ORDER WITHOUT CHAOS: RELATIONAL FAITHFULNESS AND POSITION OF

EXPONENCE IN OPTIMALITY THEORY

by

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A Dissertation submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

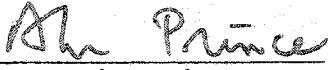in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Graduate Program in Linguistics

written under the direction of

Alan Prince

and approved by

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New Brunswick, New Jersey

October 2004

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ABSTRACT OF THE DISSERTATION

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Dissertation Director:

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This effort will argue on several counts that faithfulness constraints governing input

precedence relations must arbitrate the surface positioning of morphological exponence

(PoE henceforth), the essential claim being that where surface perturbation of

underlying concatenative morpheme order occurs—as in infixation and metathesis—

precedence faith must be crucially dominated by some constraint on phonological well-

formedness. Expansions to this basic theory will be shown to shed light on certain

problems in OT morphophonology. A longstanding problem with dislocational

approaches to infixation is found in the Austronesian language Tagalog, where 'deep'

or 'hyper'-infixation of an affix, a phenomenon predicted in traditional OT accounts,

does not occur. It will be shown that local self-conjunction of LINEARITY effectively rules out hyperinfixation in Tagalog, along with hypermetathesis in Faroese. It will further be shown that the precedence faith theory is superior to traditional, alignment-based approaches to such phenomena on several counts, as the proposed theory: preserves morpheme-ordering universals in factorial typology where the alignment-based theory cannot; predicts semantic contrast by morpheme re-order, a possibility lost under the alignment approach to PoE; and is furthermore entailed by a necessary proscription against morphologically-indexed markedness constraints more generally. We will go on to argue that cases of infixation not attributable to markedness constraints on prosodic/segmental/featural well-formedness must fall to the inter-ranking of precedence faith with constraints on input adjacency relations construed over surface-to-surface correspondence relations. We will derive from this inter-ranking the known typology of attested infixation patterns, and will examine in some detail particular cases from such diverse languages as Katu, Leti, Cupeño, Ulwa, and Alabama. What have been traditionally been referred to as Morphological Derived Environment Effects will shown to follow generally from a TETU ranking of general and homomorphemic relational faithfulness constraints with phonological markedness constraints.

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ACKNOWLEDGEMENTS

A noted linguistics professor, when once asked why the graduate student attrition rate in his department was so high, replied, "Because failure is easier than success." After the past seven years at Rutgers, a long four of which were spent working on this dissertation, I'm not so sure this is true. Failure would have meant looking Alan Prince in the eye and saying, "I quit." I—and I think Alan's other past advisees will back me up on this one—can't off hand imagine a more terrifying prospect. So it is with not undue gratitude that I thank Alan first and foremost for helping me see this dissertation (and my graduate studies more generally) through to completion. I am also indebted to the remainder of my committee. Bruce Tesar, for those of you who may not know, is always right; this remarkable quality has brought much clarity to a number of the murkier ideas upon which this document was built. I am equally lucky to have had Mark Baker on the committee, both for his wry wit and his encyclopedic knowledge of the world's most peculiar languages. I could not have asked for a more understanding external committee member than John McCarthy, whose collected works influenced this dissertation to such a degree that they almost deserve a separate bibliography of their own. It is also with warmest regards that I thank the following Rutgers faculty, not just because they were nice enough to attend my dissertation defense, but because they provided friendship, guidance, and appropriately timed moral support during my time at the department: Roger Schwarzschild, Jane Grimshaw, and Akinbiyi Akinlabi.

In chronographical order (or something like it), I would like to tip my hat to the following people, friends and cohorts, all of whom have contributed to my development

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as a linguist and as a person. Amanda Jones, Cathy Hicks-Kennard, and Valerie Mohr were the sirens that lured me unsuspecting into theoretical linguistics with just the right combination of comraderie, friendly rivalry, and nervous anxiety. Luba Butska, Madeline Holler, Zsuzsa Nagy, and I will, for the rest of our lives, have that special bond of alienation, terror, and misery that only people who suffer through the first year of graduate school together can lay claim to; wherever you are today, Angels— solidarity. Ron Artstein, Nicole Nelson, Eric Bakovic, Brett Hyde, and Yoko Futagi were each in their own ways perfect models of intellect, kindness, charm, honor, and courage; it was my pleasure to follow their examples over the years. I can say little to Heather Robinson, Judy Bauer, and Que Chi Luu but: I will love every one of you dearly until the day I die (whether you're still speaking to me or not). Markus Hiller and Lian-Hee Wee have expanded my horizons—linguistic and cultural—in many and much appreciated ways. John Alderete has been a friend and a mentor, and has greatly influenced what lies in this pages of this volume, all to the better. Nancy Hall and Daphna Heller made the 3rd floor of 18 Seminary Place an infinitely more entertaining place to spend the long grey hours of one's dissertation work. Clemencia Espiritu and Ayleen Ortiz made what could have been one of the scariest experiences of my life into the most amazing; *maraming salamat nga po sa inyo, at sana ay gantihan ko ang bait ninyo paminsan-minsan (tama ba iyan? masama pa ang Tagalog ko)*. And last but not least, thank you, Naz Merchant, for trying so hard to get me really drunk the night before my dissertation defense…I don't think I'd have slept at all, otherwise.

It is with all conviction that I say I would not have finished this dissertation without my family. To my parents, Dolores Squyres, Steve Horwood, and Angela Thomas (three

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cheers for the American nuclear family), thank you for offering shoulders to cry on…and stern words when tears weren't helping. Lastly and most importantly, I owe all of this to Amy Bain. We made it, babe. Bubble-tea's on me.

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Chapter One – Relational Faith and Position of Exponence

It may seem almost wanton to suggest the
desirableness of revising a system at once so
simple, so logical, and apparently so well
bottomed on facts. But there can never be
any real harm in studying masses of
evidence from fresh points of view.
– Andrew Lang, *The Making of Religion*

1. Introduction

In any componential theory of grammar, there are a number of distinct levels at which

constraints/principles/conditions/parameters/what-have-you may hold over the linear

ordering of the representational primitives of morphology. Morphemes can be ordered:

as category heads in the syntax, arranged through head-movement and adjunction, for

instance; or as feature bundles in a distinct morphological component, subject to word

formation rules of various types; or as strings of segments in the phonology, transposed

in various ways to satisfy phonological conditions on surface representations. This

dissertation will develop a theory of this latter sense of 'morpheme order', and to make as

transparent as possible the distinction between this sense and others, I will refer to it

throughout this work as Position of Exponence (PoE).

A theory of PoE finds greater challenge in some linguistic phenomena than in others, and

while any such theory requires straightforward treatment of normal concatenative

morphology, this dissertation will be primarily concerned with what we will collectively

refer to as 'dislocational' morphology, morpho-phonological processes which involve the

altering of canonical PoE (in whole or segmental/featural part) to satisfy phonological

well-formedness conditions on the output string. The most-discussed type of

dislocational morphology is infixation, and it is to infixation that the bulk of our attention will be directed. Infixation falls, broadly speaking, into two basic descriptive types: that brought about for reasons of prosodic or phonological well-formedness, as in the Tagalog, Kashaya, or Inor examples in (1) below; or that brought about for no immediately observable phonological reason, as in the Katu, Cupeño, and Ulwa examples (2).

(1) Phonologically conditioned infixation

      a.   Tagalog *um* avoids onsetless syllables (Schachter and Otanes 1972)
          /um+ʔabot/ → ʔ-um-abot 'to reach for.AF'
          /um+sulat/ → s-um-ulat 'to write.AF'

      b.   Kashaya *ta* avoids non-coronal codas (Buckley 1997)
          /dahqotol + ta + .../ → dahqotol-ta- 'fail (to do)'
          /bilaqʰam + ta + .../ → bilaqʰa-ta-m- 'feed'

      c.   Inor [lab] avoids [LAB, COR] segments (Zoll 1998)
          /dənəg + [lab]/ → dənəgʷ 'hit.3MSG'
          /kəfəj + [lab]/ → kəfʷəj 'open.3MSG'

(2) Aprosodic infixation

      a.   Leti Nominalization (Blevins 1999, Van Engelenhoven 1995, Yu 2003)
          /ni+kaati/ → k-ni-aati 'carving'
          /ni+atu/ → ni-atu 'knowledge'

      b.   Katu Nominalization (Costello 1998)
          /r+katas/ → ka-r-tas 'name.INF/name.N'
          /r+aloom/ → a-r-loom 'offer.gift.INF/gift.offered.N'

      c.   Cupeno Habilitative Formation (Broselow and McCarthy 1983, Crowhurst 1994, Hill 1970, McCarthy 1997)
          /čál+RED/ → čáʔaʔal 'husk.HAB'
          /páčik+RED/ → páčiʔik 'leach.acorns.HAB'

      d.   Ulwa Construct Infixation (McCarthy and Prince 1993a)
          /bas+ka/ → bas-ka 'hair.POSS'
          /siwanak+ka/ → siwa-ka-nak 'root.POSS'

In the well-known Tagalog case, an underlyingly prefixal morpheme is dislocated to the leftmost surface position that will allow it to be syllabified with an onset; the output word thus satisfies an unviolated restriction on syllable structure in the language. In Kashaya, a suffix is dislodged from its base position to satisfy a coda condition; infixation occurs to avoid a non-coronal coda (Buckley 1997). And lastly in the Inor case, a general

prohibition against the co-occurrence of the features [+cor] and [+lab] within a single segment forces a floating-feature morpheme to infix to the nearest available landing site internal to the root (Zoll 1998). The three cases share the common property of being motivated by some prosodic, phonotactic, or feature co-occurance condition.

In the aprosodic cases, however, no such phonological motivating factor can be discerned. In Leti Nominalization (Blevins 1999, Van Engelenhoven 1995), a CV affix shares the same infixational distribution of the Tagalog infix, yet its dislocation cannot be attributed to prosodic well-formedness factors, as the resulting CCV~ surface structure is considerably more marked than a simple, prefixed form would have been. Similar cases are found in Katu, Cupeño and Ulwa, where affixes that could appear external to the base of affixation with no discernable increase in absolute prosodic markedness instead surface internal to the base string.

Also falling under the 'dislocation' rubric are cases of metathesis, and especially of interest to us are those cases in which a segment or feature metathesizes only in a particular morphological environment, as in the Kui and Georgian cases below. Metathesis of these and other types will be of interest to us more in their interactions with infixation than in their isolated behaviors.

(3) Cross-boundary metathesis

    a.   <u>Kui Metathesis</u> (Hume 2001)
        /gas+pi/ → gas-p<u>i</u> 'to hang oneself.PST'
        /lek+pi/ → le<u>p</u>-k<u>i</u> 'to break.PST'

    b.   <u>Georgian v-metathesis</u> (Butskhrikidze and van de Weijer 2001)
        /tes+v+a/ → tes-v-a 'to sow'
        /k'al+v+a/ → k'vl-a 'to kill'

This dissertation will develop a number of ideas predicated upon one key theoretical notion. That notion is simply that underlying, morphosyntactically determined

morpheme order is preserved in the phonological component of grammar by faithfulness constraints. We will contend that these constraints are crucially violated in dislocational processes such as those above, and will show that a number of problems in prosodic and processual morphology are easily reconciled under such a theory, in a manner significantly less prone to overgeneration than theories which have come before. It will be shown that local conjunction of LINEARITY provides a natural account of hyperinfixation avoidance, a formal problem inherent to dislocational approaches to infixation—and, we will show, metathesis—in OT. The advances of the theory will be made without recourse to category-qualified alignment constraints, prosodic subcategorization, or language particular, post-EVAL filters on output well-formedness. Cases of infixation not attributable to prosodic/segmental/featural well-formedness factors will be shown to result from the high-ranking of constraints on input adjacency relations construed over surface-to-surface correspondence relations; the interaction of these constraints with LINEARITY will be shown necessary in cases of infixation in Katu, Leti, Cupeño, Ulwa, and Alabama. A typological prediction of an earlier theory of PoE, bitropic morphology, will be shown impossible in the proposed theory, and we will explain an apparent exception found in the Arawakan language Terêna, along with Morphological Derived Environment Effects more generally, with further appeal to homomorphemic specification of not just LINEARITY, but relational faithfulness constraints a formular specification of constraints holding over adjacency/simulataneity/association relations.

2. Precedence Faith and PoE

The theory of PoE we will advance states simply that faithfulness constraints of the familiar LINEARITY family (McCarthy and Prince 1995) preserve the ordering relations of melodic content both within and across morphemes. We will give a more formal definition of the constraint shortly, but note for the time being its basic functioning.

(4) LINEARITY

S_1 reflects the precedence structure of S_2 and v.v.

Numerous authors (for example Hume 2001, McCarthy and Prince 1993a) have relied on LINEARITY-type constraints to explain both homo- and heteromorphemic metathesis as grammatical processes. We will argue here that the grammatical importance of LINEARITY-type constraints extends far beyond the domain of phonological metathesis, touching upon almost all aspects of surface morpheme placement. As fig. (5) demonstrates for two abstract morphemes (A, B) and their segmental contents (numbered), LINEARITY is in fact violated by many types of dislocation across morpheme boundaries. The unmarked candidate demonstrates the utility of the constraint in determining the order of simple pre-/suffixal morphology; where LINEARITY for a particular morpheme is undominated, the input positioning of that morpheme will surface unaltered—whether its morphosyntactic orientation be prefix, suffix, or root. Where some higher-ranked constraints dominate LINEARITY, however, a variety of dislocational processes may arise. Violations are here counted on mismatches in the sets of precedence relations at each level, input and output, and a loss of segmental precedence relation is shown with the ' ⨯ ' symbol.

(5) Violations for contents of two morphemes, A and B

/[12]$_A$ + [34]$_B$/ A<B ∴ {1<3, 1<4, 2<3, 2<4}	LINEARITY
a. <u>12</u>-34 *underlying order*	
b. <u>1</u>-3-<u>2</u>-4 *metathesis*	* 2 ⊀ 3
c. 3-<u>12</u>-4 *infixation*	** 1⊀3, 2⊀3
d. 34-<u>12</u> *order reversal*	**** 1⊀3, 1⊀4, 2⊀3, 2⊀4

The farther a morpheme—in whole or part—is 'moved' in a given candidate from its input orientation, the greater the violation of LINEARITY. Thus a single relational faithfulness constraint may gradiently[1] attract a morpheme to a position specified in the input by the morphosyntax, rather than to some morphologically or prosodically defined edge in the output. This much follows from the standard assumptions of Correspondence Theoretic Optimality Theory (McCarthy and Prince 1995), provided we accept certain non-controversial assumptions not otherwise inherent to that framework. In order for precedence faithfulness constraints to be violable in the I-O mapping as shown above, there must be something in the input to which to be faithful.

I. Item-and-Arrangement morphology. Underlying morphological structure is generated by the (morpho)syntactic component of grammar, which composes terminal elements hierachically according to a) universal principles of morphosyntax/semantics, and/or b) language-specific subcategorization. This assumption is consistent with prevailing work in Distributed Morphology (Halle and Marantz 1993), though—as we are developing a theory of PoE—little of the architecture of that theory bears directly on the current effort, and we will note that other concatenative and/or syntactic theories of word formation

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[1] We use the term *gradient* loosely here. Properly speaking, precedence faithfulness constraints are singly violable over multiple loci of violation, rather than multiply violable over a single locus of violation; see McCarthy (2002, fn.2) for discussion.

(Baker 1988, Hale and Keyser 1993, Hockett 1958, Lieber 1992) would serve our purposes just as well. Attendant to this assumption is the understanding that prosodic morphology, including infixation, is solely the province of the phonological component of grammar; infixation is simply not a formal device available to the morphosyntax.

II. Exhaustive linearization. Again in accordance with standard generative theories we will assume that the phonological component of grammar (PF) is in a sense dependent upon (morpho)syntactic ordering relations. Whether this be the result of a standard 'T' model of grammar (Chomsky 1981, 1995) or of a universal subordination of phonological constraints to syntactic constraints (Revithiadou) will remain a matter well beyond the purview of this work. What is crucial to the proposed theory is the assumption that some function maps the morphosyntactic structure onto a linearly ordered string. That is, morphemes are linearly ordered in the phonological input, and their segmental contents are linearly ordered accordingly. Thus, for any two objects—morphemes, segments, features, tones, moras, etc.—in the phonological input, there exists a relation adjacent '⌒' or a non-adjacent ' ⌢̸ ', and a precedence relation '<'. This means, crucially, that input objects may not be *underspecified* for precedence and adjacency, i.e., bearing no relation whatever. Linear ordering is therefore exhaustive, i.e., there are no unordered segments in the phonological input, and for any two segments in said string, there exists a precedence relation, regardless of the morphological affiliations of the segments.[2]

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[2] We assume the relation '<' to be transitive, asymmetric, and irreflexive by standard definitions. Exhaustivity is a simplifying assumption; the behaviors of an unordered input segment remain to be seen.

Crucial to any OT explanation of dislocation is not just a characterization of the constraint violated by such a process, but as well the ranking of constraints in a grammar which may bring about those violations in the optimal candidate. Schematically, the following ranking conditions are necessary to any explanation of dislocation in natural language phonology. Modulo our use of LINEARITY as the constraint arbitrating the positional gravitation of morphemes, the basic ranking logic being essentially that advanced in the Prosodic Morphology program (McCarthy and Prince 1993a), where a prosodic constraint (C below) dominates a morphological constraint (here LINEARITY, which preserved input morphological information) to produce dislocational exponence positioning.

(6) Dislocation Ranking Schema:

   {C, F >> LINEARITY}

   Where:
   C is the (non-null) set of constraints marking output preservation of input precedence relations, and
   F is the (possibly null) set of faithfulness constraints violated by candidates satisfying C.

Where C is a phonological markedness constraint, the schema admits a potentially large array of possible dislocation types, and exhaustive delineation of that array without a priori knowledge of all the markedness constraints in CON is impossible. Returning to the usual suspects of dislocation we observed in §1, however, we see that C tends to instantiate a non-homogeneous set of phonological well-formedness constraints. Dislocation may arise from LINEARITY's crucial ranking with respect to prosodic well-formedness constraint, such as ONSET and CODACOND in Tagalog and Kashaya respectively, as well as constraints on feature co-occurrence, as in Inor, and phonotactic constraints, as in Kui.

(7) Phonologically conditioned cases of infixation

Dislocation occurs...	Ranking	Process
...to produce a better syllable structure	Onset >> Linearity	Tagalog um Infixation (Prince and Smolensky 1993) /um + ?abot/ → ?-um-abot 'AF-reach.for' /um + tawag/ → t-um-awag 'AF-call'
...to obey coda licensing conditions	CodaCond >> Linearity	Kashaya ta Infixation (Buckley 1997) /dahqotol + ta + .../ → dahqotol-ta- 'fail (to do)' /bilaqham + ta + .../ → bilaqha-ta-m- 'feed'
...to avoid an illicit feature combinations	*[cor, lab] >> Linearity	Inor 'Featural' Infixation (Rose 1994) /dənəg + [rnd]/ → dənəgw 'hit.3Msg' /nəkəš + [rnd]/ → nəkwəš 'bite.3Msg'
...to avoid an illicit consonant sequence	*[vel][lab] >> Linearity	Kui Metathesis (Hume 2001, Winfield 1928) /gas + pi/ → gas-pi 'to hang oneself.pst' /lek + pi/ → lep-ki 'to break.pst'

For any potentially dislocation causing ℂ and an candidate which it marks, Optimality Theory admits a potentially wide range of repair strategies in factorial typology. Surface repair of marked input structure is penalized by faithfulness constraints of various types, thus the ranking of other faithfulness constraints 𝔽 with respect to LINEARITY is crucial to any dislocation ranking. In each of the cases in (7), faithfulness constraints on segmental insertion/deletion must crucially dominate LINEARITY, else we might expect consonant epenthesis in Tagalog or Kashaya; similarly IDENT constraints must be undominated in cases where the featural quality of the involved segments is at issue, else [cor, lab] segments might be avoided in Kashaya through simple mapping of underlying coronals to velars.

Before continuing, it is important to situate LINEARITY within the larger context of *relational faithfulness constraints* (𝔽rel). LINEARITY is but one constraint among many that preserves relations between structural elements across the I-O (or B-R, O-O) mapping. We will contend here that, for each of the relations precedence, adjacency,

simultaneity, and autosegmental association,[3] there exists a faithfulness constraint attuned

to it. The constraints and their logical formalizations are given below.

(8) Relations and Constraints that govern them

Relation	Constraint	Definition
Precedence ("<")	LINEARITY 'No dislocation'	S_1 reflects the precedence structure of S_2 and v.v. If $x, y \in S_1$, then $x < y$ iff $\neg[Y' = \{y' \in S_2 \mid y'\Re y\} < X' = \{x' \in S_2 \mid x'\Re x\}]$.
Adjacency ("⌢")	CONTIGUITY 'No skipping'	The portion of S_1 standing in correspondence forms a contiguous string. If $x, y \in S_1$; $x', y' \in S_2$; $x\Re x'$ and $y\Re y'$; and $x \frown y$, then $x' \frown y'$.
Simultaneity ("≐")	UNIFORMITY 'No fusion'	No element of S_2 has multiple correspondents in S_1. For x, y $\in S_1$ and z $\in S_2$, if x$\Re$z and y$\Re$z, then x ≐ y.
Association ("⇒")	CONSISTENCY 'No spreading'	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⇒x and y'⇒z, then z≐x'.

We will discuss CONTIGUITY, UNIFORMITY, and CONSISTENCY in greater detail as they

become relevant at various points throughout this dissertation. For the time being,

however, we will note a singular disparity between the formalization of LINEARITY given

above and that originally advocated by McCarthy and Prince.

(9) LINEARITY (original)

If $x, y \in S_1$; $x', y' \in S_2$; $x\Re x'$ and $y\Re y'$; and $x < y$, then $\neg(y' < x')$.

As traditionally defined (Hume 1995, McCarthy and Prince 1995, Hume 2001),

LINEARITY straightforwardly penalizes segment fusion just as well as it penalizes

segment reversal. In the diagram below, the precedence of y' with respect to x' is very

different from that of input correspondents x and y. Given that two elements

simultaneous with each other may neither precede nor follow one another, it is certain not

the case that, as in the original definition, $y' < x'$.

(10) A typical fusion candidate

input: | x y
output: | $x'y'$

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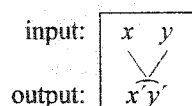
[3] What we call 'autosegmental association' relation may more theory-neutrally be considered 'dominance'.

Under the aegis of counting violations of LINEARITY and UNIFORMITY distinctly—as will prove necessary in treatment of morphological nasal harmony in Chapter 4—we will, throughout this dissertation, assume the following more pointedly anti-dislocational definition of the constraint, which holds over precedence relations among *sets* of output correspondents.

(11) Linearity (revised)

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

Under this new formulation, 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. In the case of fusion, 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. This difference is illustrated below with the full range of $\mathbb{F}_{rel}$ constraints and their violation profiles for particular process types.

(12) Complementary violation profiles of $\mathbb{F}_{rel}$

$/A_1B_2/$		LINEARITY	CONTIGUITY	UNIFORMITY	CONSISTENCY
a.	Dislocation B_2A_1	*			
b.	Skipping $A_1 \square B_2$		*		
c.	Fusion $\widehat{AB}_{12}$			*	
d.	Spreading A_1A_2				*

3. Case and consequence

We can see the workings of LINEARITY and the necessary ranking more concretely in what has become the benchmark case for determining the explanatory value of any theory of infixation since McCarthy and Prince (1986). Below are a number of familiar data

from the Austronesian language Tagalog. In each form, the actor-focus morpheme *um* occurs immediately after the first consonant of the root.[4]

(13) Actor-focus infixation in Tagalog (Schachter and Otanes 1972)

/um+ʔabot/ → ʔ-um-abot 'to reach for.AF'
/um+sulat/ → s-um-ulat 'to write.AF'
/um+tawag/ → t-um-awag 'to call.AF'

A substantial number of authors (Crowhurst 2001, McCarthy and Prince 1993a, McCarthy 2002, Orgun and Sprouse 1999, Zoll 1998) have treated this phenomenon as a phonologically motivated case of morpheme dislocation: a prefix becomes an infix to satisfy a condition on phonological well-formedness.[5] We will follow these authors in arguing this condition to be well-formedness of syllable structure, but veer crucially from their account in taking precedence faith, rather than parochial alignment, to decide the surface position of the affix in the default case. Tableau (14) below shows the straightforward ranking of LINEARITY with respect to ONSET,[6] a constraint otherwise undominated in the language.

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[4] French (1988) reports Tagalog to have following consonant inventory, where parenthesized phonemes occur only in Spanish or English loan phonology: {p, t, tš, k, ʔ, b, d, dž, g, m, n, ŋ, (f), (θ), s, (š), h, (v), (ð), z, (ž), l, r, w, y}; the language has a five-vowel system, {i, e, a, o, u}. Also, a precautionary note on the status of glottal stop in the data: as McCarthy (2002, fn.7) observes, earlier accounts of these data omitted word-initial glottal stop primarily because it fails to appear in the standard orthography of the language. This orthographic practice originates in the fact that ʔ is predictable word-initially—there are no onsetless syllables in the language, and ʔ is, by assumption, the epenthetic repair for possible inputs beginning with a vowel alone. Word-finally, however, ʔ forms minimal pairs with *h*, and so must be considered contrastive in the language.

[5] See also Anderson's (1972) account of Sundanese for a pre-OT account along similar lines.

[6] ONSET ≡ *$_\sigma$[V (Prince and Smolensky 1993).

(14) Tagalog *um*-infixation: /um+sulat/ → [s-um-ulat]

/um+sulat/	ONSET	DEP-C	LINEARITY
a. um-sulat	*!		
b. ʔ-um-sulat		*!	
☞ c. s-um-ulat			** {u, m} ≮ s
d. sul-um-at			***!*** {u, m} ≮ {s, u, l}

A number of the theory's larger predictions are evident in the lone tableau.

• First, morphosyntactic edge orientation is preserved in the account. All other actor focus morphemes in Tagalog (*mag-*, *mang-*, *ma-* and their aspectual variants) are prefixal in nature. With the assumption that *um* is underlyingly a concatenative prefix, we not only regularize any morphosyntactic analysis of the actor focus paradigm—on traditional accounts, all other actor focus morphemes in the language are prefixal[7]—but provide straightforward account of the fact that the morpheme only infixes into the leftward portion of the root morpheme. This follows straightforwardly from the fact that LINEARITY is multiply violable over the space of precedence-related segment pairs in the input. The infix gravitates to the left edge of the output word because 'movement' deeper into the root string results in greater violation of LINEARITY.

• Because the basic dislocation ranking in (6) does not distinguish between mappings in which a single segment undergoes precedence reversal from those in which many do, we formally (in addition to descriptively) unify treatment of what have traditionally been separately identified as distinct processes in particular languages: infixation and metathesis. As a result, particular accounts of infixation must be sensitive to the rankings

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[7] See, however, Rackowski (to appear) for a characterization of markers like *um* as markers of case agreement rather than focus.

of constraints causing metathesis, and v.v.; thus the present account predicts analytical dependency between the two processes. For example, in the tableau above, what in principle rules out a candidate *mu-sulat?

• Also by the precedence faith account, dislocation is phonological in character. It is not a phonologically arbitrary (lexical, morphosyntactic, etc.) property of the *um* morpheme that forces it to appear after the first consonant of the root, but rather a predictable property of Tagalog phonology—it is independently observable that all syllables must have onsets in the language. This makes immediate sense of the larger generalization that there are no VC prefixes in the language that fail to infix in this manner, a similarly VC structured goal focus morpheme *-in-* showing similar behaviors. Other candidates (not shown) that do not improve on the syllable structure of the output word, such as a hypothetical case *u-su-m-lat*, are likewise ruled out.

• Less evident from the Tagalog case, but apparent in extension of the theory, is a restriction on the space of possible morphemes. The theory of dislocation advocated here explicitly disallows *bitropic affixation*; that is, in the theory presented here it is impossible for a morpheme to simultaneously gravitate to opposite edges of an output morphological or prosodic category for non-phonological reasons. Morphemes have a single ordering in a phonological input; LINEARITY forces the surface exponence of a morpheme to gravitate to this unique position only. Because of this, we predict that, for example, there is no language in which a morpheme appears simultaneously at opposite edges of the output word, i.e., /ba+paka/→*ba-paka-ba*.

These four basic predictions of the theory—preservation of morphosyntactic locality, phonological dislocation only, no bitropic morphology, and analytical dependency of infixation and metathesis—result in a number of formal and empirical challenges when confronted with the facts of dislocational processes in a variety of languages. We will here give an overview of these complications and the necessary expansions to our basic theory of PoE necessary to surmount them. Expansions to the theory will come in the form of some enrichment of our theory of faithfulness, allowing that CON contains variants of common relational faithfulness constraints—precedence faithfulness, as well as constraints on relations such as adjacency, simultaneity, and autosegmental association—narrowed in formal scope to be operative over only certain types of input relations or within certain domains of phonological amd morphological structure.

3.1. Preservation of morphosyntactic edge orientation

All infixational processes have a descriptively local character to them; that is, there always exists some generalization of the process which situates the exponence of the affix within that of the root with respect to some left or right edge of the output root/stem/word. The descriptive edge orientation of an infix is derived typically from a) distributional regularities in morphosyntactic ordering, as in Tagalog, or b) from surface alternation with a pre-/suffixal allomorph, as in Kashaya. As we have observed, the proposed theory of PoE hinges crucially on the understanding that morphemes are linearly ordered prior to phonologization. This has the desired consequence of formalizing infixation as the migration of a morphological unit a minimal distance from its input position. Thus there is a formal analogue to the descriptive notion of infix locality—a leftward-oriented infix is underlyingly a prefix, and rightward-oriented, a

suffix in kind. Ensuring that this underlying morpheme positioning is preserved in surface exponence, however, is another matter. Where {M >> LINEARITY}, dislocation of a morpheme may occur to potentially any position in the output string that can best satisfy the prohibitions of the markedness constraint. This can, in principle, make 'local to an edge' a somewhat nebulous concept in OT, as we can see in consideration of the so-called *hyperinfixation* problem of Tagalog infixation.

Numerous authors (Klein 2002, McCarthy 2002, Orgun and Sprouse 1999, Schachter and Otanes 1972) have observed the following fact of Tagalog: *um* cannot infix immediately after a labial sonorant—in fact, in such words the morpheme typically isn't realized at all—the assumption being that consecutive sonorant-labial onsets are banned in the language by some form of undominated OCP constraint.

(15) Sonorant labial avoidance in -*um*- infixed words (Orgun and Sprouse 1999)

    a.   <u>m-, w-initial words</u>
        mahal   *m<u>um</u>ahal 'to become expensive'
        walow   *w<u>um</u>alow 'to wallow'

    b.   <u>s + m-, w-initial words</u>
        smajl   *s<u>um</u>majl, *sm<u>um</u>ajl 'to smile'
        swim   *sumwim, *swumim 'to swim'
        swiŋ   ʔs<u>um</u>wiŋ, *sw<u>um</u>iŋ 'to swing'

This fact leads to an unfortunate ranking paradox for the dislocational approach to Tagalog infixation espoused here and in Prince and Smolensky (1993). The optimal output for any input such as *mahal* is a phonetically null string, the null parse (Prince and Smolensky 1993), a candidate vacuously satisfying all markedness constraints and penalized by a constraint against maximal underparsing, MPARSE. To rule out the null parse in the majority of cases, MPARSE must dominate LINEARITY. This ranking is needful in Tagalog to insure that in normal (i.e., non-*mum*) cases of infixation, the null parse is not a more optimal candidate. As the following tableau demonstrates, however,

this necessary ranking produces an undesired result: where the null parse is ruled out, the predicted optimum positions the exponence of the actor focus morpheme at the next prosodically perspicuous position down the root string. In the terminology of Orgun and Sprouse, the morpheme is forced to 'hyperinfix' to a position non-local to its edge of input affixation.

(16) Hyperinfixation to avoid marked structure

/um+mahal/	OCP	ONSET	MPARSE	LINEARITY
a. um-mahal		*!		
b. m-um-ahal	*!			**
☞ c. mah-um-al				******
d. mahal-um				*******!***
☞ e. Ø			*!	

Such behavior is never found in Tagalog verbs. It appears that some mechanism must be available to the theory to strictly delimit a phonological domain beyond which infixation may not occur—i.e., something must strictly maintain the 'prefixal' locality of the affix. As we will see a commonly practiced operation on OT constraints, local conjunction, provides a simple solution to the problem.

The account will follow the intuition that hyperinfixation is marked in languages like Tagalog because it involves a degree of LINEARITY violation impermissible in the language—there's such a thing as too much dislocation. In OT, however, constraints are strictly dominated, and the absolute number of LINEARITY violations is irrelevant. The candidate with the fewest LINEARITY violations not marked by higher ranked constraints will be the optimum, no matter how many total violations it has. A variety of theorists have overcome this kind of problem in OT with a simple theory of constraint composition, local conjunction (Legendre et al. 1998, Smolensky 1995). Local Conjunction Theory (LCT) claims that any two constraints may be conjoined to form a

new constraint, violated when both conjunctions are violated within a given domain. An oft-appealed to extension of LCT is the theory of *local self-conjunction*, identical to LCT in all ways except that $C_1=C_2$ in the above definition. Consider the following self-conjunction of LINEARITY.

(17) (LINEARITY & LINEARITY)$_{segI}$ = LIN$^2_{segI}$

> Violated when two (or more) distinct violations of LINEARITY occur for a single string-initial segment.

The domain of conjoined violation is here the string-initial segment, a fairly natural domain for LINEARITY, a constraint whose violations are counted by precedence reversals among segments.[8] LIN$^2_{segI}$ is violated once for each segment that reverses its precedence w.r.t. other segments *more than once*. We see in tableau (18) below how this formulation of precedence faith leads to a simple account of the Tagalog problem.

(18) LIN^2 rules out hyperinfixation in Tagalog

/um+mahal/	LIN$^2_{segI}$	OCP	MPARSE	LINEARITY
a. m-um-ahal		*!		**
b. mah-um-al	*!			******
c. mahal-um	*!			*********
☞ d. Ø			*	

In candidate (b), *mah-um-al*, the only segments violating basic LINEARITY are [u] and [m]; each violates it three times. Turning to LIN$^2_{segI}$, input string-initial [u] reverses precedence relations with three root segments, for one violation of the conjoined constraint. The violations of (c) are identical on LIN$^2_{segI}$ and vertiginously worse on LINEARITY, leaving the null parse the only candidate not marked by the undominated OCP constraint.

Thus we have a simple extension of our theory of precedence faith that rules out hyperinfixation straightforwardly. As we will see in further discussion of potentially

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[8] Segments are here being construed as, among other things, sets of precedence relations. See Chapter 2 for further discussion.

hyperdislocational phenomena in Chapter Two, this approach to hyperinfixation solves a problem inherent to any dislocational approach to PoE without the need for complex hierarchies of morpheme-specific alignment constraints (Klein 2002, McCarthy 2002) or post-EVAL filters which render certain optima non-utterable on a language-specific basis (Orgun and Sprouse 1999).

3.2. Metathesis/infixation dependency

The LINEARITY constraint does not distinguish precedence reversals among segments of different morphemes from those among segments coincident to the same morpheme—it simply prefers outputs with the least gross segment reversal possible. This means that formal accounts of infixation must be particularly sensitive to the violation profiles of metathetic candidates (and accounts of metathesis v.v.). We can see this quite clearly in the Tagalog analysis presented above, where ONSET could be perfectly well satisfied by prefix-internal metathesis.

(19) Incorrect prediction of {ONSET >> LINEARITY}

	/um+sulat/	ONSET	LINEARITY
	a.　um-sulat	*!	
☞	b.　s-um-ulat		**!
☛	c.　mu-sulat		*

Such morpheme-internal metathesis does not occur in Tagalog (at least not in the *um* paradigm). Thus some other mechanism must then be called upon to rule out the unattested metathesis candidate (c) above—i.e., something must prevent the alternation of infixation with morpheme-internal metathesis.

In keeping with our basic program of restricting dislocational processes with formular variants of LINEARITY, we will propose that a homomorphemic variant of the constraint is sufficiently high-ranked in Tagalog to prevent such alternation.

(20) HOM(omorphemic)LIN(earity)

Homomorphemic precedence relations in S_1 are preserved in S_2.
If $x, y \in S_1$ **and** $x, y \in$ **M**, then $x < y$ iff $\neg [Y' = \{y' \in S_2 \mid y' \Re y\} < X' = \{x' \in S_2 \mid x' \Re x\}]$.

HOMLIN preserves exactly those precedence relations internal to a morpheme, making no consideration of the precedence relations obtaining between segments of distinct morphemes.

(21) Infixation ≠ Metathesis: /um+tawag/ → [tu.ma.wag], *[mu.ta.wag]

/um+tawag/		HOMLIN	ONSET	LINEARITY
a.	um.ta.wag		*!	
b.	tu.ma.wag			**
c.	mu.ta.wag	*!		

Observe that the {HOMLIN >> ONSET} ranking of (14) has the additional property of ruling out short- or long-range dislocation in underived contexts. ONSET and DEP must dominate LINEARITY in Tagalog in order for infixation to occur, we allow for the possibility of segment re-order to avoid onsetless syllables elsewhere. Such would be observable in the language under affixation, for example a root /ayad/ which surfaces as [daya] in isolation but [mag-ayad] in the actor focus infinitive. Tagalog has no such alternation, and this fact is capture quite clearly with the ranking of HOMLIN and ONSET above DEP.

(22) HOMLIN limits free dislocation of root material in underived contexts

/ayad/		HOMLIN	ONSET	DEP	LINEARITY
a.	ayad		*!		
b.	ʔayad			*	
c.	daya	*!**			***

Under the current theory, infixation and metathesis are no longer freely separable phenomena. And as further examination of infixation and metathesis in Tagalog will demonstrate, care must be taken in restricting the range of dislocational processes in particular grammars, since infixation and metathesis occur exclusively of one another in two cases and interact with each other in yet a third.

(23) Three kinds of segmental dislocation in Tagalog

    a. <u>Heteromorphemic infixation</u>
        /um+sulat/ → s-um-ulat 'to write.SF'

    b. <u>Homomorphemic metathesis</u>
        /talab+an/ → tabl-an 'take effect.OF'

    c. <u>*Both* hetero- and homomorphemic metathesis</u>
        /in+ligaw+an/ → ni-ligaw-an ~ l-in-gaw-an 'RLS.woo.GF'

We will see in Chapter Two that the character of the markedness constraints driving each alternation is crucial in predicting the range of attested dislocations in the language.

Limitations on the range of possible dislocations in a language will lead to a furthered understanding of how dislocational processes are construed in particular grammars, and a rough typology of available dislocation types emerges in the ranking of HOMLIN, LINEARITY, and some markedness constraint.

(24) Simplified typology of dislocation types

	Ranking(s)	*Dislocation occurs…*	*Examples*
a.	M >> LINEARITY, HOMLIN	across the board	Fur Metathesis (Jakobi 1990)
b.	HOMLIN >> M >> LINEARITY	in derived environments	Georgian Metathesis (Butskhrikidze and van de Weijer 2001); Kashaya Infixation (Buckley 1997)
c.	LINEARITY >> M; HOMLIN	not at all	n/a

Homomorphemic constraint formulation will have an important role to play in account of bitropic affix affects and morphologically derived environment effects, as we will see in §3.4.

3.3. Phonological dislocation only

For the dislocation ranking schema (6), we gave examples of C as a phonological markedness constraint. C cannot, in fact, be a faithfulness constraint construed over the same dimension of faithfulness as LINEARITY, because no set of faithfulness constraints alone may result in precedence reversal (or any other deviation from identity in the I-O mapping). In the absence of any other morphological imperative for exponence to

gravitate to particular positions in the output, the prima facie prediction of the theory is that dislocation only occurs for phonological reasons—i.e., at the behest of some undominated phonological markedness constraint.

However, it is clear that there exist cases of infixation which seem to follow no observable drive toward phonological well-formedness; many, in fact, result in output structures marked along a variety of phonological lines. Such infixation processes are exactly those we observed in fig. (2) of the last section. In Leti Nominalization (Van Engelenhoven 1995), for example, a nominalizing affix *ni* appears prefixally in vowel-initial roots, but infixally in C-initial roots; compare for example /ni+kaati/ → [k-ni-aati] 'carving' with /ni+atu/ → [ni-atu] 'knowledge'. Various authors (Blevins 1999, Yu 2003) have observed that not only does Leti infixation not seem to follow from principles of prosodic well-formedness, the output of the process in the C-initial cases is highly marked along multiple phonological axes, in fact producing an output structure with a complex onset and vowel hiatus unnecessary in the obvious competing candidate *[ni-kaati]. In the absence of a markedness constraint capable of driving the morpheme to a position internal to the segmentism of the root, the current theory is at a loss to explain the phenomenon.

The basic intuition we will work from is that base and derived forms in these cases maintain an analogical consistency of initial segmentism.[9] The nominal form of the verb *kaati* in Leti, for example, retains *k* in initial position because the verb from which it is derived begins with *k*. In OT, we capture analogical relationships between

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[9] This approach to aprosodic morphology began with McCarthy & Prince's (1993a, b) approach to infixation in Dakota.

morphologically related output forms through transderivational (output-output) faithfulness constraints (Benua 1998, Burzio 2002).

(25) Correspondence relations in Leti

/kaati/　　$\rightarrow_{IO}$　[kaati]
　　　　　　　　　$\downarrow_{OO:Verb\text{-}Derived\ Nominal}$
/ni+kaati/　$\rightarrow_{IO}$　[k-ni-aati]

Where a familiar faithfulness constraint, L-ANCHOR (McCarthy and Prince 1995), holds over the 'Verb-Derived Nominal' correspondence relation and dominates LINEARITY, infixation will occur, regardless of the performance of the resulting candidate on various low-ranked phonological markedness constraints.

(26) L-ANCHOR-$seg_{S1\text{-}S2}$

Let $Edge(\Sigma, L)$ = the segment standing at the left edge of Σ.
If $x = Edge(S_1, L)$ and $y = Edge(S_2, L)$ then $x\Re y$.

This is a crucial first step to a larger account of aprosodic infixation. It is apparent that more is required of such a theory of infixation, however, as we can see from consideration of other cases of infixation not conditioned by phonological markedness. In Katu Nominalization (Costello 1998), for example, a nominalizing affix r appears uniformly over not just a single segment, but rather over the initial σ of the root.

(27) Immobile Infixation over initial σ in Katu (Costello 1998)

  a. C-initial roots: σ_1 infixation
      verb　　　*noun*
      katas　　　ka-r-tas　　　'name.INF/name.N'
      saveeng　　sa-r-veeng　　'be.between.INF/place.between.N'
  b. V-initial roots: σ_1 infixation
      achia　　　a-r-chia　　　'advise.INF/things.given.N'
      aloom　　　a-r-loom　　　'offer.gift.INF/gift.offered.N'

While it is readily apparent that constraints on sonority-sequencing and onset complexity could, ranked over LINEARITY, rule out over-initial-C infixation and simple prefixation for an input /r + katas/, it is in no way apparent how the same ranking could produce infixation in the case of vowel initial words, [r-aloom] being a perfectly reasonably

output word on all relevant dimensions of markedness. Even allowing that anchoring forces the root-initial vowel to the left edge of the nominalized word to ensure analogical parity with respect to its derivational base, there remains no explanation for the failure of the infix to simply appear within the onset of consonant-initial roots like *katas*, Costello et al. (1998) reporting that stop-liquid onsets are perfectly permissible in the language's syllable canon. In the absence of a markedness constraint capable of driving the morpheme exactly one syllable into the segmentism of the root, the current theory is at a loss to explain the phenomenon, as shown below.

(28) Failure of σ-infixation

	mappings	L-ANCHOR$_{OO}$ {[a.loom], [ka.tas]}	LINEARITY
a.	/r + aloom/ → a-r-.loom ~ *r-a.loom	W	L
☞ b.	/r + katas/ → ka-r-tas ~ *k-r-atas		L

A conspiracy of O-O faithfulness constraints of the ANCHOR(ing) and CONTIG(uity) variety may crucially conflict with LINEARITY to produce such affixation. Consider the following constraint schemas, modeled after the domain contiguity constraints of Lamontagne (Lamontagne 1996).

(29) Contig-*PCat*

> The portion of S$_1$ standing in correspondence forms a contiguous string in S$_2$.
> Domain($\Re$) is a single contiguous string in every *PCat* of S$_1$.

Where anchoring and contiguity are undominated, the initial σ is proscribed as a domain of prosodic invariance across two morphologically related words.

(30) Immobile infixation over σ

	/r + katas/	L-ANCHOR$_{OO}$ [ka.tas]	CONTIG-σ$_{OO}$ [ka.tas]	LINEARITY
☞ a.	ka-r-tas			**
b.	r-katas	*!		
c.	k-r-atas		*!	*

Together with constraints of the anchoring variety, we now have a theory of aprosodic infixation which makes certain predictions about the range of possible infixation patterns occurring without otherwise observable phonological impetus. Namely, where domain contiguity constraints may range over the prosodic categories syllable and foot, and anchoring constraints ranging over segments, we predict that, relative to an O-O corresponding edge, an infix may appear exactly one segment, syllable, or foot into the segmentism of a root.

(31) Available kernels of infixation

$$\boxed{\begin{array}{cc} \text{ANCHOR-}seg & \text{CONTIG-}\{\sigma, \text{Ft}\} \\ & \smile \\ & \text{LINEARITY} \end{array}} \quad \Rightarrow \quad _{\text{edge}}[\,\left\{\begin{array}{l} seg \\ \left[\begin{array}{l}\sigma\\Ft\end{array}\right] \end{array}\right\}\text{-infix-}\ldots]$$
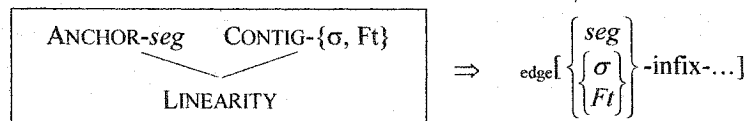
The predicted range of possible infixation types fares well against the typology of known infixation types shown below (representative examples from the larger typologies of Yu (2003) and Moravscik (2000)), each of the prosodic categories subject to the theory in (31) attested as a possible kernel of infixation. It will be the challenge of Chapter Three to investigate a number of these cases in further detail.

(32) Attested infixation-over-category

Cat	Periphery	language(s)
seg	initial	Cambodian (Stemberger and Bernhardt 1998) Leti (Blevins 1999) Arabic (McCarthy 1981) Sundanese (Benua 1998)
	final	Balantak (Broselow 2001) Coeur d'Alene (Reichard 1959) Cupeño (Hill 1970)
σ	initial	Dakota (Shaw 1980) Katu (Costello 1998) Choctaw (Nicklas 1975)
	final	Afar (McCarthy and Prince 1986) Alabama (Montler and Hardy 1991) Hua (Haiman 1980)
Foot	initial	English (McCarthy 1982) Samoan (Mosel and Hovdhaugen 1992)
	final	Ulwa (McCarthy and Prince 1993a)

3.4. No bitropic affixation

Morphemes are uniquely positioned in the input and, as we have seen, phonological and analogical conditions may force dislocation of surface exponence. This makes a unique prediction about the space of possible affixation types. Namely, we do not expect morphemes to gravitate to opposite edges of the output string for reasons independent of phonological well-formedness. This is an explicit prediction of approaches to PoE couched within Alignment Theory (McCarthy and Prince 1993b). Where left- and right-oriented alignment constraints are operative on a particular morpheme for a particular phonological or morphological category and ranked above a number of common OT faithfulness constraints, we allow a number of undesireable effects. Low-ranking of against segment contiguity will allow the affix to break across the segmentism of the root. Similary, if anti-deletion constraints are least-ranked in the grammar, the theory allows for morpheme that simply disappear in the I-O mapping, both alignment constraints being vacuously satisified in the affix's absence. If a constraint against I-O segment fission is least-ranked, we allow for a kind of faux reduplication in which a morpheme occurs in its entirety at both edges of the output word.

(33) Potential bitropic affix effects

$$
\text{/raka}_{root} + \text{bu}_{afx}\text{/} \quad
\begin{cases}
\text{[b-raka-u]}_{word} & \textit{circumfixation} \\
\text{[raka]}_{word} & \textit{morpheme deletion} \\
\text{[bu-raka-bu]}_{word} & \textit{reduplicative circumfixation}
\end{cases}
$$
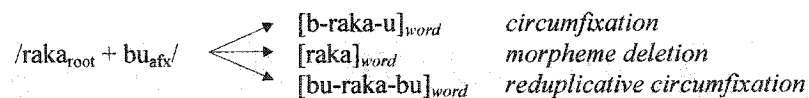
LINEARITY constraints, on the other hand, force gravitation of every morpheme to a unique input position; anchoring and contiguity constraints may force affixes to appear outside of a particular prosodic domain, but imply no gravitation between a morpheme and a string edge opposite from its input orientation. The theory thus explicitly rules out *bitropic affixation*, wherein a particular affix gravitates simultaneously to opposite edges

of an output word without phonological explanation. This would seem at first blush to be a positive state of affairs.

There is, however, one patterned set of exceptions that would seem to call our theory into question. In the following examples, the exponence of a morpheme is expressed *only* through the appearance of feature changes in the segments of the root. In Terêna, root segments are nasalized; in Etsako, root low tones are made high. The cases are interesting for having this character of featural affixation, but are particularly so for our purposes because, in each case, the featural exponence of the morpheme must (modulo certain phonological blocking conditions we will discuss at greater length in Chapter Four) spread from its underlying position all the way to the opposite edge of the output string—even though such spreading is not attested elsewhere in the language!

(34) Bitropic morphemes?

    a.   Terêna Nasal Spread (Akinlabi 1996, Bendor-Samuel 1960)
         Left to right spread: /N + arine/ → ãrĩnẽ, *arinẽ 'sickness.1SG'
         Blocked monomorphemically: /arine/ → arine, *arinẽ

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

The approach we will take to such phenomena is to argue that there in fact is a phonological motivation for the observed feature spreading, but it is obscured by a limiting factor: the process only occurs in morphologically derived environments. In Terêna, for example, the contention is that there is a simple markedness constraint, call it SPREAD, that requires nasal features generally to be associated to all segments of the output word. This constraint dominates all faithfulness constraints which would prevent the exponence of the featural affix from fusing with that of the root, in particular UNIFORMITY, a constraint on input-output identity of simultaneity relations. A complete

theory of such alternations must determine why fusion—if fusion is conditioned by a generic markedness constraint—only occurs in the 1SG inflection

The same *homomorphemic* constraint specification necessary in Tagalog for the LINEARITY constraint will, when applied to UNIFORMITY, derive exactly the correct result. Consider a HOMUN below, which penalizes any fusion of elements belonging to the same morpheme, but is never violated by merger of segments of distinct input morphemes.

(35) 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 = y.

Where SPREAD is ranked between HOMUN and UNIFORMITY, we find an emergence of unmarked structure in derived contexts. One morpheme—the 1SG nasal feature in the Terêna example—may merge with another, even though no such merger occurs internally to individual morphemes.

(36) Derived and non-derived forms compared

mappings	HOMUN	SPREAD	UNIFORMITY
a. non-derived blocking /arine/ → arine ~ ãrĩẽ	W	L	W
b. derived nasal harmony /N+arine/ → ãrĩnẽ ~ ãrĩnẽ		W	L

We thus reduce Terêna nasal harmony (and Etsako high tone spread, by extension) to a simple morphological Derived Environment Effect (MDEE), a commonly occurring phenomenon well noted in the phonological literature since Kiparsky (1973). In Chapter Four, we will go on to show that the basic ranking argument made in the Terêna case extends naturally to other MDEEs of a wide variety of processual types. We will see that, for every standard relational faithfulness constraint—LINEARITY, UNIFORMITY, CONTIG, and a fourth preserving input autosegmental association relations, CONSISTENCY—there exists a homomorphemic variant which, when in a TETU ranking

with its generic source constraint and some phonological markedness constraint, will attest a well-known case of MDEE.

(37) TETU Ranking Schema for Morphological Derived Environment Effects

$\{$HOM$F_{rel} \gg M \gg F_{rel}\}$

We will give various accounts from the OT literature which instantiate this basic ranking in for MDEE cases of epenthesis and fusion (nasal harmony) above and beyond the Terêna case, and will as well as present accounts of metathesis and deletion which fall to the same basic argumentation. We will present an extended case study of assimilatory MDEE in Korean Palatalization (Cho and Sells 1995, Cho 2001, Kiparsky 1993) both for the purposes of elaborating on the utility of the CONSISTENCY constraint and comparing the approach with earlier accounts couched within serial OT and articulatory phonology-based OT.

(38) Various types of MDEE

MDEE	Phenomenon	Examples
Assimilation	Korean Palatalization (Cho and Sells 1995, Cho 2001, Kiparsky 1993)	a. /mat$_1$+i$_2$/ → mac$_1$i$_2$, *mat$_1$i$_2$ b. /əti/ → əti, *əci
Epenthesis	Chukchee schwa epenthesis (Kenstowicz 1994, Krause 1980, Landman 1999)	a. /miml+qaca/ → mimləqaca, *mimlqaca b. /weem+lq+n/ → weeməlqən, *weemələqən
Deletion	Turkish Velar Deletion (Inkelas et al. 1997)	a. /soka$_1$k$_2$+a$_3$/ → soka$_1$■-a$_3$, *so■ak-a, *so■a■-a b. /sokak/ → sokak, *so■ak
Fusion	Indonesian Nasal Substitution (Pater 1999)	a. /məN$_1$+p$_2$ilih/ → məm$_{12}$ilih, *məm$_1$p$_2$ilih b. /əm$_1$p$_2$at/ → əm$_1$p$_2$at, *əm$_{12}$at
Metathesis	Georgian v-metathesis (Butskhrikidze and van de Weijer 2001)	a. /xar+va/ → xvr-a ~ *xr-va b. /rgol+i/ → rgol-i ~ *grol-i

4. Faith vs. Alignment

A number of formal strengths of the proposed theory become apparent in comparison with its predecessor. In the remainder of this chapter, we will see that such a theory is particularly desirable in OT in compared to its predecessor, a markedness-based theory of

PoE formulated under the precepts of Generalized Alignment (McCarthy and Prince 1993b). It will be shown that the precedence faith theory preserves morpheme-ordering universals in factorial typology where the alignment-based theory cannot. It will be shown that the faithfulness theory predicts semantic contrast by morpheme re-order, a possibility lost under the alignment approach. And finally we will see that the precedence faith theory is entailed by a necessary proscription against morphologically-indexed markedness constraints more generally.

4.1. An argument against Parochial Alignment

Since the earliest work in OT, it has been broadly understood that alignment theoretic markedness constraints enforce the surface affiliations of morphemes as pre- or suffixal; morphemes are assumed to be *unordered* in the input. As a result, morpheme position is not preserved in any sense, but rather determined exclusively by the rankings of output-oriented constraints such as the following.

(39) Examples of gradient, morpheme-specific alignment

ALIGN($[um]_{Af}$, L, Stem, L) ≡ 'The affix *um* occurs stem-initially, is a prefix' (Prince and Smolensky 1993)
ALIGN(1SG, L, Mwd, L) ≡ 'The 1st person singular morpheme is a prefix.' (Akinlabi 1996)
NOINTERVENING(*ta*; R) ≡ 'Nothing intervenes between *ta* and the right edge of the word.' (Zoll 1998)

This basic theory of PoE has influenced the vast majority of current theories of phonologically- and prosodically-conditioned morpheme dislocation, i.e., the large body of work that has proceeded from the theory of Prosodic Morphology framed in McCarthy and Prince (1993ab, et seq.). Implicit in the theory is the understanding that *every* morpheme must be subject to one or more such constraints. Were this not the case, we might reasonably expect the conceptual implausibility of fixed-segment morphemes that simply have no morphological affiliation of any kind, appearing randomly at a given

word edge. As we will see, this results in an unfortunate consequence for universals of morpheme order such, for example, as the one below.

(40) A Universal of Nominal Structure: $[\text{Noun} < (\text{Number}) < (\text{Case})]_{\text{Word}}$

Greenberg (1966) presents typological evidence from a 30-language survey suggesting that, if a nominal is overtly marked for both case (phonologically overt, either morphological or structural) and number, the number marker will always occur between the noun head and the case marker. In kind, Hawkins and Gilligan (1988), in their survey of over 200 languages conclude that, where a nominal is overtly marked for case, the morpheme will be suffixal. Bybee (1985) argues Greenberg's universal to be a function of the semantics of the involved affixes; Hawkins and Gilligan's universal is a likely result of a universal tendency for morphological heads to occur finally within the word, c.f. the Right-Hand-Head rule, Williams (1981). For our purposes, the origin of the universal is irrelevant. Whatever its ultimate explanation, the universal's result is a single statistically significant ordering of the morphemes, out of a logically possible six. The percentage chance of the single morpheme ordering occurring randomly in even Greenberg's relatively small survey of 30 languages is approximately $(0.16)^{30}$ (or 133 preceded by a decimal point and some 21 zeroes); the number is highly suggestive of some deep principle at work.

What predictions does the alignment theory make with respect to the universal? Since every morpheme effectively competes with every other morpheme for its edge-oriented position within the word or stem, factorial typology of morpheme-specific alignment predicts any of the logically possible surface arrangement of the morphemes. We see this

below, assuming both right and left alignment constraints for each morpheme (K = Case, N = Noun head).[10]

(41) Factorial typology; Align-L/R$_{Morpheme}$ ≡ Align(morpheme, L/R, PrWd, L/R)

	Surface Order	Ranking
a.	N-K-Num	ALIGN-L$_N$, ALIGN-R$_{NUM}$ >> ALIGN-R$_N$, ALIGN-L$_K$, ALIGN-L$_{NUM}$, ALIGN-R$_K$
b.	K-N-Num	ALIGN-L$_K$, ALIGN-R$_{NUM}$ >> ALIGN-R$_N$, ALIGN-L$_N$, ALIGN-L$_{NUM}$, ALIGN-R$_K$
c.	K-Num-N	ALIGN-R$_N$, ALIGN-L$_K$ >> ALIGN-R$_{NUM}$, ALIGN-L$_N$, ALIGN-L$_{NUM}$, ALIGN-R$_K$
d.	Num-K-N	ALIGN-L$_{NUM}$, ALIGN-R$_N$ >> ALIGN-L$_K$, ALIGN-R$_{NUM}$, ALIGN-L$_N$, ALIGN-R$_K$
e.	Num-N-K	ALIGN-L$_{NUM}$, ALIGN-R$_K$ >> ALIGN-L$_K$, ALIGN-R$_{NUM}$, ALIGN-L$_N$, ALIGN-R$_N$
f.	N-Num-K	ALIGN-L$_N$, ALIGN-R$_K$ >> ALIGN-R$_N$, ALIGN-L$_K$, ALIGN-R$_{NUM}$, ALIGN-L$_{NUM}$

As a result, the universal of (40) is at best an accident, with cross-linguistically rerankable constraints in the phonological component positioning morphemes independently of any morphosyntactic or semantic principles. The predictive power of any morphosyntactic/semantic theory of morpheme order is thus undermined considerably.[11]

If we abandon the parochial alignment theory, however, and position morphemes by relational faithfulness only, this problem evaporates. Where a single morpheme order is presented to phonological evaluation by the morphosyntax, LINEARITY will prefer only the faithful candidate, even when relativized to particular morphemes.[12]

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[10] Note that this is actually a limiting assumption, since the fuller expansion of the GA constraint schema for a particular morpheme potentially includes alignment of the affix to L/R edges of all prosodic categories.

[11] McCarthy and Prince (McCarthy and Prince 1995) argue that the M-/P-Scope concordance condition—roughly stating that the scopal relations of morphemes are preserved in the scopal relations of their exponents in the output—as a function of GEN does narrow down the typology somewhat. It would in this case rule out outputs (a) and (d) above since in each the exponence of input Num c-commands the exponence of K in the output. Scopal relations being what they are however, nothing in the M-/P-Scope proposal rules out the structural 'mobile' effect found in outputs (b-c) and (e).

[12] Such would presumably necessary in cases where, within a single language, the same segmental structure infixes or does not infix on a solely morphological basis, as for example in Atayal, where a base *qul* 'snatch' may be marked both *q-m-ul* (animate actor focus) and *m-qul* (animate actor focus, reciprocal). Violations of LINEARITY$_{Morpheme}$ are only calculated for those precedence relations in which the indexed morpheme is a term; thus LINEARITY$_K$ preserves only the {Num<K, N<K} precedence relations. More will be said of lexically-index faithfulness in §4.3.

(42) A universal preserved

/N<Num<K/		LINEARITY$_K$	LINEARITY$_{NUM}$	LINEARITY$_N$
a.	N-K-Num	*	*	
b.	K-N-Num	**	*	*
c.	K-Num-N	**	**	**
d.	Num-K-N	*	*	**
e.	Num-N-K		*	*
☞ f.	N-Num-K			

NB: Single-segment morphemes assumed for tabular clarity.

Obviously, constraints dominating LINEARITY will affect surface morpheme order; we will see evidence of this in numerous cases throughout the remainder of this chapter. The key distinction between the two theories is that, under the relational faithfulness approach, morphosyntactically conditioned morpheme order can only be perturbed in the phonological component by *phonological* constraints, like ONSET. In the absence of morpheme-specific alignment, there remains in the phonological component of grammar no markedness constraint capable of dislocating a morpheme from its input position for non-phonological reasons. Thus morpheme order universals will never be completely obscured through the interaction of a potentially vast set of class- or lexeme-specific alignment constraints, and designation of purely morphological information like pre-/suffixhood may be relegated safely to the input. On the strength of these observations, we will contend henceforth that precedence faithfulness constraints must supplant positioning constraints of the alignment theory in all cases.[13]

4.2. An additional argument for {F >> M}

Rackowski (1999) makes a valid observation concerning an additional prediction of the alignment theory: that, without additional formal mechanisms like constraint ties, strict domination predicts that, for a set of morphemes and a set of alignment constraints

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[13] The present work does not take issue with alignment in its more general uses, for example in the alignment of various prosodic constituents with each other and with un-indexed morphological category boundaries.

indexed to them, there will be a single ranking of the alignment constraints in a grammar and thus a single possible ordering of the morphemes. Rackowski observes that, if morpheme order is governed by the morphological component of grammar, and faithfulness preserves PoE in the output, this problem evaporates, given a sufficiently loose theory of morphosyntactic ordering. She presents two cases to defend her claim, the first in Tagalog reduplication, and the second in Turkish (44).

In Tagalog, a completive morpheme (a reduplicant) surfaces at any position between the root and the word-initial aspectual morpheme *ma*.

(43) Tagalog Reduplication (Rackowski 1999)

    ma-<u>kaa</u>-ka-pag-pa-hintay
    ma-ka-<u>paa</u>-pag-pa-hintay
    ma-ka-pag-<u>paa</u>-pa-hintay
    ?ma-ka-pag-pa-<u>hii</u>-hintay
    ABIL-TEL-TRANS-CAUS-CMPLT-wait
    'be able to cause someone to wait'

Similarly in Turkish, the plural marker may be found ultimately, penultimately, or antepenultimately in the word. Variation in this manner appears to purely morphological, having nothing to do with phonological constraints on the grammar.

(44) Turkish Pluralization (Good and Yu 1998)

    gid-iyor-du-ysa-<u>lar</u>
    gid-iyor-du-<u>lar</u>-ysa
    gid-iyor-<u>lar</u>-du-ysa
    go-PROG-PL-PST-COND
    'If they were going'

If a phonological grammar is a total ranking of constraints, and some number of those constraints align a set of morphemes with respect to output edges, there must exist a *unique* ordering of those morphemes. Without further apparatus, then, the alignment theory actually rules out variation of the type found above, regardless of conditions on the morphosyntax.

Under the theory advocated here—and under the slightly less articulated, but allied theory proposed by Rackowski—however, faithfulness to input precedence simply preserves the variable ordering mandated by the subcategorizational requirements of the morpheme; where lexical subcategorization or syntactic principle allows for variation, faithfulness will allow that variation to occur. No additional formalism is necessary, and the somewhat contentious matter of constraint ties may be put off for a more crucially relevant problem.

There are two problems with Rackowski's argument, however. First, numerous authors have presented viable means of effecting free variation in OT. Constraint ties of various sort, and differentiation constraints (Horwood 1999) all incorporate optionality into OT's bag of formal tricks, and all are capable of producing the kinds of variation found in Turkish and Tagalog. A possible, alignment-friendly solution to the problem is found in the use of global constraint ties (Itô and Mester (1996); see Müller (1999) for a detailed discussion of various types). With the added formal encumbrance of crucial non-ranking between constraints, we might account for the positional variation in Turkish as shown in (45) below.

(45) ALIGN-R(lar, Pwd) unranked w.r.t. {ALIGN-R(ysa, Pwd) >> ALIGN-R(du, Pwd)}

Subgrammar (a): *lar*-initial ranking

cand	ALIGN-R$_{lar}$	ALIGN-R$_{ysa}$	ALIGN-R$_{du}$
-lar-du-ysa	**		
-du-lar-ysa	*		*
☞ -du-ysa-lar		*	**

Subgrammar (b): *lar*-medial ranking

cand	ALIGN-R$_{ysa}$	ALIGN-R$_{lar}$	ALIGN-R$_{du}$
-lar-du-ysa		**	
☞ -du-lar-ysa		*	*
-du-ysa-lar	*		**

Subgrammar (c): *lar*-final ranking

cand	ALIGN-R$_{ysa}$	ALIGN-R$_{du}$	ALIGN-R$_{lar}$
☞ -lar-du-ysa			**
-du-lar-ysa		*	*
-du-ysa-lar	*	**	

Second, it is not entirely apparent that, in the cases upon which Rackowski stakes her claims, there is a credible morphosyntactic cause for the order variation. Good and Yu (Good and Yu 1998), in their account of the Turkish facts, ascribe the variation to linguistic accident—there simply are, under their account, no constraints of Turkish, syntactic or phonological, capable of distinguishing one order from the other—alignment constraints positioning the plural morpheme simply make no distinction between the different levels of structure at which the morpheme may be edge-aligned. It seems tendentious to ascribe free variation to the morphosyntax when the facts of the morphosyntax are entirely opaque to investigation.[14]

Rackowski similarly argues the Tagalog facts to follow from a morphosyntactic scrambling rule—based generated under AspP, the reduplicative morpheme may optionally raise to either of two potentially available vP's. It is observable, however, that a meaningful morpho-phonological generalization is obscured by this account, namely the fact that the reduplicant in all cases copies a stem-initial syllable, a constituent of notably high morpho-phonological salience. It doesn't seem that Rackowski's theory

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[14] Good and Yu's basic approach demonstrates that there *is* a means of deriving optionality through the use of a totally-ordered set of alignment constraints in a grammar: specify the alignment constraints in such a way as to ensure that they are satisfied by positioning of the morpheme at any of a number of structurally identical edges in the output string. As with all approaches to optionality that rely crucially on freely varying candidates having identical violation profiles, such an account is belied by the possibility of lower ranked markedness constraints (possibly constraints whose effects are not even otherwise observable in the grammar) rendering one of the variants less marked than the others. In the Turkish case, for example, a simple OCP constraint against syllable-adjacent low vowels, though ranked so low in the grammar as to have no observable effects elsewhere, would predict a candidate with the ordering *-lar-du-ysa* to be the optimum, inspite of its equal treatment with respect the other orderings on the alignment constraints of the grammar. Thanks to A. Prince for discussion on this subject.

(and, by extension, mine) offers any more insightful a justification of the variation than would a theory that said "Align RED to the left edge of any head syllable," with variation resulting from the placement of secondary stress in the output word.

Nevertheless, we must claim some some justification Rackowski's basic argument, if not on these grounds, then on the grounds that, in an Optimality Theoretic system, the ranking {F >> M} is required in any system that allows surface contrast of meaningfully distinct structures. Where markedness dominates faithfulness, variant structures in the input are neutralized to a single least-marked structure in the output. Where faithfulness dominates markedness, contrast emerges. Do meaningful contrasts exist in morpheme order? Certainly. Spencer (1991) observes the following cases from Equadoran Quechua, where re-ordering of reciprocal and causative suffixes signals a notable difference in interpretation.

(46) Morpheme Order Contrast in Equadoran Quechua

maqa-naku-ya-chi-n
beat-rec-dur-caus-3
'he is causing them to beat each other'

maqa-chi-naku-kya-n
beat-caus-rec-pl-3
'they let each other be beaten'

As these data show, there exist cases wherein it is not simply the segmental contents of morphemes which signal contrast in lexical meaning, but additionally the ordering (or possibly scopal) relationships between those objects that marks a different interpretation. If contrast is allowed in OT grammars by a ranking of {F >> M}, it is thus entirely natural to posit the involved faithfulness in this case to be faithfulness to the ordering of morphemes in input representations.

Consider the alternative under the alignment model. Here there exist multiple alignment constraints, each attuned to one of the involved morphemes. It is immediately apparent that, if the involved morphemes are positioned by such constraints, a different ranking is required for each word.

(47) {ALIGN-R(REC) >> ALIGN-R(CAUS)} => beat-caus-rec-pl-3

     {ALIGN-R(CAUS) >> ALIGN-R(REC)} => beat-rec-dur-caus-3

Under the thesis of Strict Domination, such an arrangement is, of course, impossible in OT. In classical OT there must be only one ranking of constraints in a particular language's grammar and, since the alignment constraints above are effectively divorced from considerations of scope, head movement, feature checking, interpretation, or any other possible syntactic or semantic mechanism that might predict the meaning contrast on some principled grounds, they should render a unique ordering of the involved morphemes. Note too that there is nothing optional about the involved order changes. No appeal to constraint ties, free ranking, etc. will salvage the simple ranking paradox produced by the alignment model in this case—constraint ties produce free variation, not contrast. In fact, the only solution would seem to be to argue that one of the involved morphemes is in fact two; i.e., that there is for example a 'naku$_1$' which must be ordered before 'chi', but a lexically distinct but homophonous morpheme 'naku$_2$' which must be ordered after.

(48) ALIGN-R(REC1) >> ALIGN-R(CAUS) >> ALIGN-R(REC2)

Such an approach seems highly suspect, if for no other reason because it is completely ad hoc. In comparison, however, the F_{rel} approach produces the observed order-based contrasts with a single, simple ranking: {LINEARITY >> M}, where M is any constraint that might cause dislocation of phonological material in the output string. In no sense can

LINEARITY—or even multiple, morphologically indexed instantiations of LINEARITY—produce the ranking paradox observable in the alignment approach.

4.3. A larger argument: there are no indexed markedness constraints

Yet a third argument against the alignment theory of morpheme order is found in a larger argument against morphological indexation of markedness constraints generally. McCarthy and Prince (1999) and Prince (1997) present a compelling argument that, if we are to prevent back-copying of emergent templatic conditions on reduplicative bases,[15] we must assume that only faithfulness constraints can refer to morphological material in a parochial manner.

The argument runs as follows. Consider a language wherein codas emerge freely in fixed-segment morphemes, but are banned from reduplicants.[16] The grammar of such a language instantiates the Emergence of the Unmarked ranking of McCarthy and Prince (1994): where NOCODA is sandwiched between undominated MAX_{IO} and subordinated MAX_{BR}, only unmarked CV syllables will be allowed in the reduplicant.

(49) Reduplicative TETU: Codas banned from RED

mappings	MAX_{IO}	NOCODA	MAX_{BR}
a. /pak/ → pak ~ *pa∎	W	L	
b. /RED + pak/ → pa∎-pak ~ *pa∎-pa∎		W	L

Against these mappings, consider an impossible language, one in which the emergent unmarkedness of the reduplicant is backcopied onto the base, i.e., /pak/→[pak], but /RED+pak/→[pa∎pa∎]. As the following factorial typology for the three constraints shows, there is no ranking which will produce the undesired [pak]/*[pa∎-pa∎] pair—the

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[15] This is known as the Kager-Hamilton Problem; we will discuss it further in a slightly different context in Chapter Two.

[16] Tagalog is such a language, ex. *mag-hi-hindot*.

backcopy candidate is harmonically bounded by another candidate in all grammars in which NoCODA does not apply across-the-board.

(50) Possible grammars/mappings

	Type	Grammar(s)	Mappings
a.	TETU	{Max$_{IO}$ >> NoCODA >> Max$_{BR}$}	/pak/ → pak /RED + pak/ → pa■-pak
b.	Full correspondence	{Max$_{IO}$, Max$_{BR}$ >> NoCODA}	/pak/ → pak /RED + pak/ → pak-pak
c.	Across-the-board unmarkedness	{NoCODA >> Max$_{IO}$; Max$_{BR}$}	/pak/ → pa■ /RED + pak/ → pa■-pa■
d.	Reduplicative backcopy	N/A	/pak/ → pak /RED + pak/ → *pa■-pa■

When we introduce the possibility of morphologically-index markedness, however, suddenly the unattested mapping becomes a very real possibility, as shown in comparison (b) below. Where {MAX$_{BR}$, NoCODA$_{RED}$} dominate constraints that would prevent deletion in fixed-segment morphemes, B-R identity forces backcopying of coda deletion onto the base.

(51) Backcopy with i-markedness

mappings	MAX$_{BR}$	NoCODA$_{RED}$	MAX$_{IO}$	NoCODA
a. /pak/ → pak ~ *pa■			W	L
b. /RED + pak/ → pa■-pak ~ *pa■-pa■	L	L	W	L

As Prince points out, the only way to save the Correspondence Theoretic approach to reduplication from this apparent danger is to prohibit morphologically indexed markedness. Let us refer to this conclusion as the Morphological Indexation Restriction.

(52) The Morphological Indexation Restriction:

Markedness constraints are non-indexical.

The MIR entails the conclusion of §4., that markedness constraints do not position morphemes. This follows rather simply from the fact that alignment constraints, referring only to output structures, *are* markedness constraints under standard OT assumptions (Moreton 2003).

Allow me to stress that this is not an indictment of parochial *constraints*, only parochial alignment. Some mechanism must exist to account for lexical exceptions in OT, and numerous compelling arguments in favor of morpheme-, class-, or stratum-specific faithfulness constraints have arisen in the literature (Alderete 2001, Benua 1998, Fukazawa and Kitahara 2001, Itô and Mester 1998, McCarthy and Prince 1995, Mohanan 2002, Pater 2000, Smith 1997, Urbanczyk 1997). In a morphologically indexed (or *i-faithfulness*) grammar, all markedness constraints are generic and totally ordered; there is thus a fixed sense of what it means for a given structure to be marked in the language as a whole. In a grammar with indexed markedness, however, each morphological category may effectively have its own total ranking of markedness constraints. As a result, there remains no reason why one morphological category should obey any of the 'basic' distributional patterns of the language, and any explanatory sense of what it means for a given structure to be unilaterally marked in a grammar is lost. If 'more marked than' is a relation that we expect to hold consistently within natural language grammars, the i-faith theory must be preferred. This argument, originally due to Benua (1998) in her arguments for output-output faithfulness constraints 'indexed' to morphological categories through the intervening medium of lexical subcategorization relations, was given more explicit substance as the Grammar Dependence generalization of Alderete (1999). Grammar Dependence stated simply is the intuition underlying the i-faith theory of subgrammatical variation: the outputs of morphological processes which are not purely arbitrary (i.e., unconditioned by any phonological factor(s)) are to some extent subject to the rigors of whatever normal distributional requirements are made by the grammar's phonology; we will have more to say on the subject of Grammar Dependence below.

Companion arguments for the i-faith theory are made by Itô & Mester (1998), who observe, citing Kiparsky (1968) and Saciuk (1969), that lexical strata in natural languages are uniformly organized in a hierarchical manner, with different strata subject to differing degrees of markedness along a fixed hierarchy. This fact falls out naturally from a theory which only allows i-faith—the markedness hierarchy is fixed and different stratal instantiations of faithfulness are intersperse within it, resulting in an inclusionary relation between constraint domains. The i-markedness theory, however, predicts fully parallel strata, i.e., strata organized along completely distinct axes of phonotactic and structural conditions.

In the face of the MIR conclusion and the apparent facility with which lexical exceptionality may be treated with i-faithfulness, a number of arguments have been made against the i-faith theory on both empirical and conceptual grounds. We will here address some of the complications and criticisms these authors present to it. What we will see in each case is that, where superficial consideration of empirical evidence suggests an account other than that couched within the i-faith theory, further investigation suggests that competing theories are no more suited to accounting for the facts than the i-faith theory or, worse, grossly over-predict the possible space of possible sub-grammatical variations within a given language.

In consideration of the locus of vowel deletion in nominal and verbal paradigms in Modern Hebrew, Bat-El (2001) presents data which are apparently counterfactual to Ito and Mester's claim that sub-grammars are internally consistent with respect to a fixed markedness hierarchy. In Modern Hebrew, nouns and verbs are subject to differing

restrictions on the placement of tri-literal root consonant clusters. In verbs, clusters

surface medially; in nouns, they are only allowed word-initially.

(53) Modern Hebrew vowel deletion (Bat-El 2001)

    a.   <u>Verbs: CVCVC → CVCCV</u>
           gadál 'grow'   ~   gadmlú 'they grew'
           gidél 'raise'   ~   gidmlá 'she raised'

    b.   <u>Nouns: CVCVC → CCVCVC</u>
           šafán 'rabbit.m' ~   šmfaním 'rabbit-pl'
           gamál 'camel.m' ~   gmmalím 'camel-pl'

Bat-El adopts the stance that verbs are the exceptional forms in the language, and that a

verb-specific version of *COMPLEX-ONSET (abbr. *CXONS below) dominates the normal

ranking of NOCODA and generic *CXONS that would force complex onsets to emerge

more generally in Hebrew nouns.

(54) i-Markedness and the noun/verb disparity (Bat-El 2001)

mappings	*CXONS-VERB	NOCODA	*CXONS
/gadal+a/ᵥₑᵣᵦ → gadm.la ~ *gmda.la	W	L	W
/šafan+im/ₙₒᵤₙ → šmfa.nim ~ *šafm.nim		W	L

Unfortunately, Bat-El's account fails to take into consideration further evidence

suggesting the opposite ranking, {*CXONS >> NOCODA}, is active in the grammar of

Hebrew.[17] In pronunciations of Hebrew acronyms {{bat-el, 1994;heller 1997}}, wherein

acronyms are syllabified into words consistent—we assume—with Hebrew syllable

structure, potential consonant sequences are always syllabified word-medially. (Note that

pl is a phonotactically acceptable for complex onset in Hebrew, for example as in *pluma*

'player'.)

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[17] An additional problem with the account is that it doesn't actually *explain* why vowels don't delete medially in nouns. Not considered in Bat-El's calculations are nominal candidates such as *ša.fmnim*, with medial V-deletion and a medial onset cluster, which would in fact satisfy all of the involved markedness constraints.

(55) Acronym formation favors Codas

        'PLMX' → pal.max , *pla.max
        'YXCG' → yaxcag
        'MXTK' → maxtak
        'MLNP' → malnap

What this suggests is that, where deletion to satisfy Hebrew's maximal word requirements (on which see Ussishkin 200x) is not a factor, *CxOns must dominate NoCoda, or else syllabification into complex onsets would result. As we can see in tableau (56) below, this has an undesirable consequence for noun formation under Bat-El's assumptions.

(56) The unfortunate consequence of {*CxOns >> NoCoda}

mappings	*CxOns	NoCoda
/gadal+a/$_{VERB}$ → gad■.la ~ *g■da.la	W	L
/šafan+im/$_{NOUN}$ → š■fa.nim ~ *šaf■.nim	L	W

Happily, there exists an i-faith approach consistent with both sets of data. Pater (2004 fn. 2) observes that such cases of 'exceptional blocking by markedness' (blocking of deletion) may be accounted for with local-conjunction of faithfulness and markedness—in this case, local conjunction of NoCoda and Max. (NoCoda & Max) will effectively penalize any candidate which surfaces with a deleted vowel and a coda consonant, exactly the candidate preferred by *CxOns in the tableau above. If we allow that the conjoined faithfulness constraint may itself be indexed to nouns, rather than verbs, the effect is effectively proscribed from applying to verbs.

(57) An indexed-faith solution

mappings	(NoCoda & Max$_{NOUN}$)	*CxOns	NoCoda	Max
a. /šafan+a/$_{NOUN}$ → š■fa.n+a ~ *šaf.■n+a	W	L	W	
b. /gadal+u/$_{VERB}$ → gad.■l+u ~ *g■da.lu		W	L	
c. /pmlx/ → palmax ~ plamax		W	L	

In addition to accounting for the data in a manner consistent with broader generalizations of Hebrew syllable structure, this account is consistent with the findings of Smith (1997)

that the category NOUN is more linguistically salient than VERB, and is in fact more prone cross-linguistically to the enjoyment of phonologically privileged (i.e., more marked) distributions. This crosslinguistic generalization is accounted for straightforwardly by a theory which indexes faithfulness constraints to the category NOUN, but not VERB.

Inkelas and Zoll (2003) argue that one of the driving goals of the i-Faith approach is maintenance of the Grammar Dependence generalization, put forth originally by Benua (1998) and argued for more extensively by Alderete (1999). I paraphrase below:

(58) Grammar Dependence

The outputs of morpho-phonological processes may be constrained by independently motivated grammatical principles of the language as a whole.

Grammar Dependence is notionally an attempt to capture the fact that morphophonological phenomena brought about by a grammatical imperative to maintain similarity or contrast among morphologically related words (OO-faithfulness in Benua's framework, OO-anti-faithfulness in Alderete's) are typically reigned in by more regular phonological tendencies found elsewhere in the grammar in question.

Zoll and Inkelas (2003) present cases similar to Hebrew in their attack on Grammar Dependence as a valid linguistic generalization. They argue that cases of 'markedness reversal', a phenomenon wherein one sub-grouping of forms in a language shows one set of markedness relations while another sub-grouping shows the exact opposite relations, constitute solid empirical evidence against Grammar Dependence and thus conceptual evidence against an i-faith approach to subgrammatical variation.

It is far from apparent, however, that their own approach, the stratum-specific reranking of constraints without recourse to morphological indexation of any kind, the *co-*

phonology, is in any way superior. Co-phonologies massively over-generate the space of morphological variation possible within natural language grammars. In their discussion of the beneficial qualities of the co-phonology approach to morphological irregularity, Inkelas and Zoll present the findings of Ito and Mester (1999) concerning stratal variation in the Japanese lexicon. Specifically, they observe the following, that there exists evidence of a fixed markedness hierarchy in Japanese: nasal/voiced-obstruent clusters are more harmonic than singleton labials, which are in turn more harmonic than voiced-obstruent geminates.

(59) A markedness hierarchy of Japanese: $\{*DD \gg *P \gg *NC\}$

This hierarchy evinces itself in the distinct behaviors of four substrata of the Japanese lexicon. The most restrictive (Yamato) stratum obeys all three markedness constraints; the Sino-Japanese stratum allows N$\underset{\circ}{C}$ clusters but disprefers voiced geminates and singleton labials; the Assimilated Foreign stratum allows everything but geminates; and finally the Unassimilated Foreign stratum allows any of the three marked structural configurations. Ito and Mester analyze this lexical variation as resultant from the interleaving of indexed faithfulness constraints with the fixed markedness hierarchy given in (59) above. Note that, in factorial typology, there are $7!/3! = 840$ rankings of the seven constraints, given the fixed ordering of the faithfulness constraints.

(60) Japanese Lexical strata as a function of i-Faith

$$\{FAITH_{UF} \gg *DD \gg FAITH_{AF} \gg *P \gg FAITH_{SJ} \gg *NC \gg FAITH_Y\}$$
No. of rankings in typology = $7!/3! = 840$

Under Ito and Mester's approach, there are exactly four lexical subdivisions of Japanese—one for each indexed faithfulness constraint—and they are arranged in a stratified hierarchy: each cophonology allows alternations which are a superset of those found in the next cophonology. Inkelas and Zoll argue against this conception of lexical

variation in Japanese on the basis of a putative 'markedness reversal' occurring in yet a fourth substratum of the Japanese lexicon. In mimetic constructions (such as *pata-pata* 'palpitating'), singleton labials are allowed where NC clusters are not, apparently in contradiction of the hierarchy in (59).

(61) Mimetic Stratum: {*DD >> *NC >> FAITH >> *P}

Inkelas and Zoll argue that markedness reversals are a possible (though undesired) consequence of i-Faith. They observe that, following the account of Fukazawa et al. (2002), breaking up monolithic FAITH into its component IDENT constraints will allow exactly the attested markedness reversal to emerge.

(62) Markedness reversal under i-Faith

{IDENT(lab)-Mimetic >> *P >> IDENT(voi)-Mimetic, IDENT(voi)-SJ >> *NC̥ >> IDENT(voi)}

How, we may ask, is this particularly an indictment of the indexed-faith approach to lexical variation? Grammar dependence does not necessarily imply that markedness reversals (NB: a descriptive designation!) do not exist; rather it holds that if a markedness reversal is a property of the phonological grammar of a particular language, then morpho-phonological alternations in that language are likely (if faithfulness permits) to exhibit the same markedness reversals found 'normally' in the language. We may furthermore question the overall logic of Inkelas and Zoll's criticism. They claim that the principal failing of the i-faith theory is its adherence to Grammar Dependence, which in turn suggests the absence of markedness reversals in natural language grammars. In the process, however, they effectively demonstrate that the i-faith theory is quite capable of capturing the very phenomenon (markedness reversal) that they argue to be impossible for it! It remains to be seen how this constitutes any particular indictment of the i-faith theory.

Regardless of the linguistic reality of Grammar Dependence, we can eschew constraint re-ranking as a means of capturing lexical variation simply on the grounds that it is considerably less restrictive than the i-Faith theory. In order to capture the notion of what it means for a language to be a language in the intuitive sense, any theory of exceptionality must maintain some notion of what it means for a grammar to reflect the internal coherence that gives a natural language its linguistic character. The i-Faith theory holds that this is a result of the fixed ranking of markedness constraints which is unperturbed by the inter-rankings of various stratally/morphologically indexed faithfulness constraints throughout the grammar. Consider an alternative approach to the Japanese problem, the one specifically espoused by Inkelas and Zoll. Rather than i-Faith, they allow for the possibility of free re-ranking of faithfulness and markedness constraints within a given subgrammar of Japanese, following Anttila (1997, 2002) in assuming that the space of possible stratal variations in a language is determined by the fixed partial-ordering of constraints that makes up the 'Master Ranking' of a language (Anttila 2002). We can see in the lattice derived from the partial order of the four constraints assumed by Inkelas and Zoll that the space of possible sub-grammars (even for four constraints) is indeed quite large.

(63) The Japanese Grammar Lattice (partial)

Japanese
{*DD, *P, *NC̥, FAITH} ⇐ Master Ranking

Unassimilated Foreign		?	
FAITH >> *DD		*DD >> FAITH	

?	?	?	?
*DD >> FAITH	*DD >> FAITH	*DD >> FAITH	*DD >> FAITH
*P >> FAITH	*NC̥ >> FAITH	FAITH >> *NC̥	FAITH >> *P

Yamato	Sino-Japanese	Mimetic	Assimilated Foreign
*DD >> FAITH	*DD >> FAITH	*DD >> FAITH	*DD >> FAITH
*NC̥ >> FAITH	FAITH >> *NC̥	*NC̥ >> FAITH	FAITH >> *NC̥
*P >> FAITH	*P >> FAITH	FAITH >> *P	FAITH >> *P
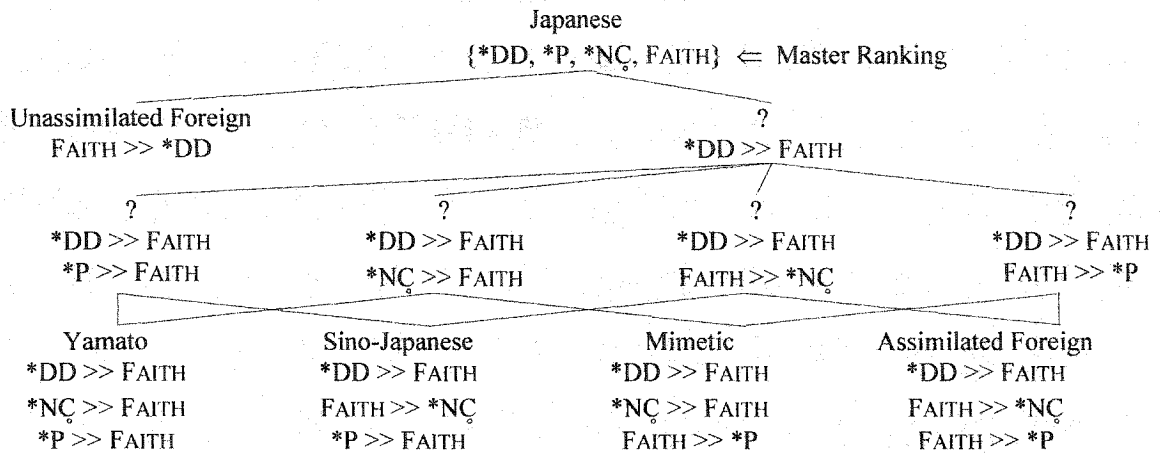
In it's full expansion, the partial ordering gives 4!=24 possible rankings of the four constraints, and concomitantly 4! distinct lexical strata for Japanese. Compare this again with the attested co-phonologies of Japanese and their attendant rankings.

(64) Japanese co-phonologies as subgrammars

Stratum	Subgrammar	# of rankings
Yamato	{*DD, *P, *NC >> FAITH}	3!=6
Sino-Japanese	{*DD, *P >> FAITH >> *NC}	2
Assimilated Foreign	{*DD >> FAITH >> *P, *NC}	2
Unassimilated Foreign	{FAITH >> *DD, *P, *NC}	3!=6
Mimetic Stratum	{*DD, *NC̥ >> FAITH >> *P}	2

TOTAL Rankings: 18

Of the 24 possible rankings, only 18 are correctly predicted. Not attested, however, are the other six perfectly legitimate sub-grammars allowed by the 'Master Ranking'.

(65) Unattested co-phonologies of Japanese

Ranking(s)	Effects
{*P, *NC̥ >> FAITH >> *DD}	geminate clusters allowed, singleton *p* and NC clusters prohibited
{*P >> FAITH >> *DD, *NC̥}	singleton *p* prohibited, geminates and NC clusters allowed
{*NC̥ >> FAITH >> *P, *DD}	no NC clusters, geminates and *p* okay

This undesirable result scales up. In general, for n tied constraints, Inkelas and Zoll's approach predicts the possibility of $n!$ distinct morphologies/strata in a given language. Under an i-faith theory, however, the number of potential lexical strata are limited to the number of indexations on the set of faithfulness constraints. Taking this to an unrealistic

extreme for purposes of comparison, the i-faith theory could at most allow only l distinct strata, where l is the number of words in a language's lexicon. This is potentially a very large number, to be sure, but nowhere near as large as $n!$, the space—if the Master Ranking leaves all constraints partially ordered—of all languages in an OT system. On the basis of these observations, and regardless of the veracity of the Grammar Dependence generalization, we will continue to maintain the primacy of the i-faith approach to lexical variation in this chapter and in those to come, simply because it happens to be more restrictive.

5. Dissertation Outline

The primacy of the current theory established, the body of this dissertation will expand upon the formal and empirical challenges outlined in the previous section.

In Chapter Two, I will demonstrate the facility with which the precedence faith approach to PoE solves the hyperdislocation problem we observed in §3.1. Further analysis of Tagalog infixation, along with consideration of a potential case of hypermetathesis in Faroese, will show that local self-conjunction of LINEARITY constraints accounts for both hyperinfixation and hypermetathesis in a unified manner unavailable to previous theories. It will further be shown that an apparent empirical complication for the account found in Tagalog loan phonology is readily dealt with under certain independently proposed assumptions about possible onset cluster structures. We will as well consider the question of whether or not there should be some universal prohibition on hyperinfixation, concluding ultimately that the range of infixation and so-called 'edge-flipping' affixation phenomena effectively rule out any such heavy-handed prohibition. The chapter will

conflate the closely related issues of preservation of morphosyntactic ordering and metathesis/infixation dependency into one extended case study of Tagalog dislocation, wherein we will consider the interaction of metathesis and infixation, using the variety of dislocational processes in Tagalog as a proving ground for the current theory.

Chapter Three will consider a significant empirical problem posed to the current approach: aprosodic infixation. The chapter will show, in consideration of infixation strategies in the languages Leti and Katu, that we must expand our dislocation ranking schema to include accounts of dislocation based on OO-F of two sorts, OO-Contiguity and OO-Anchoring. We will show that this approach predicts the range of attested aprosodic infixation types in a manner more explanatory than previous accounts dependent upon alignment-based prosodic subcategorization. Case studies of infixation processes in Akkadian, Alamaba, Cupeño, Hua, and Ulwa will demonstrate the utility of the theory in treatment of the typology of known infixation types, the core argument being that aprosodic infixation may occur over any prosodically accessible category—segment, syllable, or foot—and at either edge of the output word.

In Chapter Four we will treat the problem posed to the theory by cases of apparently bitropic morphology, especially as exemplified in a nasal harmony process found in the Arawakan language Terêna. After some necessary clarification of the morphological character of a morpheme expressed only as association of a nasal feature to root segmentism in the language, we will argue that the apparent complication for our theory is simply explained as a morphological derived environment effect (MDEE), derived under an Emergence of the Unmarked (TETU) ranking of relational faithfulness, homomorphemic relational faithfulness, and a generic markedness constraint. We will go

on to consider the implications of the TETU relational faith ranking against the larger body of MDEEs observed in the phonological literature, and we will see that cases of deletion, epenthesis, and nasal substitution have already fallen to accounts which espouse the basic argument. I will lastly offer an in-depth case study of MDEE assimilation facts in Korean to round out the observed typology of MDEE processes; along the way we will compare the approach to previous OT accounts of the phenomenon making use of such (it will be argued) unnecessary architectural devices level-ordering, underspecification, and articulatory representation.

Chapter Two – Phonological Dislocation

Tabi-tabi po, nuno!
– A Tagalog invocation of warning

1. Problems in Tagalog morphophonology

On the strength of the arguments made in Chapter One, we will take the Morphological

Indexation Restriction to be operative on CON and furthermore take it that faithfulness

constraints are the sole arbiters of the mapping from morphosyntactic ordering (input) to

positioning of surface exponence (output). These conclusions have subtle but wide-

ranging consequences for Prosodic Morphology in OT as laid out in McCarthy and

Prince (1993 et seq.), and we can explore said consequences nowhere better than in close

analysis of Tagalog, an Austronesian language well known in formal circles for its

infixation, but perhaps less known for its metathetic processes. Below we see three kinds

of segmental dislocation in the language: infixation of actor-focus *um*, discussed above;

infixation of goal-focus *in*, distinct from *um* infixation in the fact that the affix may

optionally metathesize internally when affixed to an approximant-initial base; and

metathesis of lateral/C clusters when brought together under syncope.

(1) Three kinds of segmental dislocation in Tagalog

    a. <u>*um* Infixation</u>
       /um+sulat/ → s-um-ulat 'to write.SF'

    b. <u>*in* Infixation</u>
       /in+ligaw+an/ → ni-ligaw-an ~ l-in-gaw-an 'RLS.woo.GF'

    c. <u>Syncopic Metathesis</u>
       /talab+an/ → tabl-an 'take effect.OF'

When we consider these dislocational phenomena in light of the theory of morpheme

order proposed in Chapter One, we arrive at two generalizations which the proposed

theory of PoE cannot not explain.

I. <u>Locality of Dislocation.</u>   Under no circumstance does the exponence of one morpheme, in whole or part, migrate more than one segments from its base (i.e., input) location.   Under the {ONSET >> LINEARITY} ranking argued for above, nothing in principle rules out the possibility of infixational morphemes *um* and *in* migrating farther down the base string—to the second syllable or the end of the word, for instance—to satisfy the requirements of other, higher-ranked markedness constraints.   Such is found nowhere in the paradigms of either morpheme, though in fact, as we will see in the next section, phonotactic constraints exist in the language which would seem to prefer such 'deep' or 'hyper-' infixation.

II. <u>Infixation/Metathesis Interaction.</u>   Also apparent in the data are what seem superficially to be conflicting dislocational behaviors.   In each case, segments of a different morphological status transpose.   In *-um-* infixation, the segments of one morpheme transpose with the segments of another.   Under syncope, segments of a single morpheme transpose with one another.   In *-in-* infixation, both options are available. This seems at first glance to be contrary to the predictions of the current theory: all else being equal, and in the absence of morpheme-specificity, we would expect all dislocational processes to follow the same basic patterning.

In the sections that follow, we will see that these facts are best accounted for with straightforward expansions of the LINEARITY approach to PoE.   We will treat each apparent difficulty in turn, arguing a) that hyperinfixation may be ruled out in particular instances of dislocation—both infixation and metathesis—with a ranking of LINEARITY constraints self-conjoined under local conjunction, and b) that a constraint governing *homomorphemic* precedence relations is ranked sufficiently high in the language to rule

out prefix internal metathesis except where undominated phonotactic constraints dictate otherwise, so predicting the apparent conflict observed in II above.

2. Prosodic Infixation and Hyperdislocation

Phonological processes such as infixation and metathesis share a common formal property. In both, the exponence of a morpheme (in whole or part) is output-dislocated from its base position in the input. Where some markedness constraint dominates LINEARITY, dislocation must occur, as seen in the abstract scenario below, where segments labeled '1', '2', and '3' undergo surface re-order to accommodate the demands of high-ranked markedness.

(2) Dislocation where {M >> LINEARITY}

/123/		*12	LINEARITY
a.	123	*!	
b.	213		*
c.	231		**

Because LINEARITY is multiply violable, dislocation is always minimal *to the extent allowed by higher-ranked constraints*. That is, the dislocating segment (i.e., '1' above) migrates no farther from its base position than is necessary to satisfy the markedness constraint. In a larger grammar, it would be surprising if such a dislocation candidate were itself never in turn marked by an equally high-ranked markedness constraint. We see such a scenario below, where segment 1 reverses two precedence relations (1<2, 1<3) to satisfy and additional, high-ranked markedness constraint. Thus 'minimal' dislocation is in fact illusory, the surface positioning of segments ultimately at the whim of whatever body of constraints dominates LINEARITY.

(3) Dislocation where {M₁, M₂ >> LINEARITY}

/123/	*13	*12	LINEARITY
a. 12̲3		*!	
b. 21̲3	*!		*
☞ c. 231̲			**

The problem with this state of affairs—intrinsic to the basic architecture of OT—is that it allows for the possibility of *hyperdislocation*, non-local or 'deep' dislocation occurring, as in (3) above, when an input element migrates 'excessively' far from its input orientation to satisfy other undominated constraints. The problem is simply that hyperdislocation happens rarely—if at all—in natural language. More commonly than not, when minimal dislocation would result in marked structure, some other repair (deletion and null parsing in the examples we'll see shortly) takes place and dislocation fails to occur altogether. We can see this more concretely in Tagalog *um*-infixation.

In Chapter One, we laid out a very straightforward theory of prosodically conditioned infixation which accounted for the basic facts of Tagalog *um* Infixation. The ranking central to that theory, along with a representative mapping, is shown below.

(4) Tagalog *um* Infixation

    {ONSET >> LINEARITY} ∴ /um+sulat/ → s-um-ulat 'to write.AF'

Not so straightforward, however, is an account of the following fact: *um*-infixation is avoided in Tagalog where the resulting structure would contain the sequences *mum* or *wum*.

(5) Sonorant labial avoidance in -*um*- infixed words (Orgun and Sprouse 1999)

    a.   m-, w-initial words
        mahal   *mu̲mahal 'to become expensive'
        walow   *wu̲malow 'to wallow'

    b.   s + m-/w-initial words
        smajl   *su̲mmajl, *smu̲majl 'to smile'
        swim   *sumwim, *swumim 'to swim'
        swiŋ   ˀsu̲mwiŋ, *swu̲miŋ 'to swing'

Orgun and Sprouse (1999) argue this behavior to follow from the high ranking of the following markedness constraint.[18]

(6) OCP-*um* (Orgun and Sprouse 1999)

Sonorant labials are not allowed in consecutive onsets. (*mum, *wum)

As Orgun and Sprouse observe, an unfortunate problem arises from such an approach to the Tagalog facts: if the root contains one or more sonorant labials, the *um* morpheme should drift down the base string, emerging hyperinfixed, as shown in (c) below. Treating the failure of labial-initial roots to surface with *um* as a case of absolute ungrammaticality, we see an immediate ranking paradox. The constraint mitigating against the null parse (the candidate, by hypothesis, optimal in the data in (5)) is MPARSE (Prince and Smolensky 1993). MPARSE must dominate LINEARITY in normal (i.e., non-*mum*) cases of infixation, lest infixation be barred from ever occurring in the language. As the following tableau demonstrates, however, this necessary ranking produces an undesired result: where the null parse is ruled out, the hyperinfixed candidate may surface.

(7) Hyperinfixation to avoid marked structure

◇ OCP-*um* := Sonorant labials are not allowed in consecutive onsets. (i.e., *mum, *wum)
◇ MPARSE := Avoid the null parse.

/um+mahal/	OCP-*um*	ONSET	MPARSE	LINEARITY
f. um-mahal		*!		
g. m-um-ahal	*!			**
☛ h. mah-um-al				******
i. mahal-um				*******!***
☞ j. Ø			*!	

Such behavior would be compounded in forms containing both an initial and medial labial. For the root *mumog* 'gargle', for instance, we might expect the affix to appear at

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[18] While the constraint may have an *ad hoc* air about it, Plag (Plag 1998) discusses other cases of haplology resultant from identity in onset-onset sequences, for example English *femininize, *minimumize. A more general approach of the constraint might simply view it as the local conjunction (Smolensky 1995, 1997) of OCP(onset) and some more general constraint banning sonorant labials—(OCP(ons) &_AdjSyll *SONLAB) perhaps.

the far right of the output string, *mumog-um*. Such behavior is never found in Tagalog verbs, an obvious problem for the theory.

The approach we will take to this problem will take it that hyperinfixation is not, as has been argued (Yu 2003), universally impossible, but rather is restricted from occurring in particular languages through normal constraint ranking. We will see that hyperdislocation generally—i.e., hyperinfixation, as well as hypermetathesis—may be ruled out with the ranking of a self-conjoined LINEARITY, a natural extension of the precedence faith approach to PoE set out in the last chapter. Before providing an account of the Tagalog problem, we will consider a slightly simpler case of hyperdislocation avoidance which clarifies the workings of the approach.

2.1. Hypermetathesis and local self-conjunction

Tagalog is not the only language with observable hyperdislocation avoidance. A strikingly similar problem is found in a case of metathesis in Faroese. Seo and Hume (Hume and Seo 2001) observe the following facts: where a root ends in a consonant cluster [ks], that cluster metathesizes to [sk] when followed by a consonantal (or consonant initial) affix.

(8) Faroese Metathesis (Hume and Seo 2001)

masc. sg.	*neut. sg.*	
baisk-or	baiks-t	'bitter'
tʊsk-or	tʊks-t	'German'
rask-or	raks-t	'energetic'

Seo and Hume propose that the driving force behind Faroese metathesis is an imperative to maximize perceptual salience—the perceptually weak stop migrates to a more salient position proximate to the vowel when flanked by obstruents. To capture the metathesis facts in OT, Seo and Hume argue that a set of 'contextual avoidance' constraints encodes

this functional imperative in the grammar. For our purposes, the particular formalism that Seo and Hume advocate is irrelevant; a common contextual markedness constraint barring voiceless stop sequences, *KT, will suffice. When *KT and MAX both dominate LINEARITY, the metathesis of (8) will occur to avoid the marked segmental structure, metathesis being more harmonic than an equally likely repair, deletion.

(9) Metathesis ≻ Deletion

◇ *KT := Voiceless stop sequences are marked.

/bais$_1$k$_2$+t/ → baik$_2$s$_1$-t	*KT	MAX	LINEARITY
a. ~ *bais$_1$k$_2$-t	W		L
b. ~ *bais$_1$■-t		W	L

However, if this ranking holds, we face an immediate problem in accounting for the absence of metathesis in penultimately stressed roots. Consider the following data, where [ks] metathesis is blocked from occurring in an unstressed final syllable.

(10) Deletion ≻ metathesis after V̆

    fǿːrɪsk   fǿːrɪs■-t 'Faroese'

    rǿsːɪsk   rǿsːɪs■-t 'Russian'

Suppose, as Seo and Hume suggest, that an undominated markedness constraint barring voiceless stops from immediately following unstressed vowels (something to the effect of *V̆T) acts to prevent metathesis, for example in an ungrammatical metathesis mapping, /fǿːrɪs$_1$k$_2$+t/ ⇸ *[fǿːrɪk$_2$s$_1$-t]. If {*V̆T >> MAX}, as is necessary to rule out the mapping, and {*KT >> MAX}, ruling out an identity mapping, what in principle prevents a mapping wherein the velar stop metathesizes to the coda of the preceding (stressed) syllable, satisfying all involved constraints but lowest-ranked LINEARITY?

(11) A Hypermetathesis Paradox

mappings	*VT	*KT	MAX	LINEARITY
a. /bais$_1$k$_2$+t/ → baik$_2$s$_1$-t ~ *bais$_1$■-t			W	L
b. /fø:ris$_1$k$_2$/ → fø:ris$_1$■-t ~ *fø:ris$_1$k$_2$-t		W	L	L
c. /fø:ris$_1$k$_2$/ → fø:ris$_1$■-t ~ *fø:rik$_2$s$_1$-t	W		L	W
d. /fø:ris$_1$k$_2$/ → fø:ris$_1$■-t ~ *fø:k$_2$ris$_1$-t	L		L	L

A parallel begins to take shape between the blocking of metathesis in Faroese and the blocking of *um* infixation in Tagalog. In both cases, a high-ranked markedness constraint forces violation of LINEARITY in the basic operation of the dislocational process. In both cases, some other, higher ranked constraint blocks the operation of that process, forcing avoidance of the marked structure by some other repair, deletion in the Faroese case, allomorphy in Tagalog. The question is, what's the constraint?

We will argue here that the solution to the dilemma is found in local-conjunction theory (Green 1993, Smolensky 1995, Crowhurst and Hewitt 1997, Fukazawa and Miglio 1998, Legendre et al. 1998, Bakovic 1999, Lubowicz 2002) a formal device used to construct complex constraints from simpler ones, commonly for the purpose of ruling out candidates which show a compounding of marked (or faithful) structure elsewhere allowed in a grammar.

(12) Local Conjunction Theory

> Dfn.: Given two constraints C_1 and C_2, their *Local Conjunction* (w.r.t. a domain type D), (C_1 &$_D$ C_2), is a new constraint which is violated when two distinct violations of C_1 and C_2 occur *within a single domain of type D*.
> Universal rankings: {(C_1 &$_D$ C_2) >> C_1, C_2}.

An oft-appealed to extension of LCT is the theory of *local self-conjunction*, identical to LCT in all ways except that C_1=C_2 in the above definition. Local self-conjunction is typically appealed to as a means of capturing dissimilatory effects within a given domain (Alderete 1997, Itô and Mester 1998); a number of authors (Kirchner 1995, Bye 2002, Moreton and Smolensky 2002), however, have obtained interesting results in analyzing

chains shifts of various types as the result of self-conjoined faithfulness constraints. In this tradition, we will consider the following self-conjunction of LINEARITY, the domain of conjoined violation here being the segment, a fairly natural domain for a constraint whose violations are counted by precedence reversals among segments.

(13) LINEARITY

S_1 reflects the precedence structure of S_2 and v.v.
If $x, y \in S_1$, then $x < y$ iff $\neg[Y' = \{y' \in S_2 \mid y'\Re y\} < X' = \{x' \in S_2 \mid x'\Re x\}]$.

(14) (LINEARITY & LINEARITY)$_{seg}$ = LIN$^2_{seg}$

Violated when two (or more) distinct violations of LINEARITY occur for a single segment.
I.e., for every x, a segment, accrue one violation if both of the following are false:

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

    ii.   If $x, z \in S_1$, then $x < z$ iff $\neg[Z' = \{z' \in S_2 \mid z'\Re z\} < X' = \{x' \in S_2 \mid x'\Re x\}]$ and $z \neq y$.

The intuition behind the constraint is quite clear: if a particular segment 'moves' more than one segment away from its input position, self-conjoined LINEARITY will be violated. We can see this quite clearly below, in comparison of the violation profiles of the conjoined and parent constraints.

(15) Compared violations of LIN$^2_{seg}$, LINEARITY

/1<2<3/	LIN$^2_{seg}$	LINEARITY	
a. 1<3<2		* 2⊀3	} local metathesis
b. 2<1<3		* 1⊀2	
c. 3<1<2	*	** {1, 2}⊀3	} long-distance metathesis
d. 2<3<1	*	** 1⊀{2, 3}	
e. 3<2<1	**	*** 1⊀{2, 3}, {1, 2}⊀3	} order reversal

As J. Alderete (p.c.) observes, however, this intuitive sense of the constraint is not entirely transparent in its formulation, since violations of LINEARITY are counted on precedence relations occurring *between* segments, not segments themselves. What is necessary is some clarifying sense of what it means for LINEARITY to be conjoined *over the domain of a segment*. Take a segment to be defined by, among other things, the set of

precedence relations it holds with respect to other segments. Thus in a string $/xyz/$, segment x is composed of two such relations, $x<y$ and $x<z$. If both of these relations are reversed in the output, as in $/xyz/ \to [yzx]$, it can be said that segment x has violated LINEARITY twice, once with respect to y and once with respect to z. We see this schematized below.

(16) Computed violations of $\text{LIN}^2{}_{seg}$

mapping		violates	LINEARITY(x, y)	LINEARITY(x, z)	therefore	$\text{LIN}^2{}_{seg}$
a.	$xyz \to yz\underline{x}$		*: $x<y \to y'<x'$	*: $x<z \to z'<x'$		*
b.	$zyx \to \underline{x}zy$		*: $y<x \to x'<y'$	*: $z<x \to x'<z'$		*

It is crucial to note that $\text{LIN}^2{}_{seg}$ is symmetric over the I-O correspondence relation. That is, because of the logical equivalence of "$x<z$ iff $\neg(z<x)$" and "$\neg(x<z)$ iff $z<x$", it does not matter that, in the dislocation of ((16)b), it is the final segment rather than the first that migrates two segments from its input position. In general, for any three (or more) segment substring, dislocation of an edge-bound segment more than one segment's distance from its input position—leftward or rightward—will result in violation of the constraint. Note too that $\text{LIN}^2{}_{seg}$ is violated only once for each input segment that reverses its precedence with respect to other segments *more than once*. That is, the conjoined constraint doesn't care if a segment violates LINEARITY 2 times, 5 times, or 10; as long as there two violations of LINEARITY in a particular segment, the candidate gets a mark.

These clarifications of the conjoined constraint's functioning made, it becomes readily apparent that LIN^2 derives exactly the correct result when ranked above MAX in Faroese, imposing a formal limit on the 'distance' a segment may dislocate from its input position. We see this in tableau (17) below, where any candidate in which the migratory velar stop

is positioned more than one segment way from its underlying position (d, e) will violate

LIN^2_{seg}. Deletion is left as the only viable repair for the illicit cluster.

(17) LIN^2 rules out Hypermetathesis in Faroese

/fø:rɪ₁s₂k₃+t/	LIN^2_{seg}	*KT	*VK	MAX	LINEARITY
☞ a. fø:rɪ₁s₂■-t				*	
b. fø:rɪ₁k₃s₂-t			*!		
c. fø:rɪ₁s₂k₃-t		*!			*
d. fø:rk₃ɪ₁s₂-t	*!				**
e. fø:k₃rɪ₁s₂-t	*!				***

The ranking successfully imposes a definable sense of locality on the range of possible dislocations in the Faroese grammar—a segment may dislocate no more than one segment from its underlying position. In the next section, we will see how this basic approach to hyperdislocation avoidance explains the facts of Tagalog observed above, though not without some further restriction on the domain of local self-conjunction.

2.2. Back to Tagalog and hyperinfixation

We observed above that *um*-infixation is avoided in Tagalog where the resulting structure would contain the sequences *m-um* or *w-um*. We will here advance an account of this fact in terms of the LIN^2 approach to hyperdislocation avoidance presented above.

It is readily apparent that, in an ungrammatical mapping /um + mahal/ → *mah-um-al*, for example, the only segments violating basic LINEARITY are [u] and [m]; each violates it three times. Turning to LIN^2_{seg}, [u] and [m] each have more than one LINEARITY violation, thus two violations of the constraint, one for each segment. The null parse candidate emerges optimal since, being without structure, it has neither excess reversal of precedence relations nor illicit labial sequences.

(18) LIN^2 rules out hyperinfixation in Tagalog

/um+mahal/	LIN$^2_{seg}$	OCP	MPARSE	LINEARITY
a.　m-um-ahal		*!		**
b.　mah-um-al	**!			******
c.　mahal-um	**!			*********
☞ d.　Ø			*	

However, an immediate formular problem arises when we apply the above ranking to a candidate set generated from a normal, non-labial-initial root. As we observed in the last section, LIN$^2_{seg}$ is symmetric with respect to left and right dislocation. This leads to an unexpected complication in our account of the Tagalog problem: infixation of a two (or more) segment morpheme over a single root-initial segment (regardless of its quality) is exactly as unsatisfactory on LIN$^2_{seg}$ as hypermetathesis is in Faroese. As we see below, normal infixation results in a single segment, in this case the first segment of the root, reversing precedence relations with respect to two other segments, those of the affix, with the net result of a LIN$^2_{seg}$ violation.

(19) An unexpected complication

/um+sulat/	LIN$^2_{seg}$	MPARSE	LINEARITY
☞ a.　s-um-ulat	*!		**
☞ b.　Ø		*	

The solution to this problem will require some further specification of conjoined LINEARITY, but not, happily, to a degree unanticipated by current theory. The additional qualification comes in specification of the domain of conjunction. A long line of Optimality Theoretic research (for example Casali 1997, Beckman 1998, Nelson 2003) has taken string-initial segments to be of higher linguistic salience than those found elsewhere in the string, and that faithfulness constraints may be specified for such high-salience objects to produce positional asymmetries in certain types of alternations. We will contend here that dislocation is no exception to the rule, and that the best available

account of the Tagalog problem is one in which LINEARITY is self-conjoined over the domain of the *string-initial segment*.

(20) LINEARITY conjoined over a string-initial segment

(LINEARITY & LINEARITY)$_{seg1}$ = LIN$^2_{seg1}$

Violated by two (or more) distinct violations of LINEARITY occur for a single string-initial segment.

A. Prince (p.c.) observes that this formulation recaptures some of the original insight of alignment theoretic approaches to morpheme positioning inasmuch as it treats a prefixal morpheme as a single unit with respect to dislocation over segments of the base. In a mapping /um+mahal/ → Ø, the initial vowel of the affix is simultaneously initial in the input string as a whole—precedence reversals of any other segments of the affix are not marked by the constraint. Thus dislocational candidates will violate LIN$^2_{seg1}$ in exactly those circumstances in which the initial vowel of the affix is dislocated over *more than one* segment of the root, as we see in tableau (21) below.

(21) LIN$^2_{seg1}$ rules out hyperinfixation in Tagalog

/um+mahal/	LIN$^2_{seg1}$	OCP	MPARSE	LINEARITY
a. m-um-ahal		*!		**
b. mah-um-al	*!			*****
c. mahal-um	*!			*********
☞ d. Ø			*	
/um+sulat/	/////////	/////////	/////////	/////////
☞ e. s-um-ulat				**
f. sul-um-at	*!			*****
g. sulat-um	*!			*********
h. Ø			*!	

Thus we have two superficially very different processes, but one common problem and one simple solution to it, using a formal device, self-conjunction, already argued for in the literature. While McCarthy (2002) explicitly criticizes the use of local conjunction of *alignment* constraints, it isn't clear that his criticisms apply to self-conjoined LINEARITY, since LINEARITY operates over different representational primitives (i.e., precedence

relations, rather than output edges). Also, since LINEARITY violations are counted over relations between segments, it's entirely natural that the segment would be a suitable domain for conjoined violation, as we have seen.

An additional potential problem for a constraint-conjunction account comes out of a larger prediction of local self-conjunction theory itself: that self-conjoined constraints may be recursively so conjoined indefinitely. A *power hierarchy* of constraints (Smolensky 1995, 1997) is formed through recursive self-conjunction, i.e., by conjunction of a constraint with itself, then conjunction of that conjoined constraint with the original constraint, etc., as shown below for LINEARITY.

(22) The LINEARITY Power Hierarchy

LIN^1 := Violated once for each segment undergoing one (or more) precedence reversals.
LIN^2 := Violated once for each segment undergoing more than one precedence reversal.
LIN^3 := Violated once for each segment undergoing more than two precedence reversals.
(etc.)

If we admit power hierarchies to our theory of constraint composition, suddenly by recursion there are infinitely many possible constraints. As observed in Bakovic (2000), the possibility of infinite recursion in this manner departs from a necessary assumption about the nature of CON, i.e., that it is finite. If there are infinitely many possible constraints, CON cannot be composed of all of them, and it obtains that different grammars might contain different sets of constraints, contra RotB, the end result being a considerable explanatory leakage from the theory. We will answer this potential problem with the assumption that, in the phonological domain at least, a constraint may not be conjoined with an already conjoined constraint. With this assumption we also sidestep another potential criticism, observed by Orgun and Sprouse (1999): the approach grants our UG the ability to arbitrarily count segments in dislocational processes, placing an

upper bound of potentially arbitrary length on the distance a segment may migrate from its underlying position. Given the necessary ubiquity of phonological constraints that distinguish one item from a multiplicity of items (i.e., OCP constraints, themselves formulable under local self-conjuction (Alderete 1997)), we take it here that division between one and the many is a linguistically natural operation.[19]

In sum, we thus have a single, simple approach to avoidance of hyperdislocation in natural language that follows naturally from the theory of PoE we advocated in Chapter One and makes no necessary appeal to alignment constraints of any sort, parochial or otherwise. As with any simple theory, however, we encounter a number of complications when we move from the relatively abstract level of analysis we have enjoyed thus far to the particular details of the languages under investigation. As we will see in this section, Tagalog provides a number of empirical challenges to the proposed theory.

2.3. Consonant clusters and clarifications

One of the immediate predictions of the LIN^2 account is that—since precedence is counted over segments—languages which bar deep infixation as in *mah-um-al* will find infixation over a complex onset equally marked. This fact is not problematic for native Tagalog roots words—all are of the form CVCV(C)—and is furthermore at least consistent with the 'over initial C' infixation pattern ubiquitous across Austronesian and

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[19] We will note in passing another approach to the problem. It has been common formal practice to specify faithfulness constraints for vocalism/consonantism—MAX and DEP-V/-C are staple constraints of accounts of segment deletion and epenthesis. Were a LINEARITY-V is ranked above MPARSE in Tagalog, no constraint (or conspiracy of constraints) would be able force the appearance of the infix beyond the first vowel of the root; thus *um* and any other morpheme of its segmental makeup would be forced to appear within the span of segments between the left edge and the initial vowel of the root. While this appears to be a viable alternative to the conjoined constraint approach we have taken here—and an attractive one inasmuch as it requires no further discussion of complex onsets—it fails to make sense of hyperdislocation in a unifying manner, being inapplicable to hypermetathesis avoidance in Faroese. Thanks to N. Nelson for discussion on this point.

Austroasiatic languages; c.f., Cambodian /əm+tŋun/ → *t-əm-ŋun* (Stemberger and

Bernhardt 1998). In Tagalog borrowings from Spanish and English, however, we find

that infixes are positioned variably within obstruent-glide and obstruent-liquid onset

clusters.

(23) Infixation into ₒ[CC loanwords (French 1988)

> gradwet → g-um-radwet ~ gr-um-adwet 'to graduate'
> prenoh → p-um-renoh ~ pr-um-enoh 'to brake'

Speakers of Tagalog over the age of fifty unanimously prefer the first of the two repairs.

Among younger speakers, however, the placement of *um* in these contexts varies

arbitrarily from speaker to speaker. Earlier accounts have explained this variation with

the formal device known as the constraint tie (Orgun and Sprouse 1999, McCarthy 2002),

noting that, where *CxONS and NOCODA are crucially unordered, or 'tied', with respect

to one another in the Tagalog grammar, different infixation candidates will surface

optimal at evaluation time when a total ordering is (arbitrarily) chosen. The result is two

subgrammars of Tagalog, one which permits complex onsets in morphologically complex

loanwords, and one which does not.

(24) Constraint tie {*COMPLEX = NOCODA} leads to free variation

Subgrammar 1, where {*COMPLEX >> NOCODA}

/um+gradwet/		*CxONS	NOCODA	LINEARITY
a.	um.grad.wet	*!	*	
☞ b.	gum.rad.wet		*	**
c.	gru.mad.wet	*!		****
d.	grad.wu.met	*!		*****!*****

NB: Shared NOCODA violations not shown.

Subgrammar 2, where {NOCODA >> *COMPLEX}

/um+gradwet/		NOCODA	*CxONS	LINEARITY
a.	um.grad.wet	*!	*	
b.	gum.rad.wet	*!		**
☞ c.	gru.mad.wet		*	****
d.	grad.wu.met		*	*****!*****

Such an account of the variation facts are problematic for the current approach to

hyperinfixation. LIN[2] must be ranked above MParse to ensure null parsing of potential

hyperinfixation inputs; MParse, in turn, must be ranked above NoCoda and *CxOns, else inputs possessing either form of structure would simply fail to surface in the language.. With Lin^2 ranked sufficiently high to rule out hyperinfixation, the above variation is ruled out as well, since infixation over the initial cluster results in the same two Lin^2 violations marking the hyperinfixed candidate. This is entirely consistent with the loan phonology of older Tagalog speakers, as we mentioned above; unfortunately, however, it leaves the free variation found in younger speakers unexplained.

(25) Free variation lost

	/um+gradwet/	Lin^2	*COMPLEX	NoCODA	LINEARITY
	a. um-gradwet		*!	*	
☞	b. g-um-radwet			*	**
(☞)	c. gr-um-adwet	**!	*		****
	d. gradw-um-et	**!	*		*****!*****

Fortunately for the current approach, the constraint tie approach to the variation is inherently flawed. Constraint ties are, at best, a tenuous means of establishing optionality in a given grammar. This is not because of any inherent mechanical failing of the formalism itself, but rather the fact that, in a more expanded ranking, it is typically a simple matter to find a constraint that must be crucially ranked *between* the tied constraints. When such a constraint is found, unless the candidate(s) favored by that constraint are also optionally available outputs, transitivity of ranking effectively dispels any possibility of constraint tie. We can see this in the Tagalog case with consideration of a systematic disparity in the syllable cannons of native and non-native vocabulary items. Below is a schematic inventory of possible roots in native Tagalog vocabulary (Schachter and Otanes 1972). Though codas are commonly found in ultimate and penultimate syllables, notably missing from the cannon are syllables with complex onsets.

(26) Canonical root shape in Tagalog (Schachter and Otanes 1972)

Root Schema	Possible surface forms and examples

$CV(\{^C_V\})CVC$

a. CV.CV́C $\Rightarrow$ *buháy, labás, ʔulán, ...*

b. CV́:.CVC $\Rightarrow$ *bárgah, há:los, gá:liŋ, ...*

c. CVC.CV́C $\Rightarrow$ *bigwás, gandáʔ, saplót, ...*

Capturing this fact is an elementary exercise in the ranking of syllable structure constraints. As surface contrast is found in syllables which do and do not have codas, we know that some segmental F (i.e., MAX and DEP[20]) must dominate NOCODA. Since complex onsets are systematically ruled out, we know that *COMPLEX must dominate the same F. If {*COMPLEX >> F} and {F >> NOCODA}, we know by transitivity of ranking that {*COMPLEX >> NOCODA} and that no constraint tie can exist between them.[21]

This situation is minimally complicated by the fact that non-native vocabulary, borrowed from Spanish and more recently from English, does allow complex onsets of all stripes. This we can capture with stratal faithfulness (i.e., indexed to lexical strata); DEP_loan dominates *COMPLEX, which in turn dominates DEP_native.[22]

(27) Proof of {*COMPLEX >> NOCODA}

mappings	DEP_loan	*COMPLEX	DEP_native	NOCODA
a. /CCV/_native → CVCV, *CCV		W	L	
b. /CVC/_native → CVC, *CVCV			W	L
c. /CCV/_loan → CCV, *CVCV	W	L		
d. /CVC/_loan → CVC, *CVCV	W			L

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[20] DEP ≡ No insertion.

[21] Arguing that {*COMPLEX = DEP = NOCODA} would not work, as that ranking would allow epenthesis to optionally occur in native vocabulary to repair both /CCV/ and /CVC/. Nor would attribution of the phenomenon to the interaction of *CxOns and a constraint on complex margins. First, infixation of the goal focus morpheme -in- also occurs variably in CC clusters. [nl] clusters do occur elsewhere in native vocabulary, however (ex. bunlaw 'rinse'), so a tied {Syll-Cont=*CxOns} approach to the phenomenon wouldn't generalize across the two infixation types. Two, it's my suspicion that the syllable contact approach might be subject to the same frailty of constraint ties, but in exactly the inverse manner. It's an empirical question, but if a native speaker of Tagalog says 'comrade' as [kamurad], rather than [kamrad], there would seem to be evidence for a {Syl-Cont >> Dep >> *CxOns} ranking, which would again rule out optionality.

[22] Note, however, that this is on the assumption that only faithfulness constraints are indexical; if there is a non-native *COMPLEX, it could simply be ranked lower than generic DEP, and the constraint tie could still hold.

The inutility of constraint ties thus demonstrated, it remains to be seen what factors give rise to the variable placement of *um* in loan-word onsets. We will claim here that the locus of variation for the Tagalog speaker lies in the lexicon, rather than in manipulations of the constraint set. Specifically, we will claim that the confusion on the speakers' part lies in their determination of the underlying structure of what we have taken up to this point to referred to as a complex onset.

LIN^2 rules out variation because, in order to rule out hyperinfixation, it must also be ranked high enough in the grammar to rule out infixation over multiple segments of a complex onset. But what if the confusion for the speaker of Tagalog is not found in whether or not a complex onset may be broken with an infix, but whether or not a series of consonantal gestures comprise a complex onset or a complex segment? As the violation profile below demonstrates, LIN^2 distinguishes infixation over a complex onset from infixation over complex segment, disallowing the former but allowing the latter.

(28) Complex onset vs. segment on LIN^2

mappings	LIN^2
a. $/\alpha + C_1 C_2 / \rightarrow C_1 C_2 \alpha$	* $\alpha \not< \{C_1, C_2\}$
b. $/\alpha + C^C_1 / \rightarrow C^C_1 \alpha$	✓ $\alpha < C^C_1$

The status of onset 'clusters' has ever been a hotly debated topic. The commonly held view is that complex sequences, clusters in all phonetic respects (Ladefoged and Maddieson 1996), must be clusters in the phonology as well. Others have argued, however, that the psychological reality of 'segmenthood' upon which most phonological theories rest is no more perturbed by segments of maximal internal complexity than those without. Numerous examples from the Africanist literature alone have given rise to postulation of lateralized segments (i.e., /kpl fl tl ml/, etc.) (Armstrong 1989), velarized

segments (/bˤ, bˠ, g͡b, k͡p/) (Downing 2003, Padgett 2002), and nasal contour segments of various kinds (Steriade 1993). Steriade argues that, above and beyond pre-nasalized segments and affricates, any series of complex consonantal gestures may comprise a single segment, just so long as non-conflicting feature-values do not result. Padgett (Padgett 1995a) has argued for simultaneously [+cont][-cont] segments in Kabardian. And a long line of researchers have argued that [sC] clusters form single segments (Fujimura, 1997;Kohler 1976;Selkirk 1982;yamane 2002}}.

More recently, Duanmu (2002) argues the extreme view that sonority-sequencing effects in complex onsets in all of the world's languages are in fact illusory, and that the space of available syllable structures in natural language phonology boils down to a simple CV(X) template, all pre- and post-vocalic consonantal 'sequences' in fact being complex segments. The phonotactic effects that have been attributed to contraints on sonority sequencing are, under Duanmu's theory, again a result of allowable feature combinations within single segments. Duanmu's arguments are not couched within Optimality Theory, and we explicitly eschew here his claims that complex segmentism of this sort is universal. (Especially in light of his claims that certain initial onset clusters in English, apparently contrary to his claims, are the result of 'exceptional' prosodic licensing beyond the domain of the syllable.) We will, however, allow that generalized complex segmentism of the type argued for by Duanmu and Steriade lies within the realm of the representationally possible, and assume that complex segments of all types are potential inputs and outputs of OT grammars.

We will here adopt Steriade's aperture based feature geometry as that most expedient to our purposes. The Aperture Theory of segmental representation holds that, below the root node, the closure/release state of segments is modeled with oral aperture nodes rather than the traditional [+/-consonantal] and [+/-approximant] features born by root nodes in standard feature geometry (Clements 1985, Sagey 1986, McCarthy 1988, Hume 1993, Clements and Hume 1995, Padgett 1995b). Aperture nodes supplant the root node in the theory, and may consist in: A_0, or full closure, as found in the stricture phase of a stop; A_f, or partial closure to the point of frication; and A_{max}, zero closure, as in approximants or the release phase of a stop. The inventory of potential A node combinations within a segment is taken to be (universally) as follows. Fricatives and approximants occurring as single segments map to a lone A node, while plosives and affricates are taken to be composed of an A node pair, A_0A_{max} and A_0A_f, respectively. Steriade places an additional restriction upon the types of available complex segments: the sequence of articulatory gestures within a single segment must be featurally compatible, that is, aperture nodes must not dominate conflicting [+/-] feature values.

Turning our attention to the inventory of possible consonant clusters in Tagalog,[23] we see that, with a few exceptions, the majority of clusters are decomposable into plosive-approximant sequences, or in the aperture theory, segments with complex A_0A_{max} specifications.

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[23] In the world of loan phonology, it is at times difficult to distinguish genuine borrowings into a language from foreign words which adult speakers attempt to morphologize according to native principles to suit the needs of the linguistic researcher. Ross (Ross), for instance, argue that sibilant-initial clusters like [str], [sm], [spl], etc. are significantly phonologized into Tagalog to include them in her treatment of clusters and infixation. We will here take the more conservative stance that lexicography may be a dividing line between the borrowed and the haphazardly guessed. There are no verbs in English's comprehensive *Tagalog-English Dictionary* that contain [sC] clusters, and so we will not attempt to incorporate them into the present theory.

(29) Tagalog clusters (Schachter and Otanes 1972, French)

 a. Cy: py, ty, ky, by, dy, gy, my, ny, fy, sy, hy, ly, ry
 b. Cw: pw, tw, kw, bw, dw, gw, mw, nw, fw, sw, hw, lw, rw
 c. Cr: pr, tr, kr, br, dr, gr, fr
 d. Cl: pl, kl, bl, gl, fl

Steriade herself hypothesizes that obstruent-lateral segments are essentially affricates, with a privative [lateral] feature realized on the consonantal release. Bakovic (1994) argues the tap to likewise be an approximant; it is a short formal leap to suppose that [r] may form the release phase of a stop. Labialized and palatalized segments may be represented with a VPLACE specification on the consonantal release. The necessary feature-geometric structures are shown below.

(30) Complex segments

palatal	labial	rhotic	lateralized
C^y	C^w	C^r	C^l
seg △ A_0 A_{max} | | PL VPL | [cor]	seg △ A_0 A_{max} | | PL VPL | [lab]	seg △ A_0 A_{max} | \\ PL PL [rho] | [cor]	seg △ A_0 A_{max} | \\ PL PL [lat] | [cor]

Not decomposable into single segments are fricative-approximant sequences [fy, sy, hy, fw, sw, hw] and approximant-approximant sequences [my, ny, ly, ry, mw, nw, lw, rw]. It is observable, however, that all such sequences—like, in fact, the majority of the other obstruent-glide pairs listed—in Tagalog are the result of allegro speech (i.e., optional) glide-formation in the language occurring when a high vowel precedes a homorganic glide. As such, we may safely preclude such clusters from the space of allowable inputs to the verbal morphology. The remaining recalcitrant clusters [fl] and [fr] occur only in a few nominal borrowings, and so again simply do not occur in an environment relevant to the workings of the theory.

It remains to be seen how this theory of sub-segmental complexity accounts for the facts of Tagalog infixation. The argument runs as follows. Up to this point, we have considered *COMPLEX to be a constraint on segments in onset position, *COMPLEX-ONSET. Suppose instead that we are dealing with a very different species of complexity avoidance, *COMPLEX-SEGMENT (*CXSEG). Variation is arrived at through a lexical indeterminacy brought about through oscillation on the part of the speaker between native and non-native stratal specification, and, concordant with our early findings about lexical strata in the language, we will argue that this results from differing rankings of stratally indexed faithfulness. Before we get into the specifics of exactly what kinds of faithfulness constraints govern complex segments, observe that, where a set of generic faithfulness to input loan words "F_{loan}" dominates *CXONS and *CXSEG, either input—one with a complex onset or complex segment—may surface in the language. In words belonging to the native stratum, however, a very different situation emerges. As both complex segments and onsets are ruled out therein, we may safely conclude F_{native} (or simply more general, stratum unspecified faithfulness) to be dominated by *CXONS and *CXSEG; all native stratum inputs thus neutralize to a least-marked structure of the CV~ syllable canon above.

(31) Variation by lexical strata

input	*winner ~ loser*	F_{loan}	*CXONS	*CXSEG	F_{native}
/pˈenoh/$_{loan}$	a. pˈenoh ~ prenoh b. ~ pVrenoh	W	W	L	
/prenoh/$_{loan}$	c. prenoh ~ pˈenoh d. ~ pVrenoh	W	L	W	L
/C^{C}V.../$_{native}$	e. CVCV... ~ C^{C}V...			W	L
/CCV.../$_{native}$	f. CVCV... ~ CCV...		W		L

As for the make-up of F, only two constraints are here needed to drive the above variation and attendant differences in loanword infixation. The first is, of course, DEP-V;

it prevents epenthesis to avoid structural complexity. The second constraint must simply penalize any candidate which changes the aperture node structure of a given input—for simplicity, IDENT(Aperture)[24]—as for example splitting a single complex segment into two output segments or v.v. Where the latter dominates and the former is dominated by *CxSEG, the observed (varying) inputs above will surface, one (CC) broken by infixation, the other (C^C) unmolested.

(32) Free variation regained

◇ IDENT(Aperture) := If segment $x \in S_1$ is A$_\gamma$, then segment $x' \in S_2$ is A$_\gamma$ and $x \Re x'$. (Keer)

a. Underlying [C^C] preserved

/um+g^{r}adwet/	IDENT(A)	LIN^2	*CxSeg	Dep-V	NoCoda
a. g-um-radwet	*!				*
a. gr-um-adwet	*!	**			
☞ b. g^r-um-adwet			*		
c. g-um-Vradwet	*!			*!	

b. Underlying [CC] broken by *um*

/um+gradwet/	IDENT(A)	LIN^2	*CxSeg	Dep-V	NoCoda
☞ b. g-um-radwet					*
c. gr-um-adwet		*!*			
d. g^r-um-adwet	*!		*		
d. g-um-Vradwet				*!	

Thus, the high-ranking of F allows the full range of variation in the case of loan words; no variation (or complex structure of any kind) is allowed in the native vocabulary. We have effectively put the locus of variation in the lexicon and the ranking of stratally-indexed faithfulness, in turn dispensing with constraint ties and the formal problem they pose. This is essentially the 'neutralization' approach to optionality in OT employed by Bakovic and Keer in their numerous treatments of free variation in syntax (Bakovic 1996, Bakovic and Keer 1997). The inherent complication of this approach to optionality in phonology is a notional bundling of *varying* with *contrasting*, the unfortunate consequence here being a language in which complex onset and complex segments may

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[24] This constraint is formally equivalent to simultaneous ranking of relational faithfulness constraints UNIFORMITY and INTEGRITY; we use it for the sake of tabular clarity.

be somehow contrastive. As this is not, to my knowledge, attested anywhere, we must relegate some aspects of the problem to a fuller theory of lexical contrast in OT. Some additional evidence for this approach to cluster variation is found in another verbal paradigm, however. The Tagalog OBJECT-FOCUS (OBJF) morpheme *in* is almost identical to *um* in its infixation properties—it infixes after the first consonant in native words, and infixes variably in loan words with initial clusters. The only phonological difference between the morphemes is that, when *in* is affixed to a sonorant-initial root, it (optionally) undergoes internal metathesis to *ni* to avoid placement after the root-initial sonorant, for example as in /in + lagyan/ → [ni-lagyan] [l-in-agyan] 'was putting in/on'. Interestingly, Tagalog loans with putative CC onsets that undergo *in* infixation never show this metathesis to *ni*, optionally or otherwise (*p-in-lanta* ~ *pl-in-antsa* ~ **ni-plansta* 'iron.OBJF').[25] This follows straightforwardly from the current theory: [pl] is not an obstruent-sonorant sequence, but rather a single laterally released plosive.[26]

2.4. Other approaches

We would be remiss to consider these claims without the often denuding light of counter theory. Orgun and Sprouse (1999) argue that this effect may be circumvented in Tagalog with the utilization of an additional component of grammar, CONTROL (comparable with GEN, CON, and EVAL), which acts as a sort of language-specific filter. Contraints in the filter—such as OCP(um), for example—are effectively inviolable, and thus capable

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[25] My informant reports that very small children will occasionally do so, at approximately age 2-3.

[26] There is a noticeable generation difference between younger speakers and older speakers. Filipinos over the age of 50 do not show the variation: **pr-um-enoh* was perfectly marked for the dozen or so older speakers (all Filipino professors with better-than-average linguistic self-awareness) I consulted. A more sensible account of the difference between younger and older speakers might simply be that younger speakers have a high-ranked loan-stratum faithfulness constraint barring the break-up of consonant clusters—i.e., CONTIG-C$_{loan}$—and that the 'optionality' comes in their confusion over whether or not to classify *um*-infixed forms as loanwords or native vocabulary.

of rendering absolutely ungrammatical those candidates that have emerged as most-harmonic on EVAL. Sufficiently damning criticisms of this approach have been proposed in the literature (McCarthy 2002, Klein 2004) to warrant no further consideration of it, however. A number of approaches to hyperinfixation have been presented in the literature, in addition to that of Orgun and Sprouse (Orgun and Sprouse 1999). The two counter-claims we will consider here explicitly promote the use of morpheme-indexed alignment constraints in the positioning of *um*; we will see how the theory proposed in the last section fares against them.

2.4.1. Why not Align-by-σ?

McCarthy (2002, 2003) proposes that hyperinfixation in Tagalog is best avoided with high-ranking of the following constraint, part of a larger schema of categorical constraints penalizing misalignment of morphological and prosodic edges by categories such as *segment*, *syllable*, and *foot*.

(33) ALIGN-BY-σ(Afx, L, Prwd, L) := Violated if a syllable intervenes between Afx and the left edge of the word.

When ranked with Onset and the familiar OCP constraint above MParse and the more traditional alignment constraints (i.e., ALIGN-BY-*seg*), ALIGN-BY-σ effectively rules out any hyperinfixation candidate, making the way for the null parse to emerge optimal against the prohibitions of low-ranked MPARSE.

(34) The workings of ALIGN-BY-CAT w.r.t hyperinfixation

/um+sulat/ → s-um-ulat	ALIGN-BY-σ	ONSET	OCP	MPARSE	ALIGN-BY-*seg*
a. ~ *um-sulat		W			L
b. ~ *sul-um-at	W				L
c. ~ *Ø				W	L
/um+mahal/ → Ø					
d. ~ *um-mahal		W		L	W
e. ~ *m-um-ahal			W	L	W
f. ~ *mah-um-al	W			L	W

The approach has obvious appeal in comparison with that offered in §2.2: it requires no consideration of structural complexity below the level of the segment when ruling out the hyperinfixation candidate(s). The faithfulness approach advocated here however has the advantage over McCarthy's on two fronts, primarily as a result of certain basic shortcomings of the alignment theory of PoE within which the account is couched. First, the LIN^2 account penalizes hypermetathesis the same way it penalizes hyperinfixation—it thus makes short formal work of two formally ideantical phenomena. Alignment constraints (by *seg*, σ, or otherwise), on the other hand, have nothing to say about avoidance of hypermethesis in Faroese; since metathesis occurs there within a single morpheme, the edges of the involved morphemes are, as a whole, never de-aligned.

Consistent with our larger observations in Chapter One, the LIN^2 approach also avoids morpheme-specific alignment of any kind. It might be argued that ALIGN-BY-σ is simply a general (i.e., not morphologically indexed) constraint of CON, and so could be put to use in ruling out hyperinfixation without the attendant leakages to an explanatory theory of PoE dependent upon alignment constraints alone. Consideration of Ilokano, a language closely related to Tagalog, seems to suggest that such a construal of ALIGN-BY-σ is infeasible. Consider the relevant phenomenon below. Here two morphemes, the familiar actor-focus constraint *um* and an intensifier *an*, may both infix to satisfy high-ranked ONSET.

(35) Ilokano -*an*- infixation (Vanoverburgh 1955)

    a.   <u>ag+an+root</u>
          /ag+an+sultip/ → ag-s-an-ultip 'he blows a whistle with force'
          /ag+an+bitog/ → ag-b-an-itog 'he thumps'

    b.   <u>um+an+root</u>
          /um+an+dasadas/ → d-um-an-asadas 'it rustles'
          /um+an+bitog/ → b-um-an-itog 'he thumps repeatedly'
          /um+an+wesnes/ → w-um-an-esnes 'he whirs along'

If the ALIGN-BY-σ is a general markedness constraint, an account of these facts runs into an immediate dilemma: the internal positioning of *um* and *an* cannot be determined by alignment, and so falls prey to lower-ranked markedness. In the tableau below, we see that the candidate with the desired morpheme order, *-um-an-*, is harmonically bounded by the ungrammatically-ordered candidate because generic ALIGN-BY-σ and ALIGN-BY-*seg* assign violation marks to the two candidates identically. Here the familiar OCP(onset) constraint we saw evidenced Tagalog is left to pick the winner. Observe that it doesn't matter how high or low the OCP constraint is ranked in the grammar;[27] as long as the PoE constraints cannon make a clear surface distinction between *-um-an-* and *-an-um-*, the markedness constraint will rule out the desired optima.

(36) Faulty prediction in placement of *an* for generic ALIGN-BY-σ

/um+an+wesnes/	ONSET	ALIGN-BY-σ	ALIGN-BY-*seg*	OCP
a. um-an-wesnes	*!	an: *	an: *	
b. w-um-esnes-an		an: *	um: * an: *	*!
☞ c. w-um-an-esnes		an: *	um: * an: *	*!
☛ d. w-an-um-esnes		um: *	an: * um: *	

The only solution available to the alignment theory of PoE is indexation of particular constraints to particular morphemes. Where ALIGN-BY-σ is so indexed and ranked above OCP, the desired morpheme order is saved from the vagaries of (potentially otherwise inactive) markedness.

(37) Necessity of m-specific ALIGN-BY-FT(um)

um+an+wesnes	ALIGN-BY-σ(um)	OCP
☞ a. w-um-an-esnes		*
b. w-an-um-esnes	*!	

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[27] Presumably the constraint is inactive in the actual grammar of Ilokano, else *w-um-an-esnes* would not surface.

In contrast, a precedence faith account of the phenomenon requires no morpheme-indexation, and is, in any case, not subject the criticisms we levied against the m-specific alignment theory. As long as either of the LINEARITY constraints we have discussed thus far, LINEARITY and LIN^2, are ranked above OCP, the desired order surfaces. LINEARITY marks both candidates in question, but prefers that with the -um-an- order found in the input. LIN^2 does not mark the optimal candidate at all, since each segment of each affix only reverses precedence with respect to a single segment in the output, the root-initial one.

(38) Correct predictions for the precedence F theory

/um+an+wesnes/ →	LINEARITY	LIN^2	OCP
w-um-an-esnes ~ w-an-um-esnes	W	W	L

Note too that an ALIGN-BY-X account of the Ilokano facts, even allowing for morphologically index alignment, suggests the possibility of staged hyperinfixation, where, for example, hyperinfixation beyond a foot is prohibited, but hyperinfixation beyond a syllable is not. Central to McCarthy's theory is the understanding that categorical alignment violations may be counted over any prosodic category: σ, Ft, Prwd. Indeed, the necessity of ALIGN-BY-Ft is easily discernable for Ilokano, since ALIGN-BY-σ/-seg constraints for the morpheme an—once higher-ranked constraints force violation as in the tableau below—are irrelevant in computation of optimal exponence position, leaving only ALIGN-BY-Ft(an) as the only positional constraint that can chose between the two orders. The follows simply from McCarthy's primary thesis, that alignment constraints are non-gradient.

(39) Necessity of ALIGN-BY-*Ft* in the alignment theory of PoE

um+an+wesnes	ALIGN-BY-σ(an)	ALIGN-BY-*seg*(an)	ALIGN-BY-*Ft*(an)
☞ a. w-um-an-esnes	*	*	
b. w-um-esnes-an	*	*	*

This results in the possibility of hyperinfixation by degree. If, for an Ilokano´, say, the ranking {ALIGN-BY-Ft >> M >> ALIGN-BY-σ, ALIGN-BY-*seg*} obtains, M may force hyperinfixation of one morpheme to a position just beyond the first syllable of the output word, but no farther. Whether such a language exists remains an empirical question, but it is observable that the LINEARITY approach makes no such gradual differentiation between hyperinfixation candidates. Since LINEARITY distinguishes candidates such as (a) and (b) above on the order of some 10 violation marks, and high-ranked LIN^2 would rule out any migration of *an* away from its post-*um* input positioning, it is apparent that the only distinction possible under the LINEARITY-based theory is between languages (or, i.e., particular morphemes in them) that do hyperinfix beyond a segment (to any position mandated by the remainder of the constraints in the grammar) and those that do not.

2.4.2. Prosodic Subcategorization and overgeneration

Yu (2003) argues that infixation is not formally characterizable as prosodic morphology, at least as originally envisioned by McCarthy and Prince (1993), and that all forms of infixation, be they prosodically conditioned or otherwise, are to be derived ranking of from prosodic-subcategorizational constraints, schematized below, where 'pivot' refers to any of a variety of prosodic categories adjacent to which infixes are known to occur in Yu's typology of some 130 infixation patterns attested in natural language.