 1993, Cole and Kisseberth 1994, Pulleyblank 1996, Beckman 1998, Walker 1999), the morpheme-specific formulation of alignment given above effectively divorces the attested alternations from any larger phonological tendencies in the language. As it turns out, Terêna is host to a number of other feature-spreading morphologies (Aikhenvald 1999), and dependence on the alignment theory to account for each of them renders this fact linguistically arbitrary.

Despite the apparent difficulty presented by these facts, we will show that the faithfulness theory advocated here actually sheds considerable light on such phenomenon, situating them analytically as a simple subtype of class of phenomena dubbed morphological Derived Environment Effects.

1.1. Terêna Nasal Harmony

Let us first consider the facts of the alternations in closer detail. The following data have received considerable attention in the generative literature since they were originally brought to light by Bendor-Samuel (1960). Descriptively, the signaling difference between what has been considered the morphologically basic form of a noun or verb, the

3rd person singular (3SG), and an inflectionally formed congener of it, the 1st person singular (1SG), is the presence of a span of nasal segmentism in the latter (shown '{...}').

(5) Terêna 1SG Nasal Harmony[58] (Bendor-Samuel 1960)

a. Over whole word
(3SG subject → 1SG subject)
emoʔu → {ẽmõʔũ} 'word.1SG'
anu → {ãnũ} 'neck.1SG'
ayo → {ãỹõ} 'brother.1SG'
yono → {ỹõnõ} 'walked.1SG'
arunoe → {ãrũnõẽ} 'girl.1SG'
arine → {ãr̃ĩnẽ} 'sickness.1SG'

b. To first obstruent; prenasalization
ahyahʔašo → {ãⁿž}aʔašo 'desire.1SG'
iwatako → {ĩw̃ãⁿd}ako 'sat.1SG'
nokone → {nõᵑg}one 'need.1SG'
otopiko → {õⁿd}opiko 'chopped.1SG'
owoku → {õw̃õᵑg}u 'house'

c. Prenasalization of initial obstruent
šeʔeša → {ⁿž}eʔeša 'son.1SG'
haʔa → {ⁿz}aʔa 'father.1SG'
paho → {ᵐb}aho 'mouth.1SG'
piho → {ᵐb}iho 'went.1SG'
simoa → {ⁿz}imoa 'came.1SG'
tuti → {ⁿd}uti 'head.1SG'

A number of generalizations are apparent in the data. The nasal span is oriented to the left edge of the base word in all cases. However, the nasal span is impeded from spanning the entirety of the base beyond any obstruents, which themselves undergo voicing and prenasalization when part of the span. It is also observable that 'normal' (i.e., non-morphologically conditioned) nasal harmony of this nature occurs nowhere else in the language; word-medial nasals as in *yono* and *simoa* do not spread to proximate vowels or consonants in the 3SG, for example.

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[58] The Terêna phoneme inventory consists of 14 consonants and /p, t, k, s, ʃ, h, h^y, l, r, ʔ, m, n, y, w/ and five vowels /i, e, a, o, u/ (Bendor-Samuel 1960).

The Terêna data have proved interesting to phonological theory because they seem to defy easy linguistic description. Phonologically, the alternations are descriptively most similar to nasal harmonies of the normal, phonologically conditioned sort found for example in Malay (Onn 1980), where a nasal segment triggers rightward harmony up to an obstruent consonant opaque to the process: /makan/ → [mãkan] 'to eat'. However, unlike such cases, the 1SG nasal spreading results in prenasalization and obstruent voicing of any obstruent consonant which terminates the nasal span and, of course, only occurs in a rarefied morphological environment. Piggott (Piggott 1988, 1997, 2000) reports that, if anything, these fact suggest the complex segments found in the alternations are more reminiscent of the fusion of nasal and oral consonants widely attested in languages of the Bantu family. Nasal fusion, however, is not known to result in concomitant nasal spreading of the type found in Terêna.

Morphologically, too, the Terêna facts seem not quite classifiable. Considering the forms in ((5)a), the alternations bear a remarkable resemblance to featural *transfixation*, as in Coeur d'Alene (Cole 1991), where every consonant of a word is glottalized in diminutive formation: /mar-marím-ɛntɛm-ilc/ → [m'-m'ar-m'ar'ím-ɛn'tɛm'-il'c] 'they (little ones) were treated one by one'. In such alternations, there are typically no blocking effects of the sort found in Terêna. The problem similarly bears token similarity in data (b-c) to alternations found in Inor (Rose 1994, Zoll 1998) and Japanese (Mester and Ito 1989, Zoll 1998); in each case a morpheme is realized by the appearance of some feature on a particular segment within the base, modulo various phonological licensing conditions. Such alternations, however, do not show *spreading* of a feature, as seen in the Terêna data.

Perhaps as a result of this descriptive indeterminacy, a fairly wide variety of formal approaches have been brought to bear on the Terêna problem, each attempting to reconcile the facts of the alternations with some larger theory of (morpho-)phonology. Bendor-Samuel (1960) argues that the changes are brought about by a 'nasal prosody' affecting the base word; a similar treatment of the phenomena has been more recently offered within the framework of Optimal Domains Theory by Cole and Kisserberth (1994). In a series of papers, Piggott (Piggott 1988, 1997, 2000) has championed the notion that the morpheme is underlyingly a consonant subject to various surface licensing conditions. Perhaps the most widely followed approach has been to assume the morpheme is a floating nasal autosegment which docks on the initial segment of the base and thereafter spreads throughout. Its only prerequisite being some understanding of autosegmental structure, this approach has transcended various phonological frameworks (Bivin 1986, Tourville 1991, Gerfen 1993, Akinlabi 1996, Zoll 1998).

In Optimality Theory, MDEE's have received a number of formal treatments, for example constraint conjunction (Lubowicz 2002); structural immunity (Inkelas 2000); and level-ordered OT (Cho 1998b).[59] The approach we will follow differs from such predecessors in that we take MDEE in OT to follow from a particular ranking of relational faithfulness constraints like LINEARITY, UNIFORMITY, and CONTIGUITY (McCarthy and Prince 1995)—generally speaking those constraints responsible for the preservation of structural relations such as precedence, adjacency, simultaneity, and autosegmental association across multiple dimensions of phonological representation.

[59] We make no claims here about *phonological* derived environment effects of the sort discussed in Lubowicz (1998) and more recently in McCarthy (2002a).

The schema is shown below for $\mathbb{F}_{rel}$ a relational faithfulness constraint, HOM$\mathbb{F}_{rel}$ a homomorphemic variant of it, and $\mathbb{M}$ a phonological markedness constraint.

(6) Ranking Schema for Morphologically Derived Environment Effects

$\{\text{HOM}\mathbb{F}_{rel} >> \mathbb{M} >> \mathbb{F}_{rel}\}$

This ranking schema, a subtype of the Emergence of the Unmarked ranking schema of McCarthy and Prince (McCarthy and Prince 1994), has already proven effective in accounts of MDEE. Pater (1999) argues for an almost identical ranking of $\mathbb{F}_{rel}$ and markedness (*NC̥) constraints in his account of Austronesian Nasal Substitution; Landman (1999) accounts for Chuckchee Epenthesis (an MDEE) with like ranking arguments; we saw in Chapter 1 its utility in accounting for MDEE in Georgian; and we will see in §2.2 the effectiveness of the approach in treatment of Korean Palatalization (Ahn 1986, Kiparsky 1993, Cho and Sells 1995, Hong 1997, Cho 2001a, Cho 2001b). We will see in sections to come that the Terêna facts constitute a particularly obstacle-laden field of play for a theory that seeks to restrict the application of morphologically conditioned nasal harmony to the interaction of relational faithfulness and phonological markedness alone, but we will nevertheless argue such a theory to provide the most restrictive possible account.

The argument will run as follows. First, I will show that the most restrictive account of the surface positioning of the 1SG nasal span follows from the ranking of a relational faithfulness constraint, LINEARITY (McCarthy and Prince 1995; Hume 2001), with respect to a generic markedness constraint conditioning nasal harmony. I will then show that, given this means of localizing the exponence of the 1SG morpheme, as well as certain typological observations about prenasalization and facts of Terêna phonology made by Piggott (1997), it must be concluded that the 1SG morphology can only be the result of an underlying nasal segment fused with base segmentism on the surface, an apparent violation of yet another relational faithfulness constraint, UNIFORMITY (McCarthy and Prince 1995). From there, we will see that the very narrow morphological context of the nasal fusion process may be analyzed as an MDEE, brought about through an Emergence of the Unmarked (TETU; McCarthy and Prince 1994) ranking of UNIFORMITY, homomorphemic UNIFORMITY, and the generic markedness constraint driving the fusion. It will further be shown that a high-ranked relational faithfulness constraint preserving autosegmental association works to rule out a variety of undesired forms in the language.

1.2. Necessary precursors to analysis

There are a number necessary precursors to full explanation of the Terêna facts as MDEE, however. The first concerns the apparently prefixal orientation of the featural morpheme; some component of the theory must pin the 1SG nasal span to the left edge of the output word. The second is some conclusion as to the underlying structural make-up of the 1SG; is it a floating feature or a segment? Finally, we will require some explanation of the motivating force behind the observed nasal harmony.

1.2.1. Positioning the affix

The majority of past analyses of the Terêna facts have assumed that the morphosyntactic orientation of the 1SG morpheme is essentially prefixal, as suggested by the distributional facts of the morpheme in both Terêna and in related Arawakan languages, where it is realized as a prefix, /n(u)-/ (Aikhenvald 1999). We will take this assumption without question, along with the basic Item-and-Arrangement (Hockett 1958) model of word-formation within which it is couched. It is of critical importance to any account of the harmony process to ensure that the exponence of the prefix always appears at the left edge of the stem in the output. Under the crucial assumption that morphemes are ordered in the phonological input, undominated LINEARITY will rule out any candidate without 1SG exponence at the left edge of the output string. Such ungrammatical candidates (for example, candidate (c) below) would be preferred by lower ranked markedness (𝕄 below; we will give a formal definition of the constraint in §1.2.3 below) favoring those candidates evincing the greatest amount of nasal fusion *in toto*.

(7) LINEARITY determines left-edge orientation

	/N + simoa/	*NASOBS	LINEARITY	𝕄
☞	a. {ⁿz}imoa			****
	b. simo{ã}		*!*** N ≮ {s, i, m, o}	****
	c. s{ĩmõã}		*! N ≮ {s}	*
	d. {s̃ĩmõã}	*!		

Note the necessary assumption here that we do not count LINEARITY violations over instances of segment simultaneity, as in fusion. Were fusion to voilate LINEARITY, and {LINEARITY >> 𝕄}, we would expect fusion to be ruled out completely in the language. Similarly, under the opposite ranking, {𝕄 >> LINEARITY}, candidate (c) would be the optimal candidate, best satisfying 𝕄 with the greatest amount of non-obstruent nasal fusion.

This assumption requires some clarification of LINEARITY's formulation. As traditionally defined (Hume 1995, McCarthy and Prince 1995, Hume 2001), the constraint straightforwardly penalizes segment fusion just as well as it penalizes segment reversal. Consider the accepted formulation of the constraint.

(8) LINEARITY (original)

S_1 reflects the precedence structure of S_2 and v.v.
If $x, y \in S_1$; $x', y' \in S_2$; $x\Re x'$ and $y\Re y'$; then $x < y$ iff $\neg(y' < x')$.

Consideration of a simple fusion candidate demonstrates the problem. What is the precedence relation of y' with respect to x' in the diagram below? Given that two elements simultaneous with each other may neither precede nor follow one another, it is certain not the case that $y' < x'$. Since $x < y$ in the input, a violation of LINEARITY must therefore result.

(9) A typical fusion candidate

input:	$x \quad y$
output:	$\widehat{x'y'}$

We take the Terêna case to constitute good evidence that constraints on precedence reversal and constraints on segmental fusion must be complementary in their violation profiles, and will sidestep the unfortunate consequence of the original LINEARITY formulation with a minor reformulation of the logic of the constraint. Principally, we will propose that LINEARITY must hold over precedence relations among sets of output correspondents, as shown in the revised constraint below.

(10) Linearity (revised)

If $x, y \in S_1$, then $x < y$ iff $\neg[Y' = \{y' \in S_2 \mid y'\Re y\} < X' = \{x' \in S_2 \mid x'\Re x\}]$.

In other words, LINEARITY is violated when a) x precedes y in the input and b) all correspondents of y precede all correspondents of x in the output. This reformulation makes no difference in cases of segmental metathesis and infixation, where output elements either precede or follow one another unambiguously. In the case of fusion, however, the above constraint has the desired effect of differentiating the violation profiles of dislocation candidates from those of fusion candidates, those properly in the violational domain of the UNIFORMITY constraint.

(11) Compared violations of LINEARITY and UNIFORMITY

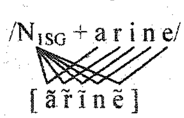
	/AB/	LINEARITY	UNIFORMITY
dislocation	a. BA	*	
fusion	b. A͡B		*

Note that under this formulation, doubling of an input element to a 'dislocated' position does not violate LINEARITY. For example, /AB/ → ABA would not result in a violation because it is not the case that B precedes all correspondents of A in the output. We leave arbitration of such candidates to the ranking of constraints such as INTEGRITY (McCarthy and Prince 1995), which ban fission of input elements.

1.2.2. Segment vs. feature

The Terêna 1SG morpheme has the rare morphological property of only surfacing as a modification to other phonological structure. It is therefore incumbent upon the researcher to deduce the underlying structure of the morpheme from typological and theoretical considerations. We will present here two lines of reasoning which support the assumption that the Terêna 1SG is underlyingly a segment, rather than a floating feature, and is subject to fusion of the sort diagrammed below.[60]

(12) Nasal harmony as fusion



We have observed that Terêna Nasal Harmony attests the same pattern of nasal harmony found in Waray and Warao, spreading which targets vowels and approximants, but is blocked by obstruents of all types. As Piggott (1997) observes, however, the Terêna case is crucially different from these phonologically-conditioned harmony processes in that

[60] We take *segment* at its simplest possible definition: a set of hierarchically ordered features with a positional index. Thus we do not necessarily rule out the possibility of the 1SG being a subsegment as defined by Zoll (1998), i.e., a segment without a root node. A *floating feature*, in constrast, is positionless by standard definitions.

Terêna's opaque obstruents voice and prenasalize as a result of the alternation; such is not known to occur in any other case of nasal harmony. On the other hand, prenasalization is a common property of nasal-consonant/oral-consonant fusion in a variety of African languages. From these facts, Piggott concludes that Terêna Nasal Harmony is indeed a case of fusion of nasal segments and provides an account of 1SG prenasalization and voicing wherein the 1SG, a placeless nasal segment, is forced to dock on base segmentism to acquire place features. Prenasalization, on this account, follows simply from a) a multiplicity of root nodes in the resulting segment and thereafter b) a number of standard assumptions of autosegmental phonology.

Piggott's argument is at least descriptively convincing, and so we take it as a first step towards proof of the 1SG's segmental underlying form. However, it is not entirely apparent how prenasalization can be completely ruled out in the case of phonologically-conditioned harmony. Under the representational assumptions of Steriade (1993), the docking of a floating nasal feature on the closure phase of a voiceless obstruent could well account for the prenasalization facts, as argued by Akinlabi (1996). Piggott's criticism of Akinlabi's approach, that fricatives do not *have* a closure phase in Steriade's theory and therefore that examples such as *simoa*$_{3SG}$ → ^{n}*zimoa*$_{1SG}$ defy explanation therein, is of little consequence as long as the feature-spreading theory makes some provision of affrication of said obstruents in the 1SG. Similarly, it is remarkable that voiced obstruents are non-phonemic in Terêna (Bendor-Samuel 1960). Flemming (2001) observes that a number of languages have prenasalized stops without having voiced stops at all and from this concludes that there is no necessary implicational relationship between the voiced and prenasalized stops. The fact that obstruents opaque to nasal harmony become prenasalized and voiced in Terêna might then simply result from the ranking of markedness constraints {*VOI/OBS >> *PRE-NAS/OBS}. Such a result could also be achieved with some theory on contrast preservation since, as Flemming also points out, prenasalized obstruents are more phonetically salient than are simple voiced obstruents; for implementations of such a theory see the frameworks of Lubowicz (2003) and Flemming (2001).

In short, while there is descriptively tenable evidence that the Terêna 1SG is formed through segment fusion, it is not entirely apparent how to capture proof of the fact within current phonological theory. We need, then, some other evidence to conclude that the 1SG is segmental rather than featural. That evidence is found in our formal conclusion above, that LINEARITY is the arbiter of position of exponence in the 1SG. The morpheme must be a full segment because LINEARITY cannot refer to features.

We arrive at this conclusion *reductio ad incommodum*. If we allow for a theory of relational faith in which LINEARITY refers to a floating nasal feature, we must by extension allow that the constraint governs the positioning of features elsewhere. For instance, consider the abstracted string of segments below, ABC, each composed of a set of features notated underneath. If we take precedence relations to hold between not only the ordered segments, but additionally among the features which make up those segments, we derive from structure ((13)a) the precedence relations in ((13)b).

(13) An abstract example

a. The featural makeup of string /ABC/:

$$\underset{\begin{bmatrix} x \\ y \end{bmatrix}}{A_1}\ \underset{\begin{bmatrix} m \\ n \\ o \end{bmatrix}}{B_2}\ \underset{[f]}{C_3}$$

b. Precedence relations of string /ABC/:

Segments: A < B < C
Features: {x, y} < {m, n, o} < {f}

Now, suppose additionally that LINEARITY governs featural precedence; perhaps there is a LINEARITY(f) specifically attuned to featural precedence relations.

(14) LINEARITY(f) [hypothetical]

S_1 reflects the *featural* precedence structure of S_2 and v.v.
If features $x, y \in S_1$; $x', y' \in S_2$; $x\Re x'$ and $y\Re y'$; then $x < y$ iff $\neg(y' < x')$.

Where any markedness constraint disfavoring the most-faithful segment ordering dominates LINEARITY(f), a highly unnatural result obtains: the number of features in a segment determines the most harmonic reordering of segments. This odd result occurs because LINEARITY(f) is multiply violable; it counts violations of each feature token-wise. Thus, for example, candidate (b) below violates the constraint a number of times equal to (# of features of B)×(# of features of A), or six times because segments A and B have been re-ordered to satisfy the high-ranked markedness constraint. The order ACB is thus optimal, solely because C has fewer features than B.

(15) Feature counting chooses order

	$A_1\ B_2\ C_3$ $[x, y]\ [m, n, o]\ [f]$	*ABC	LINEARITY(f)
	a. $A_1\ B_2\ C_3$ $[x, y]\ [m, n, o]\ [f]$	*!	
	b. $B_2\ A_1\ C_3$ $[m, n, o]\ [x, y]\ [f]$		****!** {x, y} ≮ {m, n, o}
☞	c. $A_1\ C_3\ B_2$ $[x, y]\ [f]\ [m, n, o]$		*** {m, n, o} ≮ {f}

As a result, no phonological property of the sequence determines the most harmonic segment ordering, just the gross number of features in each segment. This seems a highly unnatural property for any theory of segment ordering to predict. We are led therefore to conclude that a) there are no precedence relations between features in the input and precedence faith constraints therefore have nothing to refer to below the level of the segment, and/or b) constraints of CON refer to precedence relations among segments *only*. Whatever the proper restriction may be, we arrive at the simple fact that LINEARITY cannot govern the position of a floating-feature morpheme alone—not in Terêna or in any other language—and that, therefore, the Terêna 1SG must be a segment in the phonological input.

1.2.3. The source of nasal spreading

If alignment constraints do not force the morpheme to fuse, we must find some other mechanism in the language's grammar capable of doing so. We will take it as a point of departure that that something is the same grammatical imperative responsible for phonologically-conditioned nasal harmony more generally. Following Walker (1999), we will assume that phonological impetus to be a best formalized in constraints such as that in (16) below.

(16) SPREAD([+nasal], Prwd) (Walker 1999)

> If a segment is associated with [+nasal], then every segment is associated with [+nasal].
> Assign one violation-mark for each segment not so associated with [+nasal].

Walker argues SPREAD-type constraints to interact with a universal hierarchy of acontextual markedness constraints to produce the range of available targets of nasal harmony in a given language. In Terêna, as in Malay (Onn 1980) and Warao (Osborn 1966), the fact that stops and fricatives are opaque to nasal spread while vowel and approximants are targets of it must result from the inter-ranking of SPREAD with the following universal ranking of phonetically-grounded constraints.

(17) Obstruents block nasal spread: /owoku/ → [õw̃õ$^{\text{ŋ}}$gu], *[õw̃õk̃ũ]

{*NASOBSSTOP >> *NASFRICATIVE >> SPREAD >> *NASGLIDE >> *NASVOWEL}

We will assume here that prenasalized segments are, for all intents and purposes, a part of the nasal span. Prenasalization, as argued by Akinlabi (1996), is simply the result of nasal spreading (fusing, in our parlance) up to the closure phase of opaque obstruents, i.e., the initial aperture node of the targeted obstruent under the representational assumptions of Steriade (1993). We also assume that the larger cross-linguistic absence of gaps in the nasalization precesses follow from strict locality of spreading as argued by various authors (see for example Gafos 1997, Ní Chiosáin and Padgett 2002). Concomitant changes to prenasalized segments may be derived in a number of ways, one obvious possibility being to assume that the well-motivated *NC̥ constraint (Pater 1999) ranges over aperture nodes as well as full segments and happens to dominate faithfulness to voicing in Terêna. We capture the 1SG's fusion with the exponence of the root with the ranking of SPREAD and the familiar anti-fusional $\mathbb{F}_{rel}$ constraint shown below.

(18) UNIFORMITY

No element of S_2 has multiple correspondents in S_1.
For x, y ∈ S_1 and z ∈ S_2, if x$\Re$z, y$\Re$z, then x≐y.

(19) Nasal Harmony as Fusion

	$N_1 + a_2\ y_3\ o_4$ | [nas]	SPREAD	UNIFORMITY
	a. $n_a + a_2\ y_3\ o_4$ | [nas]	***	
	b. $a_{12}\ y_3\ o_4$ | [nas]	**	
☞	c. $a_{12}\ y_{13}\ o_{14}$ \\ | / [nas]		***** N≐{a, y, o}

More important than motivating what does happen in the alternations is ruling out what *doesn't*. A complete theory of the Terêna alternations must determine: a) why fusion—if fusion is conditioned by a generic markedness constraint like SPREAD and therefore generally available in the language—only occurs in the 1SG inflection; b) why nasal segments within morphemes do not 'collapse' to spread nasality; and c) why, if fusion is the desired outcome, simple assimilation of nasal features is ruled out. These will be the formal challenges of the next section.

1.3. Terêna Nasal Harmony as MDEE

The fusional nasal harmony we have now argued for at length occurs only under 1SG inflection in the Terêna language. Any theory of the process must predict spreading only in this rarefied morphological context and only, interestingly, of the prefixal nasal, as shown by examples such as *ⁿzimoa*, wherein the nasal feature of root /m/ does not spread. Previous accounts have captured this fact with morphologically-indexed rules or constaints. The current approach will take a slightly different tack. Nasal Harmony is an entirely general phonological process in Terêna, as suggested by the generality of the SPREAD constraint. The fact that harmony only occurs in the 1SG inflection we take to result from the particular confluence of factors: a) the 1SG's lexical representation, a lone nasal segment prefix, and b) a ranking of $\mathbb{F}_{rel}$ constraints in the Terêna language which engenders blocking of fusional processes in non-derived environments.

In Chapter One, we introduced a formulation of relational faithfulness that narrowed the operative domain of LINEARITY to reversals of precedence between elements belonging to the same morpheme; sonorant/C metathesis was limited to heteromorphemic sequences in

Georgian. Here we will take the next logical step, and argue that all $\mathbb{F}_{rel}$ constraints are subject to this special/general constraint formulation: each $\mathbb{F}_{rel}$ constraint is argued to have a *homomorphemic* variant. We will consider a fuller range of homomorphemic $\mathbb{F}_{rel}$ constraints in §2; for the time being, however, we must focus on that most relevant to the Terêna alternations, homomorphemic UNIFORMITY, below.

(20) HOM(omorphemic)UN(iformity) – "No coalescence within a morpheme."

No element of S_2 has multiple correspondents in S_1 common to a single morpheme.
For x, y $\in S_1$ and z $\in S_2$, if $x\Re z$, $y\Re z$, and x, y $\in$ M, then $x \doteq y$.

Where HOMUN is undominated in a grammar, individual morphemes will be immune to structural collapse of the sort found in Terêna. Where some markedness constraint is ranked between HOMUN and UNIFORMITY, we find an emergence of unmarked structure in derived contexts. The substance of one morpheme may merge with the substance of another, though no such merger takes place within the precincts of each morpheme individually. This is precisely the state of affairs we find in Terêna. The relevant constraint ranking is shown below in optimization over two forms of the root word *arine*, the underived 3SG in ((21)a) and the derived 1SG in ((21)b).

(21) Derived and non-derived forms compared

a. No fusion in non-derived forms

	/arine/	HOMUN	SPREAD	UNIFORMITY
☞	c. arine		****	
	d. ãr̃ĩẽ	*!***		****

b. Derived fusion

	/ $N_1 + a_2r_3i_4n_5e_6$/	HOMUN	SPREAD	UNIFORMITY
	a. $n_1a_2r_3i_4n_5e_6$		*!***	
☞	b. $\tilde{a}_{12}\tilde{r}_{13}\tilde{ı}_{14}n_{15}\tilde{e}_{16}$			***** $N \doteq \{a, r, i, n, e\}$
	c. $\tilde{a}_{125}\ \tilde{r}_{135}\ \tilde{ı}_{145}\ \tilde{e}_{156}$	*!*** $n \doteq \{a, r, i, e\}$		********** $n \doteq \{N, a, r, i, e\}$, $N \doteq \{a, r, i, n, e\}$

As the tableaux demonstrate, the {HOMUN >> SPREAD >> UNIFORMITY} ranking ensures that morpheme-medial nasals, such as the /~n~/ in underived *arine*, are not subject to

SPREAD-satisfying fusion. At the same time, the 1SG morpheme may fuse freely with segments of the base, such union not being subject to the strictures of HOMUN. As we show with the position-indexing and increased feature-geometric detail of ((21)b), however, HOMUN remains active in the optimization, continuing to rule out root-medial collapse of segmentism as in candidate (c). It is not simply the case that HOMUN protects simultaneity relations[61] when a root goes unaffixed; rather, the constraint protects homomorphemic simultaneity when and however it may occur.

It is observable that a root-specific UNIFORMITY constraint would work much the same in this particular example. Root-specific variants of faithfulness constraints have been widely proposed in the literature, and, even though root faith is itself ultimately just a subtype of homomorphemic faith, a parsimonious theory of faithfulness would eschew adding yet another faithfulness variant (homomorphemic) to the retinue of possible constraints. Note, however, that the HOMUN formulation is actually more restrictive than the $\text{UNIFORMITY}_{\text{ROOT}}$ formulation would be along a certain grammatical axis: the ranking of constraints above rules out fusion of a nasal segment contained within an affix where a $\text{UNIFORMITY}_{\text{ROOT}}$ ranking would not. If we consider a hypothetical prefix *na-*, for example, fusion of affix-initial nasal with the following vowel could not be ruled out by root-faithfulness, and a potentially undesirable mapping /na+piho/ → *[ã-^{m}biho] could result. As HOMUN prevents fusion of segmentism among morphemes of any category, root or affix, this problem does not arise in the current account. We will take this, along with other examples of derived processes blocked regardless of root/affix status have been explored in the literature, to be sufficient evidence for the $\text{HOM}\mathbb{F}_{\text{rel}}$ formulation.

[61] Simultaneity ("="). If A and B occur at position p, then A=B. A = B is transitive, symmetric, reflexive, and substitutive.

While the {HOMUN >> SPREAD >> UNIFORMITY} ranking successfully restricts fusion to derived environments, it does not restrict satisfaction of SPREAD through other means—for instance nasal harmony in its more proper sense, assimilation of the [+nasal] feature to other segments in its phonological environs. This may occur in two potentially problematic cases. Fig. ((22)a) shows the general case in non-derived environments; fig ((22)b) shows a slightly more complex possibility satisfaction of the SPREAD constraint: first fusion of the 1SG nasal segment with the initial segment of the root, followed by assimilatory feature spread through the remainder of the base string.

(22) Two undesired candidates

a. Underived assimilatory spread

* $\tilde{a}_1$ $\tilde{r}_2$ $\tilde{\imath}_3$ n_4 $\tilde{e}_5$

[+nas]

b. Derived fusion plus feature spread

* $\tilde{a}_{12}$ $\tilde{r}_3$ $\tilde{\imath}_4$ n_5 $\tilde{e}_6$

[+nas]

The latter case is only of interest theory-internally; it is not apparent how (b) above would be phonetically distinguishable from the full segmental fusion candidate we have argued for throughout this paper. As it happens, however, the grammatical restriction which saves the analysis from the empirically incorrect form shown in (a) also rules out the form in (b).

Said restriction comes in the form of another relational faithfulness constraint, one governing the autosegmental association relation.[62] Such a constraint—or constraints like it, as McCarthy (McCarthy 1997) points out—is fundamentally necessary in an Optimality Theory which seeks to incorporate the representational advantages of autosegmental phonology and will effectively rule out all forms of autosegmental feature

[62] Association ("⇒"). If A is autosegmentally linked to B and B immediately dominates A, then A⇒B. Following Hammond (1988) and Scobbie (1992), we take A⇒B to be antisymmetric and irreflexive.

spreading, as well as spread-and-delinking or 'flop'. We will adopt the following constraint, dubbed CONSISTENCY.

(23) CONSISTENCY – "No flop; no spread."

Elements in S_1 maintain their autosegmental associations in S_2.
Where $x, y \in S_1$; $x', y' \in S_2$; $x\Re x'$, $y\Re y'$,
$\forall z$, if $y \Rightarrow x$ and $y' \Rightarrow z$, then $z \doteq x'$.

CONSISTENCY penalizes any output structure whose autosegmental associations deviate from those found in the input. More particularly, however, some aspects of the formal definition above require some unpacking. Note first of all that, since the constraint penalizes any 'new' associations—those not found in the input—featural flop will perform just as poorly on the constraint as featural spread; the single constraint thus encapsulates both aspects of the NODELINK and NOSPREAD constraints proposed by McCarthy (1997). Note also that '$\doteq$' here means simultaneity, rather than identity; thus *fusion* of governing nodes does not violate CONSISTENCY, per se, even though nodes which find themselves fused may suddenly be linked to new governors, themselves.[63] This distinction is made so that CONSISTENCY will not impinge upon the violational territory of UNIFORMITY—the total fusion of segments will not violate CONSISTENCY, but will violate UNIFORMITY as shown in fig. (24) below.

[63] Note that a simpler definition of the constraint, "where $x, y \in S_1$; $x', y' \in S_2$; $x\Re x'$, $y\Re y'$; if $y \Rightarrow x$, then $y' \Rightarrow x'$," would suffice just as well on standard assumptions about correspondence theory—two output-used elements will correspond to multiple elements in the input, thus ensuring that fusional candidates will not in fact be marked by the constraint in its simpler formulation. The formulation given in the text above is an attempt to reinforce the notion that association is not bound to *identity* so much as it is *simultaneity*.

(24) Compared violations of CONSISTENCY and UNIFORMITY

	/seg$_1$ seg$_2$/ | | f_a f_b	CONSISTENCY	UNIFORMITY
spreading	seg$_1$ seg$_2$ f_a f_b	* $f_a \Rightarrow$seg$_2$	
feature flop	seg$_1$ seg$_2$ f_a f_b	** $f_a \Rightarrow$seg$_2$	
fusion	seg$_{12}$ f_a f_b		* seg$_1 \doteq$seg$_2$

Where CONSISTENCY dominates UNIFORMITY, both of the undesired candidates in (22) will be ruled out, as we see in the workings of tableau (25) below, for two candidates that maximally satisfy SPREAD. Candidate (b) is the undesired fuse-and-assimilate case, and is ruled out by undominated CONSISTENCY, which penalizes each instance of the association of the feature [+nas]$_a$ to a new segmental host. The optimal candidate (a), of course, shows segmental fusion of the 1SG nasal and no other spreading of any form.

(25) Total fusion of 1SG beats assimilation in derived forms

	/N$_1$ + a$_2$ r$_3$ i$_4$ n$_5$ e$_6$/ [+nas]$_a$ [+nas]$_b$	CONSISTENCY	UNIFORMITY
☞	a. ã$_{12}$ r̃$_{13}$ ĩ$_{14}$ n$_{15}$ ẽ$_{16}$ [+nas]$_a$ [+nas]$_b$		***** N$\doteq${ a, r, i, n, e}
	b. ã$_{12}$ r̃$_3$ ĩ$_4$ n$_5$ ẽ$_6$ [+nas]$_a$ [+nas]$_b$	a:*!*** [+nas]$_a \Rightarrow${r, i, e}	* N$\doteq$a

We will go to some lengths in §2.2 to show CONSISTENCY to be independently necessary to our theory of CON, it and its homomorphemic variant together being at the heart of a variety of assimilatory derived environment effects. For the time being, note the basic distinction made: fusion and assimilation are formally distinct on the approach advocated here. Note further that this basic distinction is impossible on a theory which restricts the application of harmony in a language through the ranking of constraints of the IDENT[64] family alone. Both fusion and assimilation involve changes to the surface featural make-up of segments. Since IDENT constraints on any standard formulation are insensate to the type of featural change—assimilatory or fusional—that a segment undergoes in the output, it would be impossible for an IDENT constraint be violated by one process type, but not the other.

1.4. Residuum

A number of residual issues remain to a full account of the Terêna data.

I. As Piggott (1997) notes, the Terêna phenomenon has the curious property of creating segments in derivation (nasal contours, nasalized approximants and nasal vowels) that are not normally a part of the language's phoneme inventory. In the parlance of Kiparsky (1985), the process is not structure preserving. This follows because the rankings of UNIFORMITY and CONSISTENCY with respect to SPREAD do not in fact make any predictions at all about the range of available segments in the language's inventory—they only ensure that nasal harmony, where it occurs, does so a) as fusion, and b) across morpheme boundaries. The remainder results from the ranking of SPREAD, IDENT(nas) and constraints on the Nasal Harmony Scale, a universal hierarchy of feature co-occurrence constraints proposed by Walker (1998) to determine the inventory of allowed nasal segmentism in a language. With IDENT(nas) ranked immediately below *NASVOWEL, we ensure that underlying nasal vowels, glides, liquids, etc., always possible in input representations under RotB, are restricted from occurring in Terêna

[64] IDENT(F) ≡ Corresponent segments have identical values for the feature F. If x$\Re$y and x is [γF], then y is [γF]. (McCarthy and Prince 1995)

except as the result of nasal fusion in the 1SG. Because SPREAD dominates IDENT(nas), along with markedness constraints on nasal liquids, glides, and vowels, we ensure that fusion will occur with segments of these types. At the same time, the ranking of SPREAD below *NASOBSSTOP and *NASFRICATIVE effects an upper bound on the types of segments which may arise through fusion, thus accounting for the fact that spreading only occurs in the language up to the first obstruent of the root.

(26) The domains of nasalization and spreading in Terêna

*NASOBSSTOP
|
*NASFRICATIVE
|
SPREAD ← *Fixes bound on the types of segments which may result from spreading (fusion).*
|
*NASLIQUID
|
*NASGLIDE
|
*NASVOWEL
|
IDENT(nas) ← *Fixes bound on available nasal segments in the Terêna inventory.*
|
*NASSONSTOP

II. Under strict locality of spreading (Gafos 1997; Ní Chiosáin and Padgett 2002), gaps in the nasal span will be prohibited universally. As a result, it is crucial to assume here that the nasal feature of the 1SG affix either a) is indexically distinct from nasal features occurring within the root, or b) replaces (i.e., deletes) those features. Were the two nasal features to simply merge on the nasal tier, high-ranked HOMLIN would prevent spread beyond the first nasal of the stem. The fact that spread is blocked in forms such as [õw̃õ^{ŋ}gu] also shows that continuancy is preserved at the cost of spreading violation.

(27) */n/→[ŋ]

$/_{[nas]}$+owoku/	NOGAP	IDENT(cont)	SPREAD
☞ õw̃õ^{ŋ}gu			**
õw̃õŋũ		*!	
õw̃õgũ	*!		

As the following data show, voiceless obstruents become voiced when prenasalized.

(28) Voiceless obstruents voice under prenasalization

/N + p/ → [^{m}b]
/N + s/ → [^{n}z]
/N + k/ → [^{ŋ}g]

Following Steriade's (1993) analysis of prenasalized consonants, we may assume, as she does, that prenasalized fricatives are in fact affricates. Because *NASOBSSTOP and *NASFRICATIVE are undominated, a fricative-aperture node (A_f) cannot be linked to [nas]. We may attribute segmental changes occurring in the data to the ranking of *NC̥ formulated over aperture nodes. The A_f or A_{max} immediately following the nasalized A_0 must change its voicing specification as long as *NC̥ >> IDENT(voi).

(29) * A_0A_α, α={$_f \vee _{max}$}
/ \ = *NC̥
[nas] [- voi]

The result, where *NC̥ and SPREAD dominate IDENT(voi), is prenasalization of obstruents under fusion.

III. Before concluding our discussion of Terêna, I will address an observed universals of nasal harmony, and consider the proposed theory's performance with respect to it. Piggott (Piggott 2000) notes that analyses of the Terena harmony problem involving morpheme-specific alignment predict a cross-linguistically unattested type of morphological contrast, contrast shown by spreading only. In a language Terêna′, for example, where a 1SG morpheme and 2PL morpheme, say, are identical, floating-feature nasals subject to their own morpheme-specific alignment constraints. Ranking one of the alignment constraints below faithfulness to nasality produces semantic contrast shown only by nasal spreading. The nasal docks on the first root consonant in one inflection, and spreads over the root in the other, as shown in (32).

(30) A possible (but unattested) contrast in Terena

If {Align-L_{1SG}, Align-R_{1SG}, Align-L_{2PL} >> Faith >> Align-R_{2PL}},
then…

/owoku/

1SG: [õw̃õ^{ŋ}gu] 2PL: [õwoku]

The question is: does the theory that we've advocated here solve this problem? Unfortunately, the answer is no. Since we allow for morpheme-specific precedence faithfulness, the contrast problem can resurface. If high-ranked MORPHREAL forces all floating-features to emerge, different rankings of morpheme-specific UNIFORMITY constraints can result in the undesired contrast, as shown (31).[65]

(31) M-specific faithfulness causes unattested contrast

mappings	UNIFORMITY_{2PL}	SPREAD	UNIFORMITY_{1SG}
$/_{[+nas]1SG}$ + arine/ → ãr̃ĩnẽ ~ ãrine		W	L
$/_{[+nas]2PL}$ + arine/ → ãrine ~ ãr̃ĩnẽ	W	L	

(MORPHREAL undominated.)

This is not a property of m-specific UNIFORMITY alone. The fact is simply that, if high-ranked MORPHREAL dominates *any* m-specific faithfulness constraint ranked high enough to prohibit the activation of SPREAD (or in fact any formulation/ranking of constraints that would result in derived harmony), spreading could occur for certain morphemes, but not for others. In tableau (32) we see this for an IDENT constraint indexed to our hypothetical 2PL; MORPHREAL forces minimal violation of IDENT, which in turn constrains spreading to a single segment. We have simply indexed a faithfulness constraint to a morphological

[65] Readers unfamiliar with comparative tableau are referred to Prince (1999).

category here, but note again that any formulation of faithfulness for a specific morpheme or lexical strata would work equally well—even high-ranked OO-Faith (Benua 1997) could give the same result through constraints selecting for different OO-correspondence relations.

(32) M-specific faithfulness causes unattested contrast

mappings	IDENT_{2PL}	SPREAD	LINEARITY
$/_{[+nas]1SG}$ + arine/ → ãr̃ĩnẽ ~ ãrine		W	L
$/_{[+nas]2PL}$ + arine/ → ãrine ~ ãr̃ĩnẽ	W	L	

We will tentatively conclude from this that the contrast problem simply can't be avoided in an OT which allows constraints to refer to specific morphemes. Indexed alignment constraints are problematic, as observed by Piggott; indexed faithfulness constraints are equally so, as we've observed here; and parochial markedness of a more direct kind (SPREAD_{1SG}, for example) would obviously allow categorically different but structurally identical morphemes to spread in different ways. This seems an unfortunate result. Observe, however, that such contrasts do exist for other types of processual morphology involving feature spread. In Chamorro umlaut (Crosswhite 1996, Klein 2000), for example, certain prefixes, infixes, and particles containing high front vowels condition fronting in following morphemes (ex., /sæn+lagu/ → [sæn-lægu] 'northward') while other such morphemes do not (/æ+tungoʔ/ → *æ-tungoʔ*). Here morphological contrast is not dependent upon feature spread alone, but we see different morphemes subject to differing translocional conditions on a lexically arbitrary basis. More convincingly still, Terêna and four other Arawakan languages use "apophony…and vowel harmony to mark mood" (Aikhenvald 1999:81). Here a back vowel suffix causes all preceding mid-vowels to harmonize in the irrealis, but not in the realis.

(33) M-specific vowel harmony

Irrealis, harmony: /yuto+š+o+a_{IRR}/ → yutą̲-š-a̲-a 'write.IRREALIS'
Realis, no harmony: /yuto+š+o+a_{RLS}/ → yutó-š-o-a̲ 'write.REALIS'

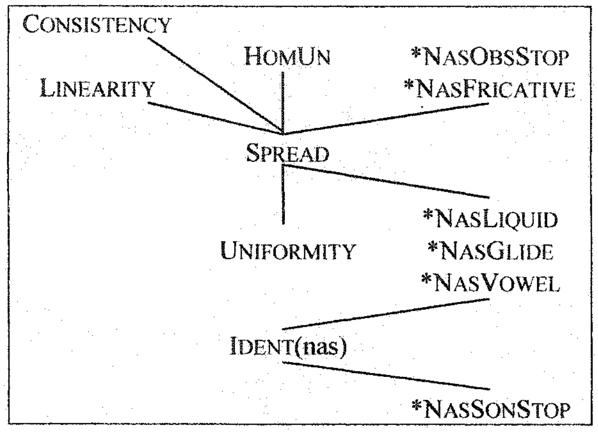
Taking these facts, as well as the relative rarity of the Terena harmony phenomenon (only one other language, Guaymi (Kopesec 1975), is known to show similar effects), we must ultimately question the veracity of the Piggott's claim, and assume that the cross-linguistic absence of the contrast in (30) results from typological accident, rather than linguistic impossibility.

1.5. Final Tally

We have thus carefully carved out of the Terêna grammar a very narrow morphological context in which spreading may occur: edge-bound nasal segments will fuse phonologically with the segments of surrounding morphemes in the prosodic word. The fact that the 1SG marker is expressed as nasal harmony is thus a function of the ranking of general phonological constraints and the morpheme's lexical representation, a prefixal nasal segment. No morpheme-specific constraints of any kind are used in deriving this result, nor are any unmotivated assumptions about the lexical representation of the 1SG morpheme. The final rankings which derive these maneuverings are shown below.

(34) Account summary and final rankings

- {LINEARITY >> SPREAD} positions 1SG exponence
- {HOMUN >> SPREAD >> UNIFORMITY} drives the 1SG MDEE
- {CONSISTENCY >> SPREAD} rules out assimilatory harmony
- {*NASOBSSTOP >> *NASFRICATIVE >> SPREAD >> *NASLIQUID >> *NASGLIDE >> *NASVOWEL >> IDENT(nas) >> *NASSONSTOP} predicts obstruent blocking the distributions of nasal segments in the inventory



In the course of the analysis, we have seen the degree to which Terêna Nasal Harmony acts as a proving-ground for a fully articulated theory of $\mathbb{F}_{rel}$, and I hope to have shown that the $\mathbb{F}_{rel}$ account provides a balanced and restrictive treatment of the phenomenon on several counts. We have situated the Terêna facts in the larger, phonetically grounded formalism of Walker (Walker 1999), treating the alternations as an anticipated subtype of phonologically-conditioned nasal harmony. We have accounted for the morphological-conditioning of the alternation without recourse to morpheme-specific alignment constraints of any sort, and have thus avoided a number of the formal pitfalls of theories which have plagued earlier OT approaches to the problem. And most importantly, we have situated Terêna Nasal Harmony as a MDEE, along the way extending the empirical domain of the TETU ranking argued for in §1.3 to cases of segmental fusion.

2. Generalizing Morphological Derived Environment Effects

Note again the basic ranking argument at work in Terêna: {HOM$\mathbb{F}_{rel}$ >> $\mathbb{M}$ >> $\mathbb{F}_{rel}$}. In this section, we will take this basic ranking argument and show it to predict a particular phonological asymmetry which has been the subject of much debate in the literature since Kiparsky (1973), wherein it was observed that phonological structures occurring within non-derived words (i.e., those listed individually in the lexicon) are often resistant to processes which apply to the same structures occurring across morpheme boundaries.

Examples of such MDEE (or Non-Derived Environment Blocking, 'NDEB') phenomena are show in fig. (35) below, where the morphologically derived (a) forms in each case show the effects of the observed phonological process, but the underived (b) forms do not.

(35) Various types of MDEE

a. Assimilation

Phenomenon	*Examples*
Basque vowel assimilation (Hualde 1989)	a. /lagun-a/ → laɣun-e b. /muga/ → muɣa
Chamorro vowel lowering in stressed closed syllable (Chung 1983, Kiparsky 1993)	a. /lapis-su/ → lapés-su b. /listu/ → lístu
Korean Palatalization (Kiparsky 1993, Cho and Sells 1995, Cho 2001b)	c. /mat_1+i_2/ → mac_1i_2, *mat_1i_2 d. /əti/ → əti, *əci
Sanskrit ruki rule (Kiparsky 1993)	a. /agni-su/ → agniṣu b. /kisalaya/ → kisalaya
Polish palatalization (Rubach 1984, Kenstowicz 1994a)	a./b. /serwis-e/ → serwiśe
Finnish Assibilation (Kiparsky 1993, Inkelas 1998)	a./b. /tilat+i/ → tilas̲i̲, *silas̲i̲
Pre-coronal laminalization in Chumash (Poser 1993)	a. /s-tepuʔ/ → štepuʔ b. / stumukun/ → stumukun
Finnish cluster assimilation (Kiparsky 1973)	a. /pur-nut/ → purrut b. /horna/ → horna
Swedish k -> ç (Kiparsky 1973)	a. /kämp-a/ → çämpa b. /kitt/ → kitt
Icelandic Umlaut (Anderson 1969, Kiparsky 1993)	a. /hard-um/ → hördum b. /akur/ → akur

b. Epenthesis

Axininca Campa t-epenthesis (McCarthy and Prince 1993a, Lombardi 1997, Landman 1999)	a./b. /i-N-koma-aa-i/ → iŋkomat̲aat̲i, *iŋkomat̲at̲at̲i
Chukchee schwa epenthesis (Krause 1980, Kenstowicz 1994b, Landman 1999)	c. /miml+qaca/ → mimlə̲qaca, *mimlqaca d. /weem+lq+n/ → weemə̲lqə̲n, *weemə̲ləqə̲n
Mohawk kw -> kew (Kiparsky 1973)	a. /k-wi'stos/ → kewi'stos b. /rukweh/ → rú:kweh

c. Deletion

Turkish Velar Deletion (Inkelas et al. 1997)	c. /$soka_1k_2+a_3$/ → $soka_1$■-a_3, *so■ak-a, *so■a■-a d. /sokak/ → sokak, *so■ak
Finnish C gradation, affecting onsets of closed sylables (Kiparsky 1973)	a. /hattu-n/ → hatun b. /sitten/ → sitten

d. Fusion

Indonesian Nasal Substitution (Pater 1999)	c. /məN$_1$+p$_2$ilih/ → məm$_{12}$ilih, *məm$_1$p$_2$ilih d. /əm$_1$p$_2$at/ → əm$_1$p$_2$at, *əm$_{12}$at

e. Metathesis

Georgian *v*-metathesis (Butskhrikidze and van de Weijer 2001)	c. /xar+va/ → xvr-a ~ *xr-va d. /rgol+i/ → rgol-i ~ *grol-i

Theorists have long sought a unified account of morphological boundary asymmetries of the type shown in fig. (35). In each case, some phonological process—assimilation, substitution, deletion, epenthesis, or interdigitation—occurs across a morpheme boundary, but never within a morpheme. In serial, rule-based theories, the assymetry has been accounted for with some formular descendent of the Strict Cycle Condition[66] (Chomsky 1973, Kean 1974, Mascaro 1976, Kiparsky 1982), which effectively prevents the application of a lexical rule just in the case that its structural description was met by a single, non-decomposable lexical item. In OT, we must recast the basic theortical insight of the SCC—that many processes occur across morphological boundaries without occuring between them—in terms of markedness and faithfulness. In each of the cases above, where some change in input structural relations occur, some marked structure is avoided in the output—NC̥ clusters in Indonesian, *ti* clusters in Korean, and intervocalic velars in Turkish, for example. Under standard Optimality-theoretic assumptions, each process must therefore be driven by an active markedness constraint 𝕄 of some form, where by 'active' we mean dominating all faithfulness constraints 𝔽 which would prohibit the unmarked structure from emerging in the output. It is the characterization of the faithfulness constraints involved which is of most interest to us.

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[66] No rule can apply to a domain dominated by a cyclic node A in such a way as to affect solely a proper subdomain of A dominated by a node B which is also a cyclic node (Chomsky 1973). Thus rules applying at the cyclic level of stem affixation cannot apply at the level of the root, itself a cyclic domain and a subdomain of the stem.

Observe that each phonological process above involves, under some set of structural assumptions, the change of some precedence along the I-O dimension. As we saw in Chapter One, in Georgian we find metathesis of sonorant/C sequences, but only where the element of the sequence are heteromorphemic. In Indonesian, we find fusion of heteromorphemic segments, but never fusion of heteromorphemic segments. This results in a change of the simultaneity relations of heteromorphemic segments only. In Korean, we find that the autosegmental association relation is modified between elements of dstinct morphemes, but not elements of the same morpheme. In Turkish, we find the adjacency relations of heteromorphemic segments are changed in the IO mapping, but the adjacency relations of homomorphemic segments are not. To summarize, each case shows a phonological process which only applies where the specified relation—or absence thereof—occurs across a morpheme boundary.

Since it is an input relation that changes in each case above, it stands to reason that some member of $\mathbb{F}$ must be a relational faithfulness constraint. We will argue here that the NDEB effect is best explained by the same division of $\mathbb{F}_{rel}$ into special and general constraints we found necessary in the account of Terêna above. If, for every relational faithfulness constraint, i.e., LINEARITY, UNIFORMITY, CONTIG, etc., there is a special homomorphemic variant of that constraint which limits its effects to relations occurring between elements of the same morpheme, then where {HOM$\mathbb{F}_{rel}$ >> $\mathbb{M}$ >> $\mathbb{F}_{rel}$}, the effects of $\mathbb{M}$ will be limited to *relations occurring across morpheme boundaries only.* We summarize this hypothesis in the following ranking schema/tableau.

(36) Morphological NDEB Ranking Schema *en tableau*

mapping	HOM$\mathbb{F}_{rel}$	$\mathbb{M}$(=*AB)	$\mathbb{F}_{rel}$
/A+B/ → AB′ ~ *AB		W	L
/AB/ → AB ~ *AB′	W	L	W

In other words, emergent unmarkedness will be restricted to derived contexts only, and the SCC is subsumed under the familiar Emergence of the Unmarked effect observed in McCarthy and Prince (McCarthy and Prince 1993a, 1994).

2.1. Earlier $\mathbb{F}_{rel}$ Accounts

This is not in fact a novel approach to NDEB in the OT literature. In fact, previous accounts have taken $\mathbb{F}_{rel}$ constraints and various morpheme-restricted varients of them to be at work in the manifestation of unmarked structure at morpheme boundaries in such varied processes as Austronesian Nasal Substitution (Pater 1999) and Chukchee Schwa Epenthesis (Landman 1999), and we can perhaps see the workings of the theory more concretely in adaptation of these accounts to present formal assumptions.

In Indonesian (Pater 1999, 2001)—and in a wide variety of Austronesian languages more generally—a prefix-final nasal merges with a root-initial, voiceless obstruent. Crucially, no such fusion is attested within individual morphemes, root-internal NC̥ clusters being found with some frequency in language.

(37) Indonesian Nasal Substitution (Pater 1999)

a. Fusion w/ voiceless obstruents
/məN+pilih/ → məmilih 'to choose, to vote'
/məN+tulis/ → mənulis 'to write'
/məN+kasih/ → məŋasih 'to give'

b. No fusion with voiced obstruents
/məN+bəli/ → məm-bəli 'to buy'
/məN+dapat/ → mən-dapat 'to get, to receive'
/məN+ganti/ → məŋ-ganti 'to change'

c. No fusion in root clusters
əmpat 'four', untuk 'for', muõkin 'possible'

Pater (Pater 1999) analyzes these facts as resultant from a more wide-spread syndrome in natural language, that is, the avoidance of NC̥ clusters. This grammatical imperative, which Pater formalizes as a constraint *NC̥, manifests itself in a variety of languages and is resolved cross-linguistically with a number of phonological repairs: deletion of one or the other of the involved segments; assimilation of place, voicing, and/or nasality to one (or both) of the segments; and finally fusion of the NC̥ cluster into a single segment bearing features of both its input progenitors. In Indonesian, the constraint crucially dominates all constraints penalizing fusion—UNIFORMITY, as well as other anti-fusional constraints such as IDENT[±nas]. Thus nasal/voiceless-obstruent clusters resolve into a single nasal segment, bearing the place features of the input obstruent.

(38) Correspondence in segmental fusion

Input: N_1 + C_2

Output: N_{12}

The problem, as tableau (39) below demonstrates, is simply that some high-ranked constraint is necessary to effect blocking of the process in derived environments.

(39) Nasal Substitution as fusion; a resultant ranking paradox

mappings	*NC̥	IDENT[NAS]	UNIFORMITY
a. $/N_1{+}p_2/ \rightarrow m_{12} \sim {*}m_1p_2$	W	L	L
b. $/N_1p_2/ \rightarrow m_1p_2 \sim {*}m_{12}$	L	W	W

Before saying what that constraint is, let us take a moment to consider what it cannot be: an IDENT constraint. IDENT constraints, as formulated in McCarthy and Prince (McCarthy and Prince 1995), refer to individual segments, independent of phonological context.

(40) IDENT(F)

Correspondent segments have identical values for the feature F.
If x$\Re$y and x is [γF], then y is [γF].

As a result there is no natural formulation of an IDENT constraint could be used to rule out fusion within morphemes only; i.e., no formulation of IDENT will distinguish the featural contents of '/~+C~/' or '/~C+~/' from '/~C~/'. Much work has been done in the area of relativizing IDENT-type constraints to prominent phonological and morphological positions, for example the onset or root (McCarthy and Prince 1995, Beckman 1998, Alderete 2001). However, in the Korean case, the dental consonant is always a constituent of the root, and would always surface in the same phonological position, onset. $\text{IDENT}_{\text{ONSET}}$ or $\text{IDENT}_{\text{ROOT}}$ constraints would, if anything, rule out palatalization in all contexts, failing to make the crucial distinction necessary to account for the NDEB problem. A boldfaced stipulation of morphological context could be always be built into a constraint; for example, "correspondent segments have identical values for a feature F *only if not adjacent to a morpheme boundary*." Unfortunately, it is unclear how 'non-adjacent to a morpheme boundary' is a position of any particular phonological salience. Furthermore, such an approach would necessarily imbue a simple notational device, boundary marker '+', with undue theoretical significance. A long line of scholarship has argued that the terminological primitives of phonological theory—much like those of syntactic theory—should include only constituency and normal predicates of string theory (see McCarthy and Prince 1993, fn. 5 for discussion). Similar criticisms can be made of a theory which places the explanatory burden of boundary stipulation in markedness constraints: {BOUNDARY-SPREAD-L(COR) >> IDENT[±ant] >> SPREAD-L(COR)}.

Relational faithfulness, on the other hand, is easily specified for morphological disparity, as we saw with HOMLIN in Chapter One and HOMUN in §1.3 above; because $\mathbb{F}_{rel}$ definitionally involves a relation between two objects at a level of representation, it is a formally simple matter to specify that the involved objects must be co-elements of the same morpheme. We see this for HOMUN, repeated from 1.3.

(41) HOM(omorphemic)UN(iformity) – "No coalescence within a morpheme."

No element of S_2 has multiple correspondents in S_1 common to a single morpheme.
For $x, y \in S_1$ and $z \in S_2$, if $x\Re z$, $y\Re z$, and $x, y \in M$,
then $x \doteq y$.

HOMUN will limit the *NC̥ effect to the observed derived environments in Indonesian. Where HOMUN outranks *NC̥, fusion will be allowed only where the NC̥ cluster breaks across a morpheme boundary. The same {HOMUN >> 𝕄 >> UNIFORMITY} ranking that delimited nasal spreading to a derived environment in Terêna will rule out morpheme-internal fusion in Indonesian, where 𝕄 is *NC̥.

(42) Fusion within morpheme prohibited

mappings	HOMUN	*NC̥	UNIFORMITY
a. /N+p/ → m ~ *mp		W	L
b. /Np/ → mp ~ *m	W	L	W

We should note that Pater's account differs from this one on a few minor, but interesting points. First, Pater assumes that UNIFORMITY and LINEARITY are the same constraint; we maintain the formal division between the two constraints because, as we saw in our treatment of Terêna, it is necessary in certain cases to distinguish preservation of morphological orientation from preservation of segmental non-simultaneity. Pater also uses a more specific kind of homomorphemic anti-fusion constraint than that advocated here. Pater argues for a root-specific variant of UNIFORMITY which in effect penalizes any fusion of root-internal elements with one another. Observe that $\text{UNIFORMITY}_{\text{Root}}$ for all intents and purposes *is* a homomorphemic UNIFORMITY constraint—it's simply a homomorphemic UNIFORMITY that only considers elements belonging to morphemes of type ROOT.

While it would be immensely appealing to reduce NDEB TETU phenomena to the interactions of $\mathbb{F}_{rel}$ and root-specific $\mathbb{F}_{rel}$—a basic division necessary among faithfulness constraints in a variety of cases of root-dominance (McCarthy and Prince 1993a, Alderete 2001)—it seems that broadly homomorphemic constraints are independently necessary in a number cases. In much of the literature on NDEB, the morphemes under discussion are a root and an affix of some sort. In such cases, it is not immediately apparent that something other than root-specific $\mathbb{F}_{rel}$ is at work in driving NDEB TETU. However, it does happen that NDEB effects can be found across non-root morphemes. Chukchee offers a useful example. In Chukchee, schwa-epenthesis occurs at morpheme boundaries, but never either within roots *or* within affixes.

(43) Chukchee schwa epenthesis at l+q *only* (Krause 1980, Kenstowicz 1994b, Landman 1999)

a. /miml+qaca/ → mimləqaca
b. /weem+lq/ → weeməlq, *weemləq

Landman (Landman 1999) analyzes the facts of Chukchee with a formulation of contiguity constraints almost identical to that anticipated by the current approach to homomorphemic faithfulness, observing that a homomorphemic CONTIG constraint, when dominated by a simple markedness constraint banning complex syllable margins, will rule out epenthesis between segments of the same morpheme, but not segments of distinct morphemes. We saw similarly in Chapter 1 that homomorphemic precedence relations are to be preserved internally to affixes as well as roots in Tagalog, lest unattested infixation patterns arise.The fact that some umbrella constraint is required in such cases to prevent the loss of segmental adjacency relations within all morphemes, regardless of their root/affix status, dovetails nicely with the observation we made at the beginning of this chapter, that some constraint preserving affix-internal precedence relations must dominate ONSET in Tagalog to prevent prefix-internal metathesis. Together we take these facts to be indicative of a larger generalization in natural language, that being that morpheme-internal elements are much more likely to maintain their precedence/adj/assoc/etc. relations in the output than are elements belonging to distinct morphemes.

Of the wide array of morphological DEE's observed in Fig. (35), we have now seen inroads to analysis of three of the four observed processual types. Pater's approach to fusion in Austronesian should extend naturally to other cases of segment union, for example vowel coalescence in Dakota and Afar (Shaw 1980, Casali 1996, Kim 2002). Landman's homomorphemic contiguity makes short shrift of MDEE in epenthesis and, by extension, deletion. We can see this in the follow example from Turkish (Zimmer and Abbott 1978, Sezer 1981, Inkelas and Orgun 1995, Inkelas et al. 1997, Inkelas 1998), where a velar deletes intervocalically, but only at a morpheme boundary.

(44) Turkish Velar Deletion

/sokak+a/ → soka▪-a, *so▪ak-a, *so▪a▪-a 'street.DAT'
/sokak/ → sokak, *so▪ak 'street'

If we follow Inkelas (Inkelas 1998) in assuming a simple markedness constraint to be at the heart of the alternation, banning vowel-velar-vowel sequences, high-ranked HOMCONTIG preserves contiguous structure *within a single morpheme*, and makes no provision for adjacency relations extant between heteromorphemic sequences.

(45) HOMCONTIG overrules markedness

- *VGV := Vowel-velar-vowel sequences are banned.

mappings	HOMCONTIG	*VGV	CONTIG	MAX-C
a. /sokak+a/ → soka▪-a ~ *sokak-a		W	L	L
b. /sokak/ → sokak ~ *so▪ak	W	L	W	W

(Inkelas 1998) argues these alternations to result from *structural immunity*, where input specification of structure—either in the lexicon or in the first cycle of a level-ordered OT—prevents the application of a given process. The $\mathbb{F}_{rel}$ account has the advantage over a structural immunity account simply because it requires none of the excess theoretical baggage inherent to such: level-ordering and constraint reranking (i.e., Serial OT). The $\mathbb{F}_{rel}$ account is also fully consistent with Richness of the Base (RotB); Inkelas readily admits that structural immunity, as a program of research derivative of Kiparsky's (1993) earlier theory of the same name, is not compatible with the RotB principle of Prince and Smolensky (Prince and Smolensky 1993, Smolensky 1996).

We have now seen the effectiveness of the HOM$\mathbb{F}_{rel}$ approach in a potentially wide array of derived environment effects. What remains to be seen is how the account can extend to assimilatory DEE's. In the pages to follow, we will offer an Optimality-theoretic account of Korean Palatal Affrication which stands upon the familiar NDEB ranking schema, where $\mathbb{F}_{rel}$ is a constraint preserving input autosegmental association relationships in the input, CONSISTENCY, the very same constraint we saw at work in Terêna.

(46) Assimilatory NDEB ranking

HOMCONS >> $\mathbb{M}$ >> CONSISTENCY

What we will see is that this ranking accounts for the facts of Korean Palatal Affrication in a straightforward manner without, crucially, any formal reference morphological boundaries. It will be shown in §2.3 that the account is formally superior to a number of competing analyses of Korean NDEB, all of which require unrestrictive (or simply unnecessary) formal devices eschewed by the current theory. From the account of the Korean facts, we will go on in later sections to consider a variety of case studies highlighting the remarkable parallelism of morphological derived environment effects subject to a $\mathbb{F}_{rel}$ TETU account.

2.2. Korean Palatalization and Associational $\mathbb{F}_{rel}$

Kiparsky (1973) first cites Korean Palatalization as a phonological process subject to what would later be termed morphological non-derived environment blocking. Since that first characterization, numerous authors have offered accounts of the process (Ahn 1986, Kiparsky 1993, Cho and Sells 1995, Hong 1997, Cho 2001a, Cho 2001b), all designed to account for the following basic facts. In Korean, coronal stops neutralize with similarly aspirated palatal affricates when immediately preceding a high front vowel, but, crucially, only when that [Ti] sequence occurs over a morpheme boundary. As numerous authors (Ahn 1986, Cho and Sells 1995, Hong 1997, Cho 2001a, Cho 2001b) observe, affricating palatalization must be distinguished from another process which induces vowel-like secondary palatalization[67] on any coronal consonant preceding a high front vowel. This process occurs in an across-the-board fashion, making no distinction between morphologically derived and underived contexts. We will refer to the former process as Palatal Affrication and the latter as Secondary Palatalization.

(47) Korean Palatal Affrication (Cho and Sells 1995, Cho 2001b)

a. Palatal Affrication: [t, tʰ] → [tʃ, tʃʰ] / __ + [i][68]

derived	*non-derived*
/mat+i/ → matʃi 'eldest.NOM'	/mati/ → matʲi 'knot'
/patʰ+i/ → patʃʰi 'field.NOM'	/tʰi/ → tʰʲi 'blemish'
/kut+i/ → kutʃi 'firm.ADV'	
/katʰ+i/ → katʃʰi 'be.like.ADV'	

[67] Also referred to as *prepalatalization* (Cho 2001b) and *n-palatalization* (Cho 2001b).

[68] The data are presented in a rarified form here for presentational clarity. Not shown first of all are the effects of intervocalic voicing, a process which occurs independently of Palatal Affrication and does not bear on the forthcoming analysis.

b. Secondary Palatalization: C → C^{j} / __ [i]

derived	*non-derived*
/san+i/ → san^{j}i ‘mountain.NOM’	/k’ini/ → k’in^{j}i ‘meal’
/os+i/ → os^{j}i ‘clothes.NOM’	/si/ → s^{j}i ‘poem’
/col+li-/ → col^{j}l^{j}i ‘to be sleepy.CAU’	/talli~/ → tal^{j}l^{j}i ‘to run’
/mat+i/ → matʃ^{j}i ‘eldest.NOM’	

Phenomena of this sort pose a unique problem for a fully parallel OT inasmuch as typical faithfulness and markedness constraints do not distinguish structures adjacent to morpheme boundaries from those not so adjacent. The present theory will account for these data with the same {HOM$\mathbb{F}_{rel}$ >> $\mathbb{M}$ >> $\mathbb{F}_{rel}$} ranking we saw in previous sections. Necessary first, however, will be some representational assumptions concerning the basic nature of the process.

We will follow Lahiri and Evers (Lahiri and Evers 1991) in treating palatalization as an assimilatory process resultant from the spread of autosegmental features, and so will rely heavily on standard representational assumptions of autosegmental phonology and feature geometry (Clements 1985, Sagey 1986, McCarthy 1988, Hume 1993, Clements and Hume 1995, Padgett 1995, Ní Chiosáin and Padgett 2002). We will assume the feature make-ups of the involved segments to be as follows, and the crucial difference between palatalized and unpalatalized coronals in the language being found in specification of anteriority. (In the table, ‘⇒’ is *associates to*.)

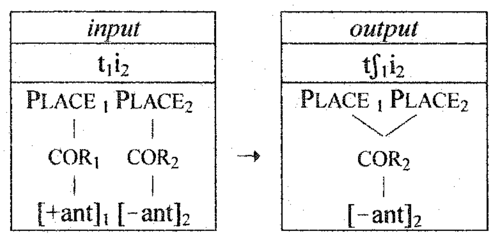
(48) Relevant feature compositions[69]

a. Dental Stops PLACE⇒COR⇒[+ant] [−del.rel.]	t	t^{h}
b. Alveopalatal Affricates PLACE⇒COR⇒[−ant] [+del.rel.]	tʃ	tʃ^{h}
c. High Front Vowel PLACE⇒VPLACE⇒COR⇒[−ant]	i	

[69] Note that [tʃ] and [t] are contrastive in the language; cf. *titi-* ‘to step on’, *tʃitʃi-* ‘to burn’.

Given these specifications, we may represent Palatal Affrication as an operation of coronal node spreading, as diagrammed below. (Note that we will for the time being suppress the effects of Secondary Palatalization in coronal obstruents to make the DEE therein as transparent as possible; we will return to interaction of Palatal Affrication and Secondary Palatalization shortly.)

(49) Primary Palatalization as COR spreading



Altered Relations
INPUT: COR$_2$⇒ PLACE$_2$
OUTPUT: COR$_2$⇒{PLACE$_1$, PLACE$_2$}

We take this mapping to be derived from the interaction of the following constraints. The first, a simple markedness constraint in the formalism of Walker (Walker 1999), ensures that the coronal node of a segment must associate leftward as in fig. (49) above.

(50) SPREAD-L(COR)

If a segment is associated with COR, then every segment to its left is associated with COR. Assign one violation-mark for each segment not so associated with COR.

A crucial difference between assimilation constraints of the SPREAD family and those formulated as AGREE constraints (Gnanadesikan 1997, Beckman 1998, Lombardi 1999, Bakovic 2000) is found in the insistence of the SPREAD constraint that structure be *shared* across the involved segments. As a result, simply changing the place specification of one segment to match that of a following segment, without association of the target feature, will not satisfy the constraint. We saw in §1.3 that structure sharing processes of this kind necessitate changes in autosegmental association relations across the I-O mapping. The relational faithfulness constraint governing these relations is CONSISTENCY; just as UNIFORMITY, CONTIG, and LINEARITY have homomorphemic variants, so do we anticipate a formular variant of CONSISTENCY penalizing only loss of precedence relations in the I-O mapping held between elements belonging to the same morpheme.

(51) HOM(omorphemic)CONS(istency) – "No flop or spread within the morpheme."

Elements the same morpheme in S_1 maintain their autosegmental associations.
Where x, y $\in S_1$; x′, y′ $\in S_2$; x$\Re$x′, y$\Re$y′; **x**, y $\in$ **M**;
$\forall$z, if y$\Rightarrow$x and y′$\Rightarrow$z, then z$\doteq$x′.

Where a by now familiar TETU ranking is observed between HOMCONS, CONSISTENCY, and some assimilatory markedness constraint such as SPREAD-L(COR) above, we expect a narrowing of the domain of application of the markedness constraint to only those segments capable of sharing structure across a morpheme boundary, just as occurs in Korean. In the tableau below we see the ranking at work. In comparison (a), HOMCONS and CONSISTENCY both penalize the changes of autosegmental association observed in the failed candidate [tʃi]; the new association of the vowel's COR node to the place node of the preceding consonant constitutes a violation on each constraint. In comparison (b), however, HOMCONS remains mute to the changes in association found between heteromorphemic [t] and [i], and so the effects of lower ranked SPREAD are felt in the optimum.

(52) HOMCONS prevents morpheme-internal assimilation

mappings	HOMCONS	SPREAD-L[COR]	CONSISTENCY
a. /ti/ → ti ~ tʃi	W	L	W
b. /t+i/ → tʃi ~ ti		W	L

A number of auxiliary considerations are further necessary to a full understanding of the alternation. First, spreading only occurs to an adjacent coronal segment—not a labial or dorsal—because IDENT[place] is undominated. Spreading of a feature to a segment underlyingly specified for an identical feature will not constitute an IDENT violation, and so we limit the applicability of Palatal Affrication to coronal-specified segments. This speaks to the necessity of IDENT constraints in the current framework; while not necessary in the restriction of assimilatory and fusional processes to derived/non-derived environments, they retain their utility in fixing the space of possible segments in a particular grammar. Second, the mapping of /t/→[tʃ]—rather than stop [c] or fricative [ʃ]—must be banned by other undominated constraints. Alveopalatal stop [c] is not found in any environment in Korean. The realization of the palatalized segment as affricate [tʃ] rather than the simple palatal stop then must result from the high ranking of some markedness constraint (or cluster of constraints), roughly of the form *[−ant, −del.rel.] (i.e., *[c]), which dominates SPREAD and all relevant faithfulness constraints (Hong, 1997). Similarly, faithfulness to [±continuant] must be high-ranked in the language, so as to ensure that /ti/ does not simply map to [ʃi]; just as in Japanese, /s/ → [ʃ] / __ [i] in Korean. We will assume this to be the result of some other undominated SPREAD constraint operative in the language, as the alternation also occurs before [ü] (Y.-M. Cho, p.c.).

This is the long and short of our approach of assimilatory NDEB. In theory, any NDEB process which can be formalized in terms of feature spreading should be subject to the CONSISTENCY account; likely cases include Basque vowel assimilation (Hualde 1989), Finnish Assibilation (Kiparsky 1993, Inkelas 1998), Finnish cluster assimilation (Kiparsky 1973), Icelandic Umlaut (Anderson 1969, Kiparsky 1993), and Polish palatalization (Rubach 1984, Kenstowicz 1994a). Some cases previously ascribed to NDEB blocking, however, might be problematic for the theory. Take pre-coronal laminalization in Chumash (Poser 1993), for instance, where a [+ant] coronal fricative becomes palatal when adjacent to another [+ant] coronal, i.e., /s+tepuʔ/ → *š-tepuʔ*. The effect is found only across morpheme boundaries, as shown in examples such as /stumukun/ → *stumukun*. Dissimilatory NDEB of this type is not predicted by the current theory, since it is in no way apparent that a feature is being shared across the morpheme boundary—in fact the very opposite occurs. It is observable, however, that such alternations fall easily to a TETU ranking of a different kind. Where a dissimilatory markedness constraint, for example $*[+ant]^2$, is ranked between special and general IDENT constraints of a more traditional kind—root-specified and generic—we predict preservation of underlying structure within a root, but not within affixes. The ranking {$\text{IDENT}_{\text{ROOT}}$ >> $*[+ant]^2$ >> IDENT} thus predicts a kind of DEE without any appeal to relational faithfulness at all.

Before moving on to consideration of the pro's and con's of the theory with respect to a number of competing alternatives in the literature, we will take a moment to expand our analysis to Korean Secondary Palatalization, as doing so will highlight the ranking necessary to derived so-called 'postlexical' effects which interact with NDEB. Recall the facts of the process from ((47)b) above.

(53) Secondary Palatalization: C → C^j / __ [i]

derived	*non-derived*
/san+i/ → san^{j}i 'mountain.NOM'	/k'ini/ → k'in^{j}i 'meal'
/os+i/ → os^{j}i 'clothes.NOM'	/si/ → s^{j}i 'poem'
/col+li-/ → col^{j}l^{j}i 'to be sleepy.CAU'	/talli~/ → tal^{j}l^{j}i 'to run'
/mat+i/ → matʃ^{j}i 'eldest.NOM'	

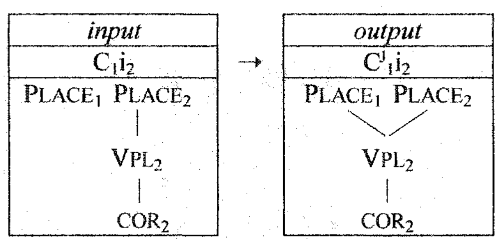
These allophonic distributions are most straightforwardly accounted for as resultant from a process with no necessary formal link to Palatal Affrication (Lahiri and Evers 1991, Hong 1997, Cho 2001b)—in other words, some markedness constraint distinct from SPREAD-L(COR) above is at work in driving the alternations. In the spirit of Hong (Hong

1997) we will assume the simple markedness constraint below to force what Clements and Hume (Clements and Hume 1995) and Hume (Hume 1994) refer to as minor coronal articulation of a consonant preceding a high front vowel, a process widely attested in natural languages as palatalization or 'Coronalization' of a velar or labial consonant to a doubly-articulated [k^j] or [p^j] (Lahiri and Evers 1991, Hume 1994, Clements and Hume 1995); see for example Polish (Rubach 1984), Zoque (Sagey 1986), and Gaelic (Borgstrøm 1940).

(54) SPREAD-L(VPL/COR)

> If a segment is associated with VPL/COR, then every segment to its left is associated with VPL/COR. Assign one violation-mark for each segment not so associated with VPL/COR.

(55) Secondary Palatalization as VPL spreading



Altered Relations
INPUT: VPL$_2$⇒ PLACE$_2$
OUTPUT: VPL$_2$ ⇒{PLACE$_1$, PLACE$_2$}

As Secondary Palatalization occurs in all contexts, derived and otherwise, SPREAD-L(VPL/COR) must dominate both homomorphemic and general CONSISTENCY. We see this below for coronal nasal/high front vowel sequences (for example; the same effect is found with other coronals, [s] and [l]).

(56) 2^{ary}-Palatalization where {$\mathbb{M} >> \mathbb{F}_{rel}$}

	/n+i/	SPREAD[VPL]	HOMCONS	CONSISTENCY
	a. ni	*		
☞	b. n^ji			*
	/ni/			
	c. ni	*		
☞	d. n^ji		*	*

The ranking is interesting inasmuch as it shows the general ranking of markedness relative to $\mathbb{F}_{rel}$ necessary in order to produce the 'postlexical' processes typically found to interact with NDEB processes. In the current theory, no level ordering of any sort is required to produce this effect; it is simply a natural consequence of constraint ranking.

(57) $\mathbb{F}_{rel}$ TETU ranking, expanded

$\mathbb{M}1 >> \text{HOM}\mathbb{F}_{rel} >> \mathbb{M}2 >> \mathbb{F}_{rel}$

<u>𝕄 activity</u>
𝕄1: Enforced across the board—'postlexical'.
𝕄2: Enforced only in morphologically derived environments.

Though up to this point we have suppressed the surface effects of the process in Palatal Affrication data, numerous authors (Lahiri and Evers 1991, Hong 1997, Cho 2001a), have argued that its effects are felt even on affricated consonants, as shown in structure (d) of Fig. (58) below, which gives various possible surface realizations of an input *Ti* sequence.[70]

(58) Feature geometries of Ti

cand	*identity* (a)		*affric.* (b)		2^{ary} *art.* (c)		*both* (d)	
seg	t_1	i_2	$tʃ_1$	i_2	t^j_1	i_2	$tʃ^j_1$	i_2
PLACE	●	●	●	●	●	●	●	●
VPL		●		●		●		●
COR	●	●		●	●	●		●
[ant]	+	–		–	+	–		–

This is exactly the prediction of the current account. Because SPREAD-L(cor) and SPREAD-L(Vpl/cor) operate on different tiers of autosegmental structure, satisfaction of neither constraint implies satisfaction of the other. As a result, in heteromorphemic contexts, both will be satisfied, resulting in a mapping of underlying /t+i/ to surface [tʃʲi], rather than the more simplified [tʃi] we assumed earlier.

We see the workings of this in the following tableau. In all environments, undominated SPREAD-L(VPL/COR) forces 2^{ary}-Palatalization through V-place spreading, ruling out all

[70] Numerous authors (Lee 1972, Kiparsky 1993, Hong 1997) argue additionally that this process applies to underlying palatals. Thus we find mappings such as /katʃʰi/ → [katʃʲʰi] 'value' and /tʃətʃ+i/ → [tʃətʃʲi] 'milk.NOM', but /tʃa/ → [tʃa] 'ruler' and /tʃətʃ+il/ → [tʃətʃil] 'milk.ACC' occur without 2^{ary}-Palatalization.

candidates without the {VPL$_2$⇒PLACE$_1$} relation. High-ranked HOMCONS is the determining factor in ruling out simultaneous affrication and palatalization in homomorphemic contexts, optimization I below. Simultaneous association of the vowel's VPL and COR nodes to the preceding consonant's PLACE node results in two violations of the constraint, and the optimum emerges: [tʲi], the candidate burdened with the least associational change that also satisfies the high-ranked VPL/COR spreading constraint. In optimization II, however, HOMCONS is inactive, there being no new homomorphemic associations in the candidates, and low-ranked SPREAD-L(COR), which penalizes secondarily palatalized [tʲi] no more or less than palatalized [ti], determines the winner, [tʃʲi].

(59) 2^{ary}-Palatalization where {$\mathbb{M} >> \mathbb{F}_{rel}$}

		SPREAD-L [VPL/COR]	HOMCONS	SPREAD-L [COR]	CONSISTENCY
I.	/ti/				
	a. ti	*		*	
	b. tʃi	*	* COR$_2$⇒PL$_1$		* COR$_2$⇒PL$_1$
☞	c. tʲi		* VPL$_2$ ⇒ PLACE$_1$	*	* VPL$_2$ ⇒ PLACE$_1$
	d. tʃʲi		**! VPL$_2$ ⇒ PLACE$_1$ COR$_2$⇒PL$_1$		** VPL$_2$ ⇒ PLACE$_1$ COR$_2$⇒PL$_1$
II.	/t+i/				
	a. ti	*		*	
	b. tʃi	*			* COR$_2$⇒PL$_1$
	c. tʲi			*	* VPL$_2$ ⇒ PLACE$_1$
☞	d. tʃʲi				** VPL$_2$ ⇒ PLACE$_1$ COR$_2$⇒PL$_1$

The high ranking of SPREAD-L(VPL/COR) has an additional effect that sheds further light on the utility of CONSISTENCY constraints. In order for 2^{ary}-Palatalization to occur at all, SPREAD-L(VPL/COR) must dominate IDENT[±ant]. But what happens now to the ranking of IDENT[±ant] with respect to the constraints involved with Palatal Affrication? As it turns out, no crucial ranking can any longer be established between them, simply because—on the standard representational assumptions we have followed thus far—all outputs, whether affricated or not, are now going to violate IDENT[±ant] by dint of the V-Place association forced by the SPREAD constraint. This is interesting inasmuch as it further highlights the inability of IDENT-type constraints to account for phenomena of this type. It is not gross featural makeup which distinguishes Palatal Affrication from 2^{ary}-Palatalization. Rather, it is the structural *path* taken from the [−ant] feature of the high-front vowel to the root of the coronal stop. This is precisely the kind of distinction which CONSISTENCY is sensitive to, as demonstrated above.

Our account of the Korean facts is thus complete; in the sections to follow, we will move on to consideration of the pro's and con's of the theory with respect to a number of competing alternatives in the literature.

2.3. Other approaches to Korean NDEB

There exists a rich literature on NDEB in Korean (and in general). We will here discuss a variety of recent approaches, in the process touching upon their respective phonological forbearers. Critical comparisons ill be made between the current theory and those couched in Underspecification Theory, Level-Ordered OT, and Articulatory Phonology. We will see in each case that the relational faithfulness approach to NDEB proves more explanatory, either in terms of formal parsimony or in its consistence with larger Optimality-theoretic principles of grammar.

2.3.1. Level-ordered OT

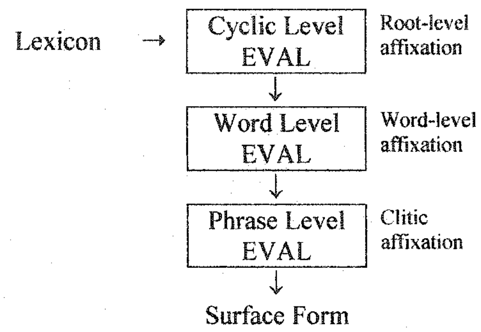
A number of earlier accounts of the phenomenon were couched within Lexical Phonology & Morphology (Kiparsky 1984, Mohanan 1986, Zec 1993) and took it that NDEB was a function of cyclic rule ordering. Under the Strict Cycle Condition (SCC) (Kean 1974), Palatal Affrication was a rule which, present at every level, could only apply to those forms not identical to some lexical entry. We see this in (60) below, a derivational summary of the account of Korean palatalization facts offered by Ahn (1986). Palatal Affrication of a root *mati* is blocked on all lexical cyles, as *mati* exists as an independent entity in the lexicon. The underlying *t* of bound root *mat-*, however, enters into the structural description of the rule under affixation, and—as there is no single lexical item *mati+i*—Palatal Affrication occurs.

(60) NDEB under level-ordering (Ahn 1986)

UR	[mat] 'eldest'	[mati] 'knot'	k'ini 'meal'	
Palatal Affrication	–	*blocked*	–	1th Cycle
Stratum-3 Suffixation	[mat]+i	–	–	2st Cycle
Palatal Affrication	[matš]+i	*blocked*	–	
2^{ary}-Palatalization	–	–	k'in^{j}i	Postlexical
SR	[matʃi]	[mati]	[k'in^{j}i]	

Cho (2001b) recaptures the formal thrust of theories such as this one within the LPM-OT (Lexical Phonology & Morphology Optimality Theory) framework of (Kiparsky *forthcoming*), wherein the markedness constraints may be ranked differently with respect to lexical-item faithfulness constraints at three levels of harmony evaluation, 'cyclic', 'word', and 'phrase'. At each level, new morphological material is added in a cyclic fashion, per the original assumptions of Lexical Phonology.

(61) Architecture of LPM-OT



Cho's basic claims run as follows. In Korean, Palatal Affrication only occurs at the 'cyclic' level, but only to inputs which do not match independent lexemes in the lexicon. Higher-ranked faithfulness constraints at the 'word' and 'phrase' levels prevent further affrication, while the constraint responsible for 2^{ary}-Palatalization, a postlexical effect, is argued to be undominated at the 'phrase' level, thus applying across the board.

The faithfulness constraints needed to derive the effects of the SCC in this framework are given below. Cho needs, in effect, two types of faithfulness constraints. FAITH to lexical entries (faithfulness in the traditional sense) and FAITH-*Lex* to inputs of various types occurring in the different stratal harmony evaluations.

(62) Cycle-specific Faithfulness

FAITH	There should be identity between a lexeme and its corresponding output.
FAITH-*Lex* (constraint schema)	There should be identity between a lexeme of type *Lex* ∈ {Root, Stem, Pwd} and its corresponding output.

(All constraints are categorically violable.)

These constraints, when inter-ranked with the following markedness constraints, result in palatalization of the types we have seen. Note that, on Cho's formulation of the palatalizing markedness constraints, PAL1 and PAL2 stand in a special-general relation with one another, and thus that a candidate satisfying PAL1 will necessarily satisfy PAL2, though not v.v.

(63) Constraints on Palatalization[71]

PAL1 (Palatal Affrication)	A dental stop must agree in [−ant] with a following [i], *and* [Cor/−ant] ⊃ [+del.rel.].
PAL2 (2ary-Palatalization)	A dental consonant must agree in [−ant] with a following [i].

At the lowest level of optimization, NDEB results from the ranking of PAL1 with FAITH and FAITH-*Root*. The latter constraint, undominated, only preserves candidates which are independently listed as lexemes in the lexicon. The constraint is active for lexical item *mati*, thus preventing it from undergoing the mutating effects of PAL1. Since *mat+i* is not listed in the lexicon as an independent root, however, affrication is forced in comparison (b). Low-ranked general FAITH is inactive, but would have the effect of preventing palatalization if higher ranked. The optimal candidate in each optimization emerges as a Stem and is passed on to the Word level harmony evaluation. Note that inputs in this theory are, in effect, ordered pairs, composed of first a set of morphemes (roots plus affixes) and second a lexeme, either listed in the lexicon on the Cyclic level or the optimized output of the previous level of optimization on the Word and Phrase levels. The first member of the pair is subject to FAITH, and the second to FAITH-*Lex* of the appropriate type. We notate these input pairs as ⟨/*morpheme(s)*/, [*lexeme*]$_{Cat}$⟩ in tableaux to come.

(64) Cyclic-level: 'lexical' Palatal Affrication

Cyclic-level mappings	FAITH-ROOT	PAL1	FAITH
a. ⟨/mati/, [ma.ti]$_{Root}$⟩ → mati ~ *matʃi	W	L	W
b. ⟨/mat + i/, Ø⟩ → matʃ-i ~ *mat-i		W	L

A different ranking of constraints is needed at the Word level. As the data below demonstrates, not all boundaries are treated equally in Korean—Palatal Affrication does not occur across compound boundaries.

[71] Note that PAL1 and PAL2 as shown here are a formally identical but presentationally more compact version of Cho's original constraints, which are formulated over feature-geometric diagrams.

(65) Different boundaries, different effects

a. ROOT+SFX, affrication: /pat$^h_{Root}$+ilaŋ$_{Sfx}$/ → patʃ^{h}ilaŋ 'field.COM'
b. ROOT+ROOT, no affrication: /pat$^h_{Root}$+ilaŋ$_{Root}$/ → pat^{h}ilaŋ 'ridge of a field'

Cho accounts for these facts with a ranking of {FAITH-STEM >> FAITH >> PAL1}. Suffixation is (by stipulation) a root-level morphological process, and so /pat$^h_{Root}$+ilaŋ$_{Sfx}$/ maps to [patʃ^h+ilaŋ]$_{Stem}$ on the Cyclic level of evaluation. As a result, high-ranked FAITH-*Stem* will effectively preserve whatever changes occurred on the Cyclic level from the effects of markedness or generic faithfulness. In this case, it is the latter type of constraint that would *depalatalize* the suffixed input; generic faith is satisfied by total identity of underlying morpheme *pat^h*-, and so would effectively undo the changes brought about on the Cyclic level if appropriately high-ranked. Suffixation contrasts with compounding, a (again by stipulation) word-level process. Since compounding does not occur, then, in the Cyclic level, there simply is no object of the form *[patʃ$^h_{Root}$ilaŋ$_{Root}$]$_{Stem}$ for FAITH-*Stem* to be faithful to. As a result, FAITH-*Stem* is vacuously satisfied by all candidates generated from a compound input, and lower-ranked constraints must prevent boundary Palatal Affrication from occurring at the Word level. As is shown in tableau (66) below, FAITH must dominate PAL1 on this level, or the facts of (65) will go unexplained.

(66) Word-level: no 'lexical' Palatal Affrication

Word-level mappings	FAITH-*Stem*	FAITH	PAL1
a. *suffixation* ⟨/pat^h+ilaŋ/, [patʃ^h+ilaŋ]$_{Stem}$⟩ → patʃ^{h}ilaŋ ~ *pat^{h}ilaŋ	W	L	W
b. *compounding* ⟨/pat^h#ilaŋ/, Ø⟩ → pat^{h}ilaŋ ~ *patʃ^{h}ilaŋ		W	L

The ranking thus motivated, we see its effects in the *mati*/*mat-i* pair, i.e., none. As both [mati] and [matʃ-i] are Stems of the previous optimization, high-ranked FAITH-*Stem* prevents lower-ranked FAITH from depalatalizing [matʃ-i].

(67) Cyclic-level: 'lexical' Palatal Affrication

Cyclic-level mappings	FAITH-*Stem*	FAITH	PAL1
a. ⟨/mati/, $[\text{mati}]_{Stem}$⟩ → mati ~ *matʃi	W	W	L
b. ⟨/mat + i/, $[\text{matʃ-i}]_{Stem}$⟩ → matʃ-i ~ *mat-i	W	L	W

Lastly, the 'postlexical' effects of PAL2 are felt under the following ranking at the Phrase Level. Observe that there is no crucial ranking of PAL2 at any prior level, since PAL2 and PAL1 are formulated in a special/general relation. Note also that the 'postlexical' quality of 2^{ary}-Palatalization is a function of the formulation of PAL2, not necessarily its ranking at the Phrasal level. In fact, were PAL2 to be high-ranked at some earlier level, its effects would be preserved throughout the remainder of the derivation, since at both Word and Phrase levels FAITH-*Lex* preserves the output form of the preceding level.

(68) Phrasal-level: across-the-board, 'postlexical' 2^{ary}-Palatalization

Phrasal-level mappings	PAL2	FAITH-PWD	FAITH	PAL1
a. ⟨/ma.ti_{Root}/, $[\text{ma.ti}]_{Pwd}$⟩ → mat^ji ~ *mati	W	(L)[72]	L	
b. ⟨/mat + i/, $[\text{ma.tʃi}]_{Pwd}$⟩ → matʃi ~ *mat^ji		W	L	W

Such criticisms as are to be made of the account follow primarily from criticisms of the level-ordered OT framework within which it is developed. As pointed out by Benua (1998), the rankings of constraints at each level is arbitrary as far as the preceding/following levels are concerned. Nothing rules out languages with entirely disparate Root, Word, and Phrase level phonologies. The framework also allows Duke-of-York (DY) derivations (Pullum 1976, McCarthy 1999), i.e., opaque mappings of the form /A/→[B]→[A]. In tableau (69) below we see the basic rankings required for what

[72] If PAL2 is undominated at earlier levels, FAITH-*Prwd* will in fact prefer [mat^ji].

McCarthy (1999) terms a 'vacuous DY derivation', where the grammar is needlessly encumbered by rankings and re-rankings of constraints at each level with a net grain of zero modification to the overall input/output mapping. A second form of DY, termed *feeding* by McCarthy, could also arise. If Cho's monolithic 'FAITH' constraints were decomposed into familiar faithfulness constraints operative over different perturbations of correspondence relations (i.e., IDENT, MAX, DEP, etc.), it is fairly simple to conceive of a situation where the non-surfacing structure, i.e., 'B' below, forces structural changes to the rest of the representation at one level which are then preserved at all subsequent levels by FAITH-*Lex*, even though 'B' itself is later converted back to input identical structure 'A'.

(69) Vacuous Duke-of-York effect: [A] → [B] → [A]

Ranking/Level	*Mapping*
{FAITH >> *A, FAITH-*Root*}$_{\text{CYCLE}}$	⟨/A/, /A/⟩ →[A]
{*A >> FAITH, FAITH-*Stem*}$_{\text{WORD}}$	⟨/A/, [A]⟩ → [B]
{FAITH >> *A, FAITH-*Pwd*}$_{\text{PHRASE}}$	{/A/, [B]}→[A]

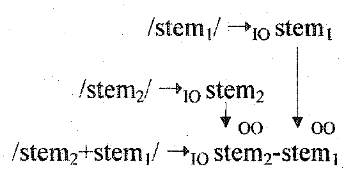
The $\mathbb{F}_{rel}$ account is couched within a fully parallel OT, and thus requires no constraint re-ranking across lexical levels, and thus suffers none of the above conceptual difficulties. An empirical problem for the $\mathbb{F}_{rel}$ account, however, is raised by Cho's account. How does the theory advocated in §2.2 account for the facts in (65), i.e., that different morphological boundaries seem to behave differently with respect to Palatal Affrication? We will argue here that the observed absence of affrication across compound boundaries results from the ranking of paradigm uniformity constraints, particularly in the form of Output-Output Faithfulness (OOF) constraints (Burzio 1995, Benua 1998) protecting the segmental contents of the subconstituents of compounds.

Output-output faithfulness to subconstituents of compounds has been elsewhere argued for by Itô and Mester (1997) as a blocking agent in processes such as Voiced Velar Nasalization in Japanese. In particular, they argue for the following constraint on segmental identity.

(70) IDENT($Stem_{bound}$, $Stem_{free}$) (Itô and Mester 1997)

The bound form of a stem is segmentally identical with its corresponding free form.

(71) Stem/Stem Correspondence Relations



Where IDENT-SS dominates SPREAD-L(COR), the segmental melody of compound forms such as /patʰ#ilaŋ/ 'ridge of a field' will be preserved from Palatal Affrication. At the same time, affixed forms such as /patʰ+ilaŋ/, not being subject to the OOF constraint, will be subjected to the normal rigors of SPREAD-L(COR).

(72) OO-F preserves compound identity

mappings	IDENT-SS: {patʰ}Stem	SPREAD-L(COR)	CONSISTENCY
a. *compounding* /patʰ # ilaŋ/ → patʰilaŋ ~ *patʃʰilaŋ	W	L	W
b. *affixation* /patʰ + ilaŋ/ → patʃʰilaŋ ~ *patʰ-ilaŋ		W	L

As a result, the differing behaviors of prefixes and suffixes are derivable from the normal interaction of $\mathbb{F}_{rel}$, constraints on feature spread, and constraints on paradigmatic uniformity.[73]

[73] Similar results may be obtained with the use of a constraint such as CRISPEDGE[PWD], "No element belonging to a PrWd may be linked to a prosodic category external to that PrWd" (Hong 1997, Ito and Mester 1994), where prosodic boundary stability would prohibit the normal application of assimilatory processes such as Palatal Affrication. Such an account would, however, necessitate a nesting if prosodic word structure in Korean compounds not required by the proposed account.

2.3.2. Underspecification and Richness of the Base (RotB)

The most thorough OT account of the Korean facts, and the one from which we have drawn the most representational insight thus far, is undoubtedly that of Hong (1997). Unfortunately, it is the account most flawed in formal implementation. As we will see, the account—in its persistent adherence to notions of lexical underspecification laid out in Kiparsky (1993)—is fundamentally incompatible with one of the most basic principles of Optimality Theory, Richness of the Base (Prince and Smolensky 1993, Smolensky 1996).

(73) Richness of the Base (RotB)

> "The source of all systematic cross-linguistic variation is constraint reranking. In particular, the set of inputs to the grammars of all languages is the same. The grammatical inventories of a language are the outputs which emerge from the grammar when it is fed the universal set of all possible inputs." (Smolensky 1996)

RotB states, in other words, that for any linguistic axis along which languages systematically vary, that variation must be controlled exclusively by language-specific re-ranking of the universal set of constraints. The alternative—that languages may vary solely by the specifications of their inputs—significantly undermines OT's position as a restrictive theory of grammar. Consider what would happen if we were to allow a model in which, for example, two languages could have identical grammars (constraint rankings), but distinct input spaces (lexica), as with hypothetical languages A and B in (74)a below. The lexicon is the sole determiner of the set of allowed surface obstruents; in fact, for language A′, the ranking of universal constraints is completely irrelevant. This model must be compared with the RotB-respecting model in (74)b, however, where the ranking of two simple, universal constraints determines which obstruents are allowed to surface in which language.

(74) Theories compared: RotB and ¬RotB

a. ¬RotB: Identical grammars; distinct input spaces

language	*lexicon*	*grammar*	*output(s)*
A	{t}	FAITH>>*K	{t}
B	{k, t}	FAITH>>*K	{k, t}

b. RotB: Identical input spaces; distinct grammars

language	*lexicon*	*grammar*	*output(s)*
A′	{k, t}	*K>>FAITH	{t}
B′	{k, t}	FAITH>>*K	{k, t}

Both systems derive a predictable property of the two languages, the obstruent inventory, but each model compartmentalizes explanation differently. The model which does not respect RotB bases the locus of cross-linguistic variation in the lexicon—traditionally the repository of all things arbitrary in a language. Of these two models, then, the RotB-respecting theory must be preferred if there is to be any understanding of what it means for universal principles to dictate the particulars of individual grammars. It furthermore goes without saying that a theory which assumes *both* lexicon restriction *and* constraint ranking to be necessary in explaining the surface properties of a language is necessarily less restrictive than one which requires only one or the other.

A species of this, unfortunately, is exactly what we find in Hong's account of Korean palatalization. Hong argues that the distribution of segments structurally immune to Palatalization is dependent entirely on specification of input features. This notion is taken wholesale from the rule-based approach to NDEB advanced by Kiparsky (1993), which argue for the following lexical prespecifications of Korean consonants.

(75) Underspecification of Korean Coronals (Kiparsky 1993)

	/t, tʰ/	/tʃ, tʃʰ/	/s, n, l/
Before [i]	[+ant]	[Øant]	[Øant]
Elsewhere	[Øant]	[−ant]	[Øant]

In brief, Kiparsky assumes that both Palatal Affrication and 2^{ary}-Palatalization result from a single rule which spreads the coronal node [COR/(−ant, +back)] of a high vowel to a preceding coronal consonant. This rule applies at the lexical level in a *feature-building* fashion. Thus, since the /t/ of /mat+i/ is featurally underspecified for anteriority ([Øant]) by the chart above (and, apparently, by no other reason beyond the authority of the author), feature-building application of the Palatalization rule will generate a /ti/ sequence within whose segments the features [−ant] and [+high] are shared. In contrast, the /t/ of lexeme /mati/ is fully specified [+ant], and so is immune to the effects the Palatalization rule—structure cannot be build where it already exists. At the word level, these machinations are followed by the application of rules a) affricating [−ant, +high] consonants to [+delayed release] and b) filling in underspecified coronals with a default [+ant] feature. At this point, the crucial distinction in derived /mat+i/ and underived /mati/ is accounted for, and, at the post-lexical level, the Palatalization rule applies once more in a *feature-changing* fashion, resulting in 2^{ary}-Palatalization in all coronals.

As Hong points out, Kiparsky's account suffers from an unfortunate rule ordering paradox when considered in light of an umlaut process in the Kyungsang dialect of Korean, wherein a [+back] vowel is fronted when preceding a high front vowel. Umlaut, like 2^{ary}-Palatalization, applies in both derived and underived contexts; as observed in numerous sources (Hume 1993, Lee 1993, Hong 1997), however, the umlaut process is blocked by an intervening, 2^{ary}-Palatalized consonant. This means that umlaut, which Hong argues must precede Palatalization, must be ordered *after* Palatalization in the postlexical component, an obvious ordering paradox.[74]

[74] It remains to be seen why umlaut can't just be a postlexical process ordered **after** Palatalization on Hong's account.

Hong seeks to ameliorate this situation by couching his own analysis within OT, taking Kiparsky's lexical underspecification of coronal stops as a starting point. Thus morpheme-internally, /t/ is [+ant] before /i/; elsewhere it is underspecified, [Øant], as shown below for the crucial pair *matʃ-i* and *mati*.

(76) Lexical prespecification of /t/

	monomorphemic ti	*polymorphemic* t+i
prespecified [+ant]	/mati/ [+ant]	
unspecified for [±ant]		/mat+i/ Ø

Optimizing these input representations are constraints on feature *licensing* (Ito et al. 1995), which effectively force certain structural dependencies to obtain in output representations.

(77) Constraints on palatalization and [−ant] licensing

LICENSE[−ant]	[−ant] is licensed when linked to [−son].
FRONT-HI[−ant]	A front high vowel implies [−ant]. I.e., [V-Pl/Cor, +high]⊃[−ant].

LICENSE[−ant], for example, requires any surface [−ant] feature to be autosegmentally linked to some (any) obstruent. FRONT-HI[−ant] forces an output [i] to be specified for [−ant]—redundantly, in this case, since Hong assumes high front vowels to be specified [−ant] in the input, as well. Together, the constraints will force Palatal Affrication (of the structural type we presented in §2.2); the latter constraint forces [i] to be [−ant], and the former requires that feature to spread to a (preceding) obstruent. These effects are shown below for the heteromorphemic /t+i/ sequence. Note that, by stipulation of (76) above, /t_I/ is *not* a [+ant] coronal; it has no feature specification for anteriority in the lexical representation of the root.

(NB: In an attempt to prevent the following tableaux form ballooning off of the page with autosegmental tree structures, feature-geometric representations are given in the form of indexed bracketings, where numeric index connotes the segment to which a feature bundle belongs, new associations are represented by arrowed lines, and hierarchical linking is represented 'X/Y', where X is an autosegmental node associating toanother node Y.)

(78) IDENT[+ant] *can't* block affrication of unspecified heteromorphemic [t+i][75]

	input: /t_1 + i_2 / [C-Pl/Cor]$_1$ [V-Pl/Cor/−ant]$_2$	LICENSE [−ant]	IDENT [+ant]	FRONT-HI [−ant]
	a. t_1 i_2 [C-Pl/Cor/+ant]$_1$[V-Pl/Cor/−ant]$_2$	*		
	b. t_1 i_2 [C-Pl/Cor/+ant]$_1$[V-Pl/Cor]$_2$			*
☞	c. tʃ$_1$ i_2 [C-Pl/Cor]$_1$[V-Pl/Cor/−ant]$_2$			

It is also important to note here the ranking of IDENT[+ant]. Because t_1 is underlyingly unspecified [Øant], any change in anteriority—such as palatal affrication—will not violate IDENT[+ant]. This is crucial, under Hong's account, to explanation of NDEB in the language. When we compare the above tableau with that below, where t_1 of a homomorphemic /ti/ sequence *is* specified [+ant] in the input per (76), we find that IDENT conveniently blocks palatalizing candidate (c) from losing the feature. (Also necessary, obviously, is an undominated constraint ruling out segments which are both plus- and minus-anterior.) The final optimum satisfies both the licensing constraint and the faithfulness constraint by simply *removing the [−ant] specification of the vowel*, (b).

[75] Note that Hong's actual account includes treatment of 2^{ary}-Palatalization, as well, and provisions for the fact that /t+i/ would actually surface as [tʃʲi]. As this portion of Hong's account is irrelevant to the workings of NDEB, we omit it from the present summary of his findings.

(79) IDENT[+ant] blocks affrication of prespecified homomorphemic [ti]

	input: /t_1 i_2 / [C-Pl/Cor/+ant]$_1$[V-Pl/Cor/−ant]$_2$	LICENSE [−ant]	IDENT [+ant]	FRONT-HI [−ant]
	a. t_1 i_2 [C-Pl/Cor/+ant]$_1$[V-Pl/Cor/−ant]$_2$	*		
☞	b. t_1 i_2 [C-Pl/Cor/+ant]$_1$[V-Pl/Cor]$_2$			*
	c. $tʃ_1$ i_2 [C-Pl/Cor]$_1$[V-Pl/Cor/−ant]$_2$		*	

This surface underspecification of i_2 is employed similarly in the mappings of non-stop coronals. Consider /n+i/ sequences below, which do not become fully palatal [ɲi] sequences in the output. This follows because high-ranked LICENSE[−ant] penalizes any candidate in which i_2 surfaces as [−ant]—there is no obstruent for the feature to associate to, so the constraint can never be satisfied. The only grammatical recourse is to remove the [−ant] specification of the vowel, thus vacuously satisfying LICENSE[−ant] and violating lower-ranked FRONT-HI[−ant]. The optimal candidate thus depends crucially on the *surface* presence or absence of the feature [−ant] in the high front vowel.

(80) Surface underspecification in high front vowels

	input: / n_1 + i_2 / [C-Pl/Cor, +nas]$_1$[V-Pl/Cor, +high]$_2$	LICENSE [−ant]	FRONT-HI [−ant]
☞	a. n_1 i_2 [C-Pl/Cor, +nas]$_1$[V-Pl/Cor, +high]$_2$		*
	b. $ɲ_1$ i_2 [C-Pl/Cor, +nas]$_1$[V-Pl/Cor/−ant, +high]$_2$	*!	
	c. n_1 i_2 [C-Pl/Cor, +nas]$_1$[V-Pl/Cor/−ant, +high]$_2$	*!	

So we see two sorts of featural underspecification at work in Hong's account. Lexical underspecification of anteriority features in dental stops needed to produce NDEB effects in one case, and surface underspecification of the same features in vowels to prevent them in another. The surface underspecification of Korean vowels is troublesome, inasmuch as it relies upon abstract—and phonetically meaningless—surface features to distinguish candidates. The relational faithfulness account of the phenomenon in §2.2 treats all surface [i]'s as featurally identical; thus no separate rules of phonetic interpretation—presumably necessary under Hong's account—are required to conflate abstractly divergent segments. We take this to be a desirable trait of the $\mathbb{F}_{rel}$ account.

Lexical underspecification as Hong uses it is a much larger problem—it is exactly such maneuverings which have been shown (McCarthy and Taub 1992, Prince and Smolensky 1993, Steriade 1993, Inkelas 1994) to run entirely counter to the assumptions of RotB outlined above. Under RotB, we expect prespecified coronals to occur freely in any phonological or morphological context in the input.

Such, in fact, is necessary to account for a set of related palatalization phenomena in Macedonian, where two distinct types of affrication are found in identical phonological (but not morphological) contexts. Before nominalizer '-ina', root-final [~k] becomes palatal [~tʃ]; before the plural marker '-i', however, it maps to [+ant] affricate, [~ts].

(81) Macedonian Coronalization (Kochovska 2003)

a. /ʃirok + ina/ → ʃirotʃ-ina 'width'
b. /podarok + i/ → podarots-i 'gift.PL'

The conditioning environments of the two processes being identical, we expect to account for the phenomenon by some exceptional property of the involved morphemes. Lexical irregularity of this kind is straightforwardy accounted for with lexical underspecification of the type advocated in (Inkelas 1994).

Even if we allow the use of archiphonemic underspecification (Inkelas 1994) to account for lexical variation (a non-predictable property of particular, morpho-phonologically alternating lexical items within a single language), we find the following possible lexical items available to the Korean grammar.

(82) Possible lexical items under RotB

	monomorphemic 'ti'	*polymorphemic* 't+i'
/t/ prespecified [+ant]	/mati/ | [+ant]	/mat+i/ | [+ant]
/T/ = {/t/, /c/} unspecified [±ant]	/maTi/ | Ø	/maT+i/ | Ø

Once we allow the above representations as *possible* structures of the Korean lexicon, the surface distributions of [t] and [tʃ] suddenly become entirely random under Hong's analysis. High-ranked IDENT[+ant] will block palatalization otherwise forced by the licensing constraints, but *only where a [+ant] feature exists in the input.* As some potential inputs will have [+ant] /t/ before homomorphemic /i/ and some will have it before heteromorphemic /i/, there is no possible way to constrain palatal affrication to heteromorphemic /t+i/ sequences alone. In other words, Hong's theory ceases to actually *explain* anything about the surface distribution of palatalized segments vis-à-vis NDEB. The palatalization of a consonant is got only by stipulation of arbitrary properties of the Korean lexicon.

The relational faith approach to Korean NDEB, on the other hand, will produce more restrictive results regardless of the specifications of input structures. A minimal amount of further analysis is, however, required. First let us note the interesting behavior of the Korean Palatal Affrication account in §2.2. On the $\mathbb{F}_{rel}$ analysis, the input specification of a dental stop as COR/[+ant] (or not) is irrelevant. It is the Association of the vowel's COR/[−ant] features which are crucial as far as our CONSISTENCY constraints are concerned. Where COR/[−ant] can spread to a heteromorphemic dental stop, SPREAD-L(COR) will force such; when the only available consonantal target is homomorphemic with COR/[−ant], higher-ranked HOMCONS will rule out spreading. But what if, in a framework allowing archiphonemic underspecification, the segment /I/ is featurally unspecified for COR/[±ant], i.e., as a set of input segments $\{i_{[+ant]}, i_{[-ant]}\}$? After all, by RotB, we expect any possible input to be available to the Korean grammar; featurally deficient segments must be considered along with fully-specified ones. (Crucially, the archiphoneme may appear *anywhere* in the input space, per diagram (82), above.) When underspecified /I/ varies with fully specified /i/ in distinct lexical items, we predict that homomorphemic Palatal Affrication will occur variably across the Korean lexicon. This result is shown in tableau (83) below, where we find two distinct, homomorphemic coronal/high front vowel sequences

(83) Where /I/ is underspecified, markedness controls Palatal Affrication

mappings	HOMCONS	SPREAD-L(COR)	CONSISTENCY
a. /tI/ → ti ~ *tʃi		L	
b. /ti/ → ti ~ *tʃi	W	L	W

The problematic mapping is shown in comparison (a). The correct account predicts *any* high front vowel, whether fully specified or not, to be subject to NDEB. As the tableau shows, however, our $\mathbb{F}_{rel}$ constraints make no distinction between palatalized and unpalatalized candidates in the comparison. This is a direct result of underspecification: there simply is no input [−ant] feature to which to be faithful. Thus, while fully specified /ti/ will emerge [ti] as attested, /tI/ will undergo Palatal Affrication at the behest of suddenly active SPREAD-L(COR). This is undesirable as non-derived blocking of affrication is a predictable property of Korean lexical items.

The present account must appeal to other constraints to rule out variation of this sort in the language. Specifically, we will argue the lack of variation here to result from the ranking of MPARSE (Prince and Smolensky 1993). MPARSE is violated where an input maps to a phonetically null candidate. As a general rule, constraints which dominate MPARSE in a grammar will prevent certain types of mappings from occurring—at all—in a language. This is the case in Korean, where a featural faithfulness constraint mitigating against the insertion of anteriority features, MAX[ant], ensures that only those inputs which have vowels fully specified for [±ant] features will survive to the surface.

(84) The null candidate preferred to feature epenthesis

mappings	DEP[ant]	MPARSE
a. /t+I/ → Ø ~ *tʃi	W	L
b. /tI/ → Ø ~ *ti	W	L
c. /t+i/ → tʃi ~ *Ø		W
d. /ti/ → ti ~ *Ø		W

These constraints must in turn be ranked above the {HOMCONS >> SPREAD-L(COR) >> CONSISTENCY} hierarchy we have argued for thus far. We arrive at this ranking as follows. The null parse violates none of the constraints governing palatalization—markedness constraints SPREAD-L(COR) and SPREAD-L(VPL/COR) cannot be violated by the absence of phonological structure and our CONSISTENCY constraints are not violated by *deletion* of input features. As a result, ranking of MPARSE below any of these constraints will immediately favor the null-parse in fully-specified mappings /t+i/→[tʃi] and /ti/→[ti]. The final ranking {DEP[ant] >> MPARSE >> SPREAD-L(VPL/COR) >> HOMCONS >> SPREAD-L(COR) >> CONSISTENCY} will allow only attested Palatal Affrication—that is, heteromorphemic—to occur in Korean. And, crucially, without any necessary stipulation of where segments are and are not featurally specified in the input.

We do find some questionable predictions in the {DEP[ant] >> MPARSE} ranking. In general, the MPARSE account predicts that, wherever an NDEB effect is found, certain lexical items may idiosyncractically show the effects of the derived environment process within a single lexical item where an underlying high front vowel is underspecified. For example, where we have argued Korean to be a language wherein the null parse bests all candidates which must epenthesize anteriority features to become surface realized. We predict at the same time a language almost identical to Korean, but allowing Palatal Affrication to occur homomorphemically in particular lexical items on an arbitrary basis.

(85) Korean and lexically varying Korean′

effect	*mapping*	*language*
• Across-the-board 2^ary^-Palatalization • NDEB Palatal Affrication	/ti/→tʲi /t+i/→tʃʲi /tI/→Ø /t+I/→Ø	Korean
• Across-the-board 2^ary^-Palatalization • NDEB Palatal Affrication • Palatal Affrication in particular lexical items	/ti/→tʲi /t+i/→tʃʲi /tI/→ tʃʲi /t+I/→ tʃʲi	?

Given the, well, *arbitrary* nature of lexical variation, such a language doesn't seem particularly unlikely, as a number of cases of NDEB discussed at length in the literature are notoriously prone to variation of just this kind. Take English Trisyllabic Shortening, for instance: *divine ~ divinity*, but *desire ~ desirous*. A number of the other predictions of MPARSE arising under factorial typology are not, however, quite so easy to digest. We see a number of the bizarre predictions of the constraint in (86) below.

(86) Strange effects of MPARSE

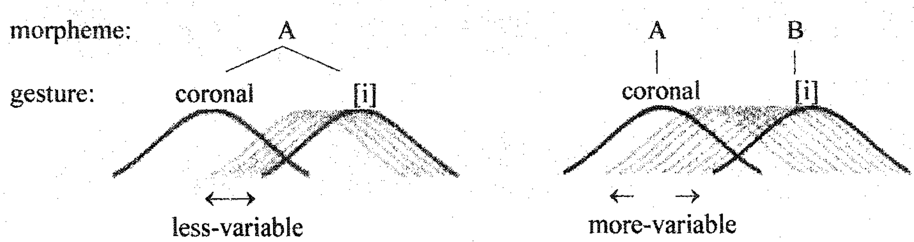
effect	*mapping*	*grammar*
underparsing of all underlying Ci sequences…except /t+i/	/ti/→Ø /t+i/→tʃʲi /tI/→Ø /t+I/→Ø	SPREAD-L(VPL/COR), IDENT[±cont], *[c], HOMCONS, IDENT[±del.rel.], CONSISTENCY >> MPARSE >> SPREAD-L(COR), DEP[ant], IDENT[±ant]
underparsing of fully-specified inputs only	/ti/→Ø /t+i/→Ø /tI/→ tʲi /t+I/→tʲi	SPREAD-L(VPL/COR), IDENT[±cont], *[c], HOMCONS, IDENT[±del.rel.], CONSISTENCY >> MPARSE >> SPREAD-L(COR), DEP[ant], IDENT[±ant]
underparsing of all underlying Ci sequences	/ti/→Ø /t+i/→Ø /tI/→Ø /t+I/→Ø	SPREAD-L(VPL/COR), IDENT[±cont], *[c], HOMCONS, IDENT[±del.rel.], SPREAD-L(COR), DEP[ant], CONSISTENCY, IDENT[±ant] >> MPARSE
only /ti/ underparsed	/ti/→Ø /t+i/→ tʲi /tI/→ tʲi /t+I/→tʲi	SPREAD-L(VPL/COR), IDENT[±cont], *[c], HOMCONS, IDENT[±del.rel.] >> MPARSE >> SPREAD-L(COR), DEP[ant], CONSISTENCY, IDENT[±ant]

The alternative to such an account is to simply abandon lexical underspecification altogether and assume full specification of all inputs; such stipulation would not adversely affect the account given thus far, effectively making the {DEP[ant] >> MPARSE} ranking we argued for above a function of GEN. As Inkelas (1994) and Tesar and Smolensky (2000) have respectively shown, however, lexical underspecification is a) a necessary mechanism in accounting for lexical variation of various kinds, and is b) furthermore a direct prediction of Lexicon Optimization performed over paradigm sets showing morphophonological alternation. In the absence of some more restrictive technology, MPARSE remains the most viable means of reigning in lexical variation.

2.3.3. Gestural Overlap

Cho (1998a) takes a more functionally-oriented approach to Korean palatalization, arguing that what we have taken thus far to be autosegmental assimilation of [−ant] is in fact articulatory overlap of adjacent tongue gestures found in the production of *ti* sequences. Based on EPG (electropalatography) studies of Korean *ti* and *ni* sequences, in both homomorphemic and heteromorphemic contexts, Cho shows a remarkable disparity between 'C+i' and 'Ci', namely that the intergestural timing of a coronal and following vowel is less variable for homomorphemic sequences than heteromorphemic ones.

(87) Lexical status and timing variability (Cho 1998)



Cho assumes that what we have termed Palatal Affrication and 2^{ary}-Palatalization are in fact the same phenomenon, gestural overlap, and concludes that the NDEB effects are a direct result of the above variability in gestural overlap, and argues further that this basic premise is best formalized in an OT based in Articulatory Phonology, wherein intergestural timing relations are represented in the lexicon, and are subject to the following constraints and ranking.

(88) Constraints on gestural overlap

IDENT[timing]	Intergestural timing must be preserved in the output.
OVERLAP	Two gestures must be maximally overlapped.

(89) Timing faith prevents palatalization

mappings	IDENT[timing]	OVERLAP
a. /mati/ → mati ~ *matʃi	W	L
b. /mat+i/ → matʃi ~ *mati	n/a	W

The essential argument is that there are no timing relations extant between segments of different morphemes in the input. Thus in 'ti' sequences, as in /mati/ in comparison (a) below, IDENT[timing] protects the relatively fixed timing relations extant between *t* and *i* in the lexicon. IDENT[timing] will have no effect on 't+i' sequences, however, and OVERLAP will force the coronal and vocalic gestures to merge together—voila, palatalization. The greater variability of intergestural timing at morpheme boundaries shown above, is taken to be a result of a simple abcense of timing relations between morphemes in the input.

Of course, it's not really that simple. As Cho observes, if timing irregularities are maintained in the lexicon and CON includes faithfulness constraints which range over them, we expect gradient *contrast* in timing unattested in natural language (but see Steriade 1996). It's a simple fact of OT that, where faithfulness to a variant input property dominates markedness constraints restricting the distribution of that property, phonological contrast will emerge in the lexicon. Under the simplified Articulatory OT approach shown above, it would just be a stunning coincidence that all homomorphemic sequences happen to have the same *single* timing relation over which IDENT[timing] ranges in every case, and thus that ti_1 with one millimeter of gestural overlap happens to never form a minimal pair with a gesturally distinct ti_2 with ten millimeters of overlap (see Hall 2003 for discussion).

To avoid this problem, Cho assumes that IDENT[timing] and OVERLAP are both violated in a categorical manner, specifically, over three gesturally defined degrees of overlap.

(90) Constraints (revised) on Gestural Overlap in TI sequences (Cho 1998a)

IDENT[timing]	Degrees of intergestural timing must be preserved in the output. I.e., *minimal/partial* overlap ↛ *maximal* overlap.
OVERLAP	Two gestures must be maximally overlapped. Accrue violations as follows: a. *maximum* overlap: no penalty; b. *partial* overlap: penalized by one *; c. *minimal* overlap: penalized by two **.

These degrees of overlap, conveniently enough, derive the inventory of Ti and Ni sequence mappings in (91) below, where shaded cells represent those Ci sequences which are argued absent from Korean speech. Several things about this diagram require further explanation, not least of which being the notational convenience used here and in tableaux to come: Cho uses the top ligature '⁀' to denote Ci sequences which are maximally overlapped, i.e., fully palatal; superscript 'ʲ' denote partially overlapped (secondarily palatalized) sequences; and '|' denotes sequences with almost no overlap of which to speak (unpalatalized).

(91) Degrees of gestural overlap

	Ti	Ni
maximal	/t+i/ → t͡i	/n+i/ → n͡i
partial	tʲi	/ni/ → nʲi
minimal	/ti/ → t|i	n|i

Surprising in fig. (91) is the fact that there is more than one surface type of Ni sequence in Korean. The account we presented in §2.2, along with every other phonological account cited previously, has assumed coronal stops to be the only segments which are subject to derived environment effects: affrication at a morpheme boundary, secondary palatalization (or none at all depending upon the account) elsewhere. Cho shows to the contrary from EPG data that what we have thus far termed 2^{ary}-Palatalization of non-stop coronals shows the same homomorphemic/heteromorphemic asymmetry found in Palatal Affrication. As shown in the table above, however, the disparity in overlap is not so great among the nasal/vowel pairs as in the stop/vowel pairs. Heteromorphemic 't+i' and 'n+i' sequences both show approximately the same degree of gestural overlap—'maximal'. Homomorphemic sequences, however, show some dissimilarity, and motivate the partial/minimal split in degree of overlap; 'ni' show some overlap, but neither as much as 'n+i', nor as little as 'ti'.

Cho seeks to account for this fact with a constraint which will force sounds contrasting in overlap to do so by a particular degree, i.e., two.

(92) Minimal contrast enforcement

MINDIST(OVERLAP) = 2	Sounds that contrast in gestural overlap should differ by at least two degrees.

MINDIST is an attempt to formalize the intuitive notion that, since [t] and [tʃ] are contrastive in Korean, they must maintain a wide gestural berth of one another; [tʲ] is too close to either segment to form an appropriate contrast, and so is banned. Since [n] does not contrast with [ɲ] or [nʲ] in Korean, however, so the above constraint does not penalized their surface manifestation. On Cho's account, then, NDEB occurs *everywhere*, and the phonetic differences between the realizations of stops and nasals hinges upon a larger theory of contrast preservation. These machinations are shown in the tableaux below.

(93) IDENT[timing] drives NDEB

a. <u>'ti' and 't+i':</u>
- Timing faith prevents full overlap in homomorphemic 'ti';
- Heteromorphemic 't+i' receives no such protection;
- Contrasting [t] and [tʃ] must differ by two degrees of overlap; [tʲi] ruled out.

	/mati/	IDENT[timing]	MINDIST (OVERLAP) = 2	OVERLAP
	a. mat͡i	*!		
	b. matʲi		*!	*
☞	c. mat|i			**
	/mat+i/			
☞	d. mat͡i			
	e. matʲi		*!	*
	f. mat|i			**!

b. <u>'ni' and 'n+i':</u>
- Timing faith prevents full overlap in homomorphemic 'ni';
- Heteromorphic 'n+i' receives no such protection;
- MINDIST doesn't apply to nasals.

	/sani/	IDENT[timing]	MINDIST (OVERLAP) = 2	OVERLAP
	a. san͡i	*!		
☞	b. sanʲi			*
	c. san|i			**!
	/san+i/			
☞	d. san͡i			
	e. sanʲi			*
	f. san|i			**!

There are a number of conceptual problems with such an account.[76] First, there exists no clear connection between the phonetic fact (greater *variability* in overlap at morpheme boundaries) and its phonological explanation. Why should outputs more subject to the effects of markedness constraints show more variation? Why couldn't it equally well be the case that variability is encoded in the lexicon and preserved in the output by IDENT[timing]?

This leads to a familiar Richness of the Base problem. There seems to be no reason why single lexical items shouldn't be prespecified as either minimal/partial overlap or maximal overlap. The ranking {IDENT[timing] >> OVERLAP} should in principle, then, mean that underlying {/ɲi/, /nʲi/} *are contrastive* with /ni/, regardless of the ranking of MINDIST. Also, the crucial assumption that input timing relations don't exist heteromorphemically seems to put the cart before the horse, as it were. If NDEB is a systematic property of natural languages, we would hope it to fall out from constraint ranking, rather than a stipulation of the crude form "some input segments have timing relations and some don't". In Cho's model, NDEB is effectively a precondition to analysis, just as in Hong's Underspecification approach, discussed above. It may or may not follow from more natural set of assumptions than the Underspecification theory, perhaps, but it still fails to derive NDEB effects from constraint ranking, and still results in a theory which does not respect RotB.

The MINDIST constraint causes a number of difficulties in its own right. Being native to Dispersion Theory (Flemming 1996), the constraint necessarily operates over entire

[76] I am considerably indebted to N. Hall and the class of her 2003 phonology seminar for the bulk of these observations.

inventories. Since the inventory of a language is determined in standard OT by constraint ranking, it seems that Cho's theory is in fact optimizing over *grammars*, not I-O mappings. Even if we allow that Cho's constraint hierarchy is optimizing over inventories, it remains to be seen—since MINDIST(OVERLAP) = 2 itself does not distinguish Ni and Ti sequences—how the same degree of lexical contrast found in Ti sequences would not be required in Ni sequences. Tableaux (94) demonstrate the ranking of MINDIST with respect to a Dispersion-theoretic constraint MAXIMIZECONTRAST necessary to derived the two-step contrast in 't|i'/'n|i'.

(94) A Problem with MINDIST

a. MINDIST derives lexical contrast of Ti sequences

	inventory sets	MINDIST(OVERLAP) = 2	MAXIMIZECONTRASTS
	a. t|i - t^ji	*!	a≻{b, c}
	b. t^j - t͡i	*!	
☞	c. t|i - t͡i		

b. MINDIST derives *the same* lexical contrast in Ni sequences

	inventory sets	MINDIST(OVERLAP) = 2	MAXIMIZECONTRASTS
	d. n|i - n^ji	*!	a≻{b, c}
	e. n^j - n͡i	*!	
☛	f. n|i - n͡i		

N. Hall (p.c) observes an additional, unanswered question for Cho's analysis. What if the mapping /ti/→[tʃ] isn't a result of overlap, but rather a complete replacement of the consonantal gestures responsible for palatalization? Affricate /tʃ/ is an independently occurring segment of Korean, and so must, presumably, be able to occur without any gestural overlap at all in the context of non-high, non-front vowels. What precludes the phonetically identical outputs shown below?

(95) Overlap vs. Replacement in /t+i/→[tʃi]