Association Faith and Korean Palatalization*

Graham Horwood
Center for International Issues Research, SAIC

1. Relational Faithfulness and NDEB

Kiparsky (1973) first cites Korean Palatal Affrication (KPA henceforth) as a process subject to what would later be termed non-derived environment blocking (NDEB), a syndrome characterized by the tendency of alternations to take effect in phonologically or morphologically derived environments, but to be blocked elsewhere. Since that first characterization, numerous authors (Ahn 1985; Kiparsky 1993; Cho and Sells 1995; Hong 1997; Y.-M. Cho 2001) have offered accounts of the process designed to accommodate the following basic facts. In Korean, the coronal stops in (1a) 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.

(1) Korean Palatal Affrication[1,2] (Cho and Sells 1995; Y.-M. Cho 2001)

a. Descriptively
[t, t^h] → [tʃ, $tʃ^h$] / __ + [i]

b. Derived Palatal Affrication
/mat+i/ → matʃi 'eldest.NOM'
/pat^h+i/ → $patʃ^h$i 'field.NOM'
/kut+i/ → kutʃi 'firm.ADV'
/kat^h+i/ → $katʃ^h$i 'be.like.ADV'

c. No affrication within roots: /ti/ → [ti]
mati 'knot', əti 'where', t^hi 'blemish', titi-ta 'to tread', nit^hi-namu 'zelkova tree'

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 adjacent. Consider a simple markedness constraint in the formalism of Walker (1999) which will, under the appropriate ranking with faithfulness constraints and constraints on the Korean phoneme inventory, force a palatalization mapping.[3]

---

* Many thanks to Alan Prince, Young-Mee Cho, and Arto Anttila for comments on early versions of this work. All errors are, as usual, on the author.

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

[2] The data here are presented in a rarified form for 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. Also omitted from transcription here are the effects of secondary palatalization (Hong 1997), which we will discuss at length in §2.3.

[3] The mapping of /t/→[tʃ] rather than stop [c] or fricative [ʃ] is mediated by undominated constraints on the Korean phoneme inventory. Neither alveopalatal stop [c] nor alveopalatal fricative [ʃ] are found phonemically in Korean. The realization of the palatalized segment as [tʃ] then must result from the high ranking of some markedness constraint (or cluster of constraints), roughly of the form *[C-pl/Cor, !ant, !del.rel.], which dominates AGR[ant] and all relevant faithfulness constraints (Hong 1997).

(2) 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.

The palatalization mapping (/ti/→[tʃi]) occurs only if SPREAD-L[cor] dominates all constraints preserving the anteriority of [t]. For the sake of discussion, consider one such constraint of the familiar IDENT variety, in (3) below, where two inputs, distinct only on the presence of a morpheme boundary, show diametrically opposed behaviors.

(3) IDENT[±ant]
Correspondent segments have identical values for the feature F.
If xℜy and x is [γF], then y is [γF].

(4) Palatal affrication in derived environment only, *but why?*

Mappings	?	SPREAD-L[cor]	IDENT[±ant]
a. /t+i/ → tʃi ~ *ti		W	L
b. /ti/ → ti ~ *tʃi	W	L	W

As tableau (4) demonstrates, some high-ranked constraint must prevent SPREAD-L[cor] from exacting Palatal Affrication in non-derived strings. We would assume that, since said constraint is preserving output featural identity with the input, a faithfulness constraint of the IDENT family must be at work. It is not apparent, however, how any such constraint could be formulated to preserve input material only in non-derived environments. IDENT constraints, as formulated in McCarthy and Prince (1995), refer to individual segments, independent of phonological context. 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 1995, 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]}.[4]

[4] Lubowicz's (2002) approach to morphologically derived environment effects follows a similar line of attack, though in a much more formally graceful manner, through local conjunction of phonological markedness constraints and constraints anchoring segments to mor-

A solution to this apparent dilemma obtains in the observation that it is not only the gross featural compositions of coronal consonants that are altered in Korean, but, under standard assumptions of autosegmental phonology, the structural relationships holding between those segments and their features. The current effort will advance the notion that faithfulness to underlying structural relationships ($\mathbb{F}_{rel}$) may be relativized to homomorphemic strings only (HOM$\mathbb{F}_{rel}$). Under the appropriate ranking with markedness constraints ($\mathbb{M}$), shown below, this approach allows us to capture the facts of such phenomena as KPA much in the spirit of Kiparsky's original observation, that alternations may be blocked from application in non-derived environments, within a fully parallel OT.

(5) Relational Faith TETU ranking:
HOM$\mathbb{F}_{rel}$ >> $\mathbb{M}$ >> $\mathbb{F}_{rel}$

The ranking subsumes morphological NDEB under the general rubric of Emergence of the Unmarked (TETU; McCarthy and Prince 1994, et seq.): structure marked on $\mathbb{M}$ is allowed across morpheme boundaries, but prohibited within morphemes where homomorphemic $\mathbb{F}_{rel}$ preserves input relations from the deteriorating forces of $\mathbb{M}$.[5] This is not a novel approach to NDEB phenomena. Previous accounts have taken $\mathbb{F}_{rel}$ constraints and various morpheme-restricted variants 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 2003). Horwood (2002, 2004) argues that relational faithfulness constraints such as LINEARITY, UNIFORMITY, and CONTIGUITY may be specialized to preserve homomorphemic input relationships generally, effectively limiting the application of various relation-changing phonological alternations to heteromorphemic contexts only under the ranking in (5). The current effort will advocate a fourth constraint of the relational faithfulness family, CONSISTENCY, which militates against the change of association relations across the I-O faithfulness dimension. We will see in pages to come that Consistency, when ranked with palatalizing constraints according to the ranking in (5) accounts for the facts of Korean Palatal Affrication in a straightforward manner without any formal reference morphological boundaries themselves as linguistic primitives. It will be shown in §3 that the account is formally superior to a number of competing analyses of Korean Palatal Affrication, all of which require formal devices obviated under the current theory.

2. A $\mathbb{F}_{rel}$ analysis of Palatal Affrication

2.1. Representational assumptions

We will follow 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 1994, Clements and

---

phological and phonological boundary positions. Our only critique of Lubowicz's approach is that it is somewhat limited in empirical coverage, not accounting for any morphological NDEB found, for example, under umlaut. See Inkelas (1998) for further discussion.

[5] Note that the approach contends that only *morphological* NDEB may be subsumed under TETU. For OT approaches to *phonological* NDEB, in which a process is blocked by 'prior' application of a phonological process, see Lubowicz (2002).

Hume 1995, Ní Chiosáin and Padgett 2001). 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.

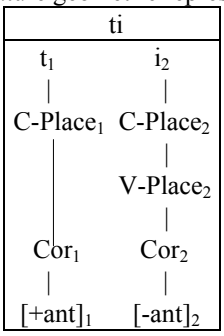
(6) Relevant feature compositions

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	

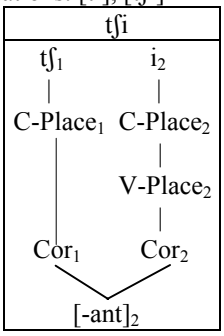
Given these specifications, we may represent Palatal Affrication as an operation of coronal node spreading, as diagrammed below.

(7) Feature geometric representations: [ti], [tʃi]

a.



b.



Altered Association Relations
Input: $[\text{-ant}]_2 \Rightarrow \text{Cor}_2$
Output: $[\text{-ant}]_2 \Rightarrow \{\text{Cor}_1, \text{Cor}_2\}$

As we will model our account of the Korean phenomenon within a Correspondence Theoretic OT, we will also assume that features correspond with one another across the various available dimensions of faithfulness: I-O, B-R, O-O. We will additionally assume a relation-rich input. That is, for any two elements capable of bearing a particular relationship *r*, relation *r* exists between them. We take the set of such possible relations to include Adjacency, Precedence, Simultaneity, and—most importantly for the present problem—autosegmental Association, which we will define after Hammond (1988) and Scobbie (1992).

(8) Association ("⇒").
If A is autosegmentally linked to B and B immediately dominates A, then A⇒B.

These assumptions in place, we make a first step toward accounting for the Korean facts. Observe that input-output featural identity is not the only representational change forced by Palatal Affrication; Association relations between input features are changed, as well. In the Palatalization mapping below, the Association relation $[\text{-ant}]_2 \Rightarrow \text{Cor}_2$ obtains in the input. In the output, however, two relations obtain, the identical $[\text{-ant}]_2 \Rightarrow \text{Cor}_2$ and a new relation, $[\text{-ant}]_2 \Rightarrow \text{Cor}_1$, which we conflate to the complex relation $[\text{-ant}]_2 \Rightarrow \{\text{Cor}_1, \text{Cor}_2\}$ as noted in figure (7) above.

2.2. Faith to autosegmental association

We will argue here that Association, just like every other relation, has an associated faithfulness constraint, CONSISTENCY, violated by exactly such assimilatory phenomena as Palatal Affrication.

(9) CONSISTENCY – "No flop; no spread."
Elements in S_1 maintain their autosegmental associations in S_2.
Where x, y ∈ S_1; x′, y′ ∈ S_2; x$\Re$x′, y$\Re$y′;
if y⇒x and y′⇒z, then z_x′.

Simply put, CONSISTENCY penalizes any output structure whose autosegmental associations deviate in any way from those found in the input. Since the constraint penalizes any 'new' associations, i.e., 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 in McCarthy (2000). We use the symbol '_' here to clearly distinguish simultaneity from identity; *fusion* of two distinct governing nodes into one doubly indexed node does not violate CONSISTENCY, per se, though nodes which find themselves fused may suddenly be linked to new governors themselves. Thus CONSISTENCY is violated by the Palatal Affrication mapping in (7) above because $tʃ_1$ is not simultaneous with i_2. 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, and feature spread/flop will in turn fail to violate UNIFORMITY. Thus processes of coalescence and fusion are not expected to conflate with processes of assimilation and umlaut in particular grammars.

(10) SPREAD-L[cor] forces underived assimilation; paradox remains

	/t+i/ [-ant]$_2$⇒Cor$_2$	SPREAD-L[cor]	CONSISTENCY	IDENT
☞	a. tʃi		* [-ant]$_2$⇒{Cor$_1$, Cor$_2$}	*
	b. ti	*!		
	/ti/			
💣	a. tʃi		* [-ant]$_2$⇒{Cor$_1$, Cor$_2$}	*
	b. ti	*!		

CONSISTENCY does principally the same work as IDENT, and so must be dominated by SPREAD-L[COR] in Korean to ensure Palatal Affrication occurs in any environment. If SPREAD-L[COR] dominates CONSISTENCY, we also force palatalization in underived contexts. Unlike IDENT, however, CONSISTENCY, along with the other relational faithfulness constraints we will consider in this chapter, is straightforwardly relativized to hold only over *homomorphemic* relations, those occurring between elements of the same lexical item. The resulting constraint, HOMCONS below, effects to preserve autosegmental association, but crucially only *within* individual lexical items. No stipulation of boundary-adjacency is required, only notation of morphological constituency.

(11) HOM(omorphemic)CONS(istency) – "No flop or spread within the morpheme."
Elements in S_1 maintain their autosegmental associations w.r.t. homomorphemic elements in S_2.
Where x, y ∈ S_1; x′, y′ ∈ S_2; x$\Re$x′, y$\Re$y′; x, y ∈ *morpheme*;
if y⇒x and y′⇒z, then z≐x′ and z ∈ *morpheme*.

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.

(12) 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 in the grammar. 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 are understood retain their utility in fixing the space of possible segments in a particular grammar. The mapping of /t/→[tʃ]—rather than stop [c] or fricative [ʃ]—must also be ruled out 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 must then 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.).

In theory, any NDEB process which can be formalized in terms of feature spreading should be subject to the {HOMCONS >> 𝕄 >> CONSISTENCY} account; likely cases include Basque vowel assimilation (Hualde 1989), Finnish Assibilation (Kiparsky 1993, Inkelas 2000), Finnish cluster assimilation (Kiparsky 1973), Icelandic Umlaut (Anderson 1969, Kiparsky 1993), and Polish palatalization (Rubach 1984, Lubowicz 2002). 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/ → *ʃ-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, but is fully consistent with the understanding that NDEB effects are ultimately a subcase of TETU.

1.3. Interaction with Secondary Palatalization

Before moving on to consider the pros and cons 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.

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

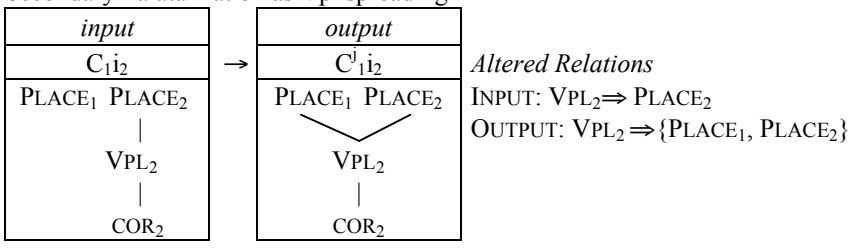
derived	*non-derived*
/san+i/ → san^{j}i 'mountain.NOM'	/k'ini/ → k'in^{j}i 'meal'
/os+i/ → os^{j}i 'clothes.NOM'	/si/ → s^{j}i 'poem'
/col+li-/ → col^{j}l^{j}i 'to be sleepy.CAU'	/talli~/ → tal^{j}l^{j}i 'to run'
/mat+i/ → mat$\int^j$i 'eldest.NOM'	

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, Y.-M. Cho 2001)—in other words, some markedness constraint distinct from SPREAD-L(COR) above is at work in driving the alternations. In the spirit of Hong (1997) we will assume the simple markedness constraint below force what Clements and Hume (1995) and 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).

(14) 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.

(15) Secondary Palatalization as Vpl spreading



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]).

(16) 2^{ary}-Palatalization where $\{\mathbb{M} >> \mathbb{F}_{rel}\}$

	SPREAD[VPL]	HOMCONS	CONSISTENCY
a. /n+i/ → nʲi ~ ni	W		L
b. /ni/ → nʲi ~ ni	W	L	L

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.

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

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

$\mathbb{M}$ activity

$\mathbb{M}1$: Enforced across the board—'postlexical'.

$\mathbb{M}2$: 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, T. Cho 2001), have argued that its effects are felt even on affricated consonants, as shown in structure (d) of Fig. (18) below, which gives various possible surface realizations of an input *Ti* sequence.[6]

(18) Feature geometries of *Ti*

cand	(a) *identity*		(b) *affric.*		(c) *2ary art.*		(d) *both*	
seg	t_1	i_2	$t\int_1$	i_2	t^j_1	i_2	$t\int^j_1$	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 one constraint does not imply 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 [tʃi].

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 candidates without the $\{VPL_2 \Rightarrow PLACE_1\}$ relation. High-ranked

[6] 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+ɨl/ → [tʃətʃɨl] 'milk.ACC' occur without 2^{ary}-Palatalization.

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].

(19) 2^{ary}-Palatalization where $\{\mathbb{M} >> \mathbb{F}_{rel}\}$

		SPREAD-L [VPL/COR]	HOMCONS	SPREAD-L [COR]	CONSISTENCY
I.	/ti/ $COR_2 \Rightarrow PLACE_2$ $VPL_2 \Rightarrow PLACE_2$				
	a. ti	*		*	
	b. tʃi	*	* $COR_2 \Rightarrow PLACE_1$		* $COR_2 \Rightarrow PLACE_1$
☞	c. tʲi		* $VPL_2 \Rightarrow PLACE_1$	*	* $VPL_2 \Rightarrow PLACE_1$
	d. tʃʲi		**! $VPL_2 \Rightarrow PLACE_1$ $COR_2 \Rightarrow PLACE_1$		** $VPL_2 \Rightarrow PLACE_1$ $COR_2 \Rightarrow PLACE_1$
II.	/t+i/				
	a. ti	*		*	
	b. tʃi	*			* $COR_2 \Rightarrow PLACE_1$
	c. tʲi			*	* $VPL_2 \Rightarrow PLACE_1$
☞	d. tʃʲi				** $VPL_2 \Rightarrow PLACE_1$ $COR_2 \Rightarrow PLACE_1$

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.

2. 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.

2.1. Level-ordered OT

A number of earlier accounts of the NDEB 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 (20) 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.

(20) 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	[matʃ]+i	*blocked*	–	
2ary-Palatalization	–	–	k'inʲi	Postlexical
SR	[matʃi]	[mati]	[k'inʲi]	

Y.-M. Cho (2001) recaptures the formal thrust of theories such as this one within the LPM-OT (Lexical Phonology & Morphology Optimality Theory) framework of Kiparsky (2000), 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.

Cho's basic claim runs 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 2ary-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.

(21) 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 vice-versa.

(22) Constraints on palatalization[7]

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

(23) 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 demonstrate, not all boundaries are treated equally in Korean—Palatal Affrication does not occur across compound boundaries.

[7] 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.

(24) 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 (25) below, FAITH must dominate PAL1 on this level, or the facts of (24) will go unexplained.

(25) 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].

(26) Cyclic-level: ‘lexical’ Palatal Affrication

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

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

Phrasal-level mappings	PAL2	FAITH-PWD	FAITH	PAL1
a. +/ma.ti$_{Root}$/, [ma.ti]$_{Pwd}$, → mat^{j}i ~ *mati	W	(L)[8]	L	
b. +/mat + i/, [ma.tʃi]$_{Pwd}$, → matʃi ~ *mat^{j}i		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 (28) below we see the basic rankings required for what 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'.

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

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

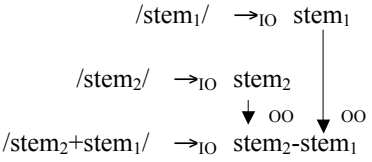
The $\mathbb{F}_{rel}$ account is couched within a fully parallel OT, and thus requires no constraint re-ranking across lexical levels, and thus suffers none of the above conceptual difficulties. An empirical problem for the $\mathbb{F}_{rel}$ account, however, is raised by Cho's account. How does the theory advocated in §2 account for the facts in (24), 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 (Benua 1997, Burzio 2001) protecting the segmental contents of the subconstituents of compounds.

Output-output faithfulness to subconstituents of compounds has been elsewhere argued for by Ito 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.

(29) IDENT(Stem$_{bound}$, Stem$_{free}$) (Ito and Mester 1997)
The bound form of a stem is segmentally identical with its corresponding free form.

[8] If PAL2 is undominated at earlier levels, FAITH-*Prwd* will in fact prefer [mat^{j}i].

(30) Stem/stem correspondence relations



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

(31) OO-F preserves compound identity

Mappings	IDENT-SS: {pat^h}$_{Stem}$	SPREAD-L(COR)	CONSISTENCY
a. *Compounding* /pat^h # ilaŋ/ → pat^{h}ilaŋ ~ *patʃ^{h}ilaŋ	W	L	W
b. *Affixation* /pat^h + ilaŋ/ → patʃ^{h}ilaŋ ~ *pat^h-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.[9]

2.2. 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).

(32) 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 under-

[9] 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.

mines 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 (33)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 (33)b, however, where the ranking of two simple, universal constraints determines which obstruents are allowed to surface in which language.

(33) 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.

(34) Underspecification of Korean coronals (Kiparsky 1993)

	/t, t^h/	/tʃ, $tʃ^h$/	/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 postlexical 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 1994, 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.[10]

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*.

(35) 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.

(36) 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; 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 (35) above, /t_1/ is *not* a

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

[+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 dashed lines, and hierarchical linking is represented 'X/Y', where Y is an autosegmental node associating to another node X.)

(37) IDENT[+ant] *can't* block affrication of unspecified heteromorphemic [t+i][11]

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. $t\int_1$ 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 (35), 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).

(38) 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. $t\int_1$ i_2 [C-Pl/Cor]$_1$[V-Pl/Cor/-ant]$_2$		*	

[11] 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 [t$\int^j$i]. As this portion of Hong's account is irrelevant to the workings of NDEB, we omit it from the present summary of his findings.

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 [ñi] 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.

(39) Surface underspecification in high front vowels

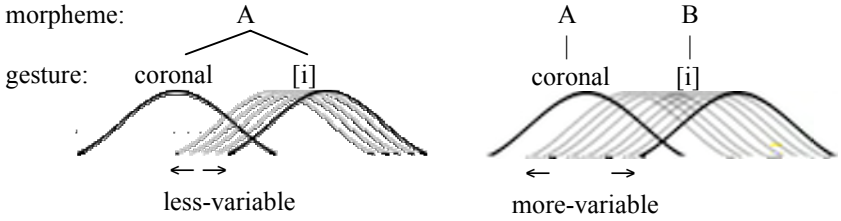
	Input: / n_1 + i_2 / [C-Pl/Cor, +nas]$_1$[V-Pl/Cor, +high]$_2$	LICENSE [-ant]	FRONT-HI [-ant]
☞	a. N_1 i_2 [C-Pl/Cor, +nas]$_1$[V-Pl/Cor, +high]$_2$		*
	b. $\tilde{n}_1$ i_2 [C-Pl/Cor, +nas]$_1$[V-Pl/Cor/-ant, +high]$_2$	*!	
	c. N_1 i_2 [C-Pl/Cor, +nas]$_1$[V-Pl/Cor/-ant, +high]$_2$	*!	

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 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.

2.3. Gestural overlap

T. Cho (1998) 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.

(40) Lexical status and timing variability (T. Cho 1998)



Cho assumes that what we have termed Palatal Affrication and 2^{ary}-Palatalization are in fact the same phenomenon, gestural overlap, 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.

(41) Constraints on gestural overlap

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

(42) Timing faith prevents palatalization

Mappings	IDENT[timing]	OVERLAP
a. /mati/ → mati ~ *matʃi	W	L
b. /mat+i/ → matʃi ~ *mati		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 2000). 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.

(43) Constraints (revised) on Gestural Overlap in *Ti* sequences (T. Cho 1998)

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 (44) 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).

(44) 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. (44) is the fact that there is more than one surface type of *Ni* sequence in Korean. The account we presented in §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.

(45) 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.

(46) IDENT[timing] drives NDEB

a. 'ti' and 't+i':

- 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; [t^{j}i] ruled out.

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

b.

c. 'ni' and 'n+i':

- 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. san^{j}i			*
c. san|i			**!
/san+i/			
☞ d. san͡i			
e. san^{j}i			*
f. san|i			**!

There are a number of conceptual problems with such an account.[12] 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]?

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

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 to the effect that 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 1995), the constraint necessarily operates over entire 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 (47) 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'.

(47) A problem with MINDIST

a. MINDIST derives lexical contrast of *Ti* sequences

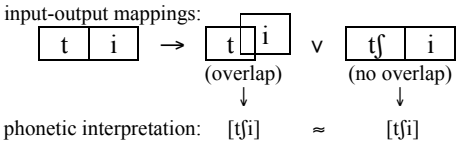
	inventory sets	MINDIST(OVERLAP) = 2	MAXIMIZECONTRASTS
	a. t|i - tʲi	*!	a_{b, c}
	b. tʲ - t͡i	*!	
☞	c. t|i - t͡i		

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

	inventory sets	MINDIST(OVERLAP) = 2	MAXIMIZECONTRASTS
	a. n|i - nʲi	*!	a_{b, c}
	b. nʲ - n͡i	*!	
☞	c. 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?

(48) Overlap vs. replacement in /t+i/→[tʃi]



N. Hall (p.c.) additionally observes that, rather than the MINDIST constraint above, some undominated constraint(s) proscribing the degree of gestural overlap allowed in nasals could account for at least some of the observed variation. For example, if there is a markedness constraint ℳ barring *minimal* overlap of *n* and *i*, and ℳ dominates IDENT[timing], a candidate with [n|i] could be ruled out on the simple phonetic grounds that sonorants are more susceptible to overlap than are obstruents.

The relational faithfulness account is subject to none of these criticisms, relying on more traditional notions of what constitutes an input representation and relying on the rankings of normal constraints on the I-O mapping to determine the contrastive inventories of Korean.

3. Summary

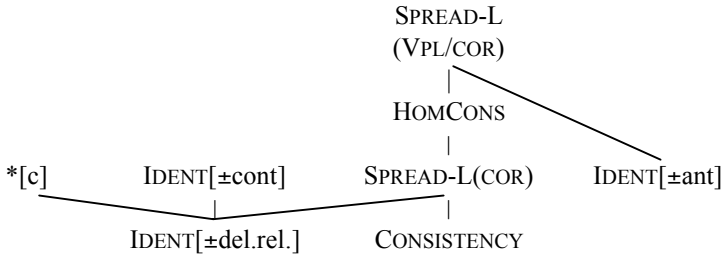
The current account of Korean palatalization has hinged upon a number of crucial ranking arguments. As we saw in §2, Non-Derived Environment Blocking in Korean Palatal Affrication results from a TETU ranking of relational faithfulness constraints; homomorphemic CONSISTENCY preserves morpheme-internal Association relations from the assimilatory pressures of SPREAD-L(COR), which in turn dominates general CONSISTENCY and other faithfulness constraints militating against autosegmental spread less stringently. The Palatal Affrication mapping we have argued for is further mediated by constraints on the surface realization of [-ant] segments in Korean, as well as the across-the-board effects of 2^{ary}-Palatalization, itself resultant from the high ranking of an additional constraint of the SPREAD family which forces secondary articulation in *ti* sequences. We summarize these various arguments below.

(49) Account summary

a. NDEB TETU: Palatalization
   IDENT(PLACE), HOMCONS >> SPREAD-L(COR) >> CONSISTENCY
b. Realization of palatalization as affrication: /ti/ → [tʃi], *[ci], *[ʃi]
   IDENT[±cont], *[c] >> IDENT[±del.rel.]
c. 2ary-Palatalization occurs across the board
   SPREAD-L(VPL/COR) >> HOMCONS, IDENT[±ant]

Together, these constraints fall into the following set of dominance relations.

(50) Final rankings



Factorial typology of the above constraints yields a variety of results—some surprising, some not. Re-ranking of CONSISTENCY, HOMCONS and any appropriate markedness constraint will lead to a typology of assimilatory processes wherein assimilation occurs either a) across morpheme boundaries (NDEB), or b) both within and across morpheme boundaries (across-the-board), as we have seen. We predict a fairly natural range of variation in /ti/→X mappings, resultant from the generic nature of the markedness constraints we have adopted here. Because SPREAD-L[COR] could be satisfied by a variety of repairs on the input sequence /ti/, we predict that NDEB effects could arise for assibiliation (/ti/→[ti], but /t+i/→[ʃi]) and simple palatalization (/ti/→[ti], but /t+i/→[ci]) in addition to the affrication we have seen in Korean. Assibilation of *ti* is widely attested in natural languages, for example as in the famous Finnish NDEB case of Kiparsky (1993). I am unaware of a parallel case of simple palatalization under NDEB, however, this seems hardly surprising given the crosslinguistic rarity of the segment [c], and whether this an accidental gap or not remains to be seen. Combining the NDEB prediction with the range of repairs gives us certain implicational relations between *Ci* sequences in homo- and heteromorphemic environments. If a language allows [ti] sequences homomorphemically, it may allow [ti], [ci], [ʃi], or [tʃi] heteromorphemically. Similarly, if a language allows singly-articulated [Ci] homomorphemically, it may show [Ci] or [Cʲi] heteromorphemically. These implicational relations combine to produce the range of potential variation found in the chart below.

(51) Implicational relations between homo- and hetero-morphemic environments

if *Ci* is:	then *C+i* may be:
ti	ti, ci, ʃi, tʃi, tʲi, cʲi, ʃʲi, tʃʲi
ci	ci, cʲi
ʃi	ʃi, ʃʲi
tʃi	tʃi, tʃʲi
tʲi	tʲi, cʲi, ʃʲi, tʃʲi
cʲi	cʲi
ʃʲi	ʃʲi
tʃʲi	tʃʲi

These considerations made, let us briefly summarize the current framework's advantages. The current analysis has argued Korean palatalization to fall out from a simple and widely applicable constraint schema, repeated again below.

(52) Morphological NDEB TETU schema

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

The account demonstrated that simple relational faithfulness constraints HOMCONS and CONSISTENCY, when ranked with appropriate markedness constraints, can produce assimilatory NDEB, crucially without any of the following theoretical liabilities. First, the account requires none of the level-based machinery necessary in LPM-OT (Kiparsky 2000), and so does not subject the framework to Duke-of-York effects of various kinds. And second, account derives NDEB while staying fully consistent with the Richness of the Base principle (Prince and Smolensky 1993), requiring neither a) input specification of specific features in specific morphological contexts, nor b) surface indeterminacy of featural structure, nor yet c) stipulation of

gestural variance in the lexicon. We take these formal advantages as significant motivation for adopting the current approach over its predecessors.

References

Ahn, S.-C. 1985. *The Interplay of Phonology and Morphology in Korean.* Doctoral dissertation, University of Illinois. [Seoul: Hanshin Publishing Company, 1986.]

Alderete, J. 2001. Root-controlled accent in Cupeño. *NLLT* 19, 455-502.

Anderson, S. 1969. *West Scandinavian Vowel Systems and the Ordering of Phonological Rules*. Doctoral dissertation, MIT.

Beckman, J. 1998. *Positional Faithfulness*. Doctoral dissertation, University of Massachusetts, Amherst. [ROA-234; New York: Garland Publishing, 1999.]

Benua, L. 1997. *Transderivational Identity: Phonological Relations Between Words.* Doctoral dissertation, University of Massachusetts, Amherst. [ROA-259; New York: Garland Publishing, 2000.]

Borgstrøm, C. H. 1940. *A Linguistic Survey of the Gaelic Dialects of Scotland, vol. 1: The Dialects of the Outer Hebrides*. Oslo: Norwegian Universities Press.

Burzio, L. 2001. Surface-to-surface morphology: when your representations turn into constraints. In P. Boucher (ed.), *Many Morphologies*, 142-177. Somerville, MA: Cascadilla Press. [ROA-341.]

Cho, T. 1998. *Specification of Intergestural Timing and Gestural Overlap: EMA and EPG Studies*. Masters thesis, UCLA.

Cho, T. 2001. Effects of morpheme boundaries on intergestural timing: evidence from Korean. *Phonetica* 58, 129-162.

Cho, Y.-M. 2001. A historical perspective on nonderived environment blocking: the case of Korean palatalization. Ms., Rutgers University.

Cho, Y.-M. and P. Sells. 1995. A lexical account of inflectional suffixes in Korean. *Journal of East Asian Linguistics* 4, 119-174.

Clements, G. N. 1985. The geometry of phonological features. *Phonology Yearbook, 2*, 223-252.

Clements, G. N. and E. Hume. 1995. The internal organization of speech sounds. In J. Goldsmith (ed.), *The Handbook of Phonological Theory*, 245-306. Oxford: Blackwell.

Flemming, E. 1995. *Auditory Representations in Phonology*. Doctoral dissertation, UCLA.

Hall, N. 2003. *Gestures and Segments: Vowel Intrusion as Overlap.* Doctoral dissertation, University of Massachusetts, Amherst.

Hammond, M. 1988. On deriving the well-formedness condition. *LI* 19, 319-325.

Hong, S. 1997. Palatalization and umlaut in Korean. *University of Pennsylvania Working Papers in Linguistics* 4, 87-132.

Horwood, G. 2002. Precedence faithfulness governs morpheme position. *WCCFL* 21, 166-179. [ROA-527.]

Horwood, G. 2004. *Relational Faithfulness and Position of Exponence in Optimality Theory*. Doctoral dissertation, Rutgers University.

Hualde, J. I. 1989. The strict cycle condition and noncyclic rules. *LI* 20, 675-680.

Hume, E. 1994. *Front Vowels, Coronal Consonants, and Their Interaction in Nonlinear Phonology*. New York: Garland Publishing.

Inkelas, S. 2000. Phonotactic blocking through structural immunity. In B. Stiebels and D. Wunderlich (eds.), *Lexicon in Focus*, 7-40. Berlin: Akademie Verlag.

Ito, J. and A. Mester. 1994. Reflections on CodaCond and Alignment. In J. Merchant, J. Padgett, and R. Walker (eds.), *Phonology at Santa Cruz* 3, 79-85. [ROA-141.]

Ito, J. and A. Mester. 1997. Correspondence and compositionality: the ga-gyo variation in Japanese phonology. In I. Roca (ed.), *Derivations and Constraints in Phonology*, 419-462. Oxford: Oxford University Press.

Ito, J., A. Mester, and J. Padgett. 1995. Licensing and underspecification in Optimality Theory. *LI* 26, 571-613.

Kean, M. L. 1974. The strict cycle in phonology. *LI* 5, 179-203.

Kiparsky, P. 1973. Abstractness, opacity, and global rules. In O. Fujimura (ed.), *Three Dimensions of Linguistic Theory*, 57-86. Tokyo: TEC.

Kiparsky, P. 1984. On the lexical phonology of Icelandic. In C.-C. Elert, I. Johansson, and E. Strangert (eds.), *Nordic Prosody II: Papers from a Symposium*, 135-163. Umeå: University of Umeå.

Kiparsky, P. 1993. Blocking in nonderived environments. In S. Hargus and E. Kaisse (eds.), *Studies in Lexical Phonology*, 277-313. San Diego: Academic Press.

Kiparsky, P. 2000. Opacity and cyclicity. *The Linguistic Review* 17, 351-365.

Lahiri, A. and V. Evers. 1991. Palatalization and coronality. In C. Paradis and J.-F. Prunet (eds.), *The Special Status of Coronals: Internal and External Evidence*, 79-100. San Diego: Academic Press.

Landman, M. 2003. Morphological contiguity. In A. Carpenter, A. Coetzee, and P. de Lacy (eds.), *University of Massachusetts Occasional Papers 26: Papers in Optimality Theory II*, 141-169. Amherst, MA: GLSA.

Lee, Chungmin. 1972. Boundary phenomena in Korean revisited. *Papers in Linguistics* 5, 454-485.

Lee, Yongsung. 1993. *Topics in the Vowel Phonology of Korean.* Doctoral dissertation, Indiana University.

Lubowicz, A. 2002. Derived environment effects in Optimality Theory. *Lingua* 112, 243-280.

McCarthy, J. 1988. Feature geometry and dependency: a review. *Phonetica* 45. 373-418.

McCarthy, J. 2000. Faithfulness and prosodic circumscription. In J. Dekkers, F. van der Leeuw, and J. van de Weijer (eds.), *The Pointing Finger: Conceptual Studies in Optimality Theory*, 151-189. Amsterdam: HIL. [ROA-201.]

McCarthy, J. 2003. Sympathy, cumulativity, and the Duke-of-York gambit. In C. Féry and R. van de Vijver (eds.), *The Optimal Syllable*, 23-76. Cambridge: Cambridge University Press.

McCarthy, J. and A. Prince. 1993. Generalized alignment. In G. Booij and J. van Marle (eds.), *Yearbook of Morphology 1993*, 79-153. [ROA-7.]

McCarthy, J. and A. Prince. 1994. The emergence of the unmarked. *NELS 24*, 333-379. [ROA-13.]

McCarthy, J. and A. Prince. 1995. Faithfulness and reduplicative identity. In J. Beckman, L. Walsh Dickey, and S. Urbanczyk (eds.), *University of Massachusetts Occasional Papers 18: Papers on Optimality Theory*, 249-384. [ROA-216.]

Mohanan, K. P. 1986. *Lexical Phonology.* Dordrecht: Kluwer.

Ní Chiosáin, M., and J. Padgett. 2001. Markedness, segment realization, and locality in spreading. In L. Lombardi (ed.), *Segmental Phonology in Optimality Theory: Constraints and Representations*, 118-156. Cambridge: Cambridge University Press.

Pater, J. 1999. Austronesian nasal substitution and other NC effects. In R. Kager, H. van der Hulst, and W. Zonneveld (eds.), *The Prosody-Morphology Interface*, 310-343. Cambridge: Cambridge University Press.

Poser, W. J. 1993. Are strict cycle effects derivable? In S. Hargus and E. Kaisse (eds.), *Studies in Lexical Phonology*, 315-321. San Diego: Academic Press.

Prince, A. and P. Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Technical report RuCCS-TR-2. New Brunswick, NJ: Rutgers University Center for Cognitive Science. [ROA-537. Published 2004, Malden, MA: Blackwell.]

Pullum, G. 1976. The Duke of York gambit. *Journal of Linguistics* 12, 83-102.

Rubach, J. 1984. *Cyclic and Lexical Phonology the Structure of Polish.* Dordrecht: Foris.

Sagey, E. 1986. *The Representation of Features and Relations in Nonlinear Phonology*. Doctoral dissertation, MIT.

Scobbie, J. M. 1992. *Attribute-Value Phonology*. Doctoral dissertation, University of Edingburgh.

Smolensky, P. 1996. The initial state and 'Richness of the Base.' Technical Report JHUCogSci-96-4. [ROA-154.]

Steriade, D. 2000. Paradigm Uniformity and the phonetics-phonology boundary. In M. Broe and J. Pierrehumbert (eds.), *Papers in Laboratory Phonology 5: Acquisition and the Lexicon*, 313-334. Cambridge: Cambridge University Press.

Walker, R. 1999. Esimbi vowel height shift: implications for faith and markedness. ROA-336.

Zec, D. 1993. Rule domains and phonological change. In S. Hargus and E. Kaisse (eds.), *Studies in Lexical Phonology*, 365-405. San Diego: Academic Press.

Center for International Issues Research, SAIC
1330 Braddock Place, Suite 200
Alexandria, VA 22314
graham.v.horwood [at] saic.com