

OPTIMAL INTERLEAVING: SERIAL PHONOLOGY-MORPHOLOGY INTERACTION IN A
CONSTRAINT-BASED MODEL

A Dissertation Presented

by

MATTHEW ADAM WOLF

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2008

Department of Linguistics

© Copyright by Matthew Adam Wolf 2008

All Rights Reserved

OPTIMAL INTERLEAVING:
SERIAL PHONOLOGY-MORPHOLOGY INTERACTION IN A CONSTRAINT-BASED MODEL

A Dissertation Presented

by

MATTHEW A. WOLF

Approved as to style and content by:

John J. McCarthy, Chair

Joseph V. Pater, Member

Elisabeth O. Selkirk, Member

Mark H. Feinstein, Member

Elisabeth O. Selkirk, Head
Department of Linguistics

ACKNOWLEDGEMENTS

I've learned from my own habits over the years that the acknowledgements are likely to be the most-read part of any dissertation. It is therefore with a degree of trepidation that I set down these words of thanks, knowing that any omissions or infelicities I might commit will be a source of amusement for who-knows-how-many future generations of first-year graduate students. So while I'll make an effort to avoid cliché, falling into it will sometimes be inevitable—for example, when I say (as I must, for it is true) that this work could never have been completed without the help of my advisor, John McCarthy. John's willingness to patiently hear out half-baked ideas, his encyclopedic knowledge of the phonology literature, his almost unbelievably thorough critical eye, and his dogged insistence on making the vague explicit have made this dissertation far better, and far better presented, than I could have hoped to achieve on my own.

Joe Pater provided invaluable assistance through his reliable talent for noticing important connections and implications which no one else would have. My conversations with Lisa Selkirk resulted in major improvements in the exposition of the thesis, and brought many important foundational questions to the surface which would otherwise have remained dormant. With Mark Feinstein I had valuable exchanges regarding the place of my theory within a broader cognitive picture.

The basic idea pursued in this thesis—putting spell-out and phonology in one tableau—was born in an independent study on morphological theory with Peggy Speas. Gaja Jarosz, John Kingston, Chris Potts, and Ellen Woolford also provided helpful

comments related to material contained herein. Chris Potts and Lyn Frazier deserve special thanks for overseeing the torturously over-long writing of my second general's paper. It was a privilege to work with Kyle Johnson the first time that I TAed Linguistics 201. My other teachers Angelika Kratzer, Tom Roeper, and Yorghos Tripodis helped make me a more well-rounded linguist. My undergraduate linguistics teachers, in particular Bill Badecker, Luigi Burzio, Robert Frank, and Paul Smolensky, helped lay the earliest foundations for this project.

My fellow phonology students have made UMass a great place to do what I do. Leah Bateman, Michael Becker, Tim Beechey, Emily Elfner, Kathryn Flack, Elena Innes, Shigeto Kawahara, Mike Key, Wendell Kimper, Kathryn Pruitt, Anne-Michelle Tessier, and Adam Werle deserve particular thanks. Outside the phonology world, Rajesh Bhatt, Tom Braden, Shai Cohen, Amy Rose Deal, Andrew McKenzie, Barbara Partee, Helen Stickney, and Youri Zabbal helped in their different ways to make the grad school experience nicer. Tim Beechey, Ilaria Frana, Vincent van Gerven-Oei, Tanja Heizmann, Keir Moulton, and Florian Schwarz were excellent company to have during the roller-coaster ride of first year.

Many parts of this dissertation owe a significant debt to the assistance of phonologists from beyond UMass. The 'once/always' and 'only one way of deriving counts' predictions of the account of non-derived environment blocking in chapter 4 were identified by Donca Steriade. The analyses of Dyirbal and Pitjantjatjara in chapter 2 are adapted from my chapter 'Lexical insertion occurs in the phonological component' (Wolf to appear), which is forthcoming in *Understanding Allomorphy: Perspectives from OT*, edited by Bernard Tranel, whom I thank for inviting me to

contribute to the volume. The same material was presented in somewhat different form at the 15th Manchester Phonology Meeting, where I received valuable feedback from Ricardo Bermúdez-Otero, Patrik Bye, Bruce Morén, Mary Paster, Jochen Trommer, and Christian Uffman. Marc van Oostendorp also shared interesting comments on the chapter. I had fruitful discussions of NDEB and allomorph selection with Joan Mascaró. I presented portions of chapter 3 at Reed College in April 2008, where I received many helpful comments and questions, especially from Matt Pearson. Over the years, I've also had valuable exchanges about various aspects of the phonology/morphology interface with Adam Albright, Lev Blumenfeld, Luigi Burzio, Paul de Lacy, Melissa Frazier, Gillian Gallagher, Bruce Hayes, Ania Łubowicz, Ehren Reilly, Curt Rice, Patricia Shaw, and Paul Smolensky. At HUMDRUM 2006 at Johns Hopkins, I also had the chance to get comments on a (very) early version of the dissertation's core proposal from Alan Prince and Bruce Tesar. Extra-special thanks are due to Elizabeth Zsiga and everyone else at Georgetown for offering me a job, which provided crucial motivation for getting this thing finished.

Kathy Adamczyk, Sarah Vega-Liros, Lynne Ballard, and Tom Maxfield cannot be thanked enough for their many acts of administrative help.

Pages could be filled describing the ways in which Karen Jesney helped keep me level-headed throughout the dissertation process, and the many times when she patiently put up with me when I couldn't keep myself from coming unhinged. Her intellectual assistance was just as valuable. My parents were unfailing in their willingness to help me in every way that I asked, even as I retreated further and further into the cocoon of late-stage dissertating. The completion of this work was made

immeasurably easier by a University of Massachusetts University fellowship, which allowed me to focus full-time on this project for the last twelve months. I am eternally in awe of everyone who has ever completed a Ph.D. on time while also teaching in their dissertation year.

ABSTRACT

OPTIMAL INTERLEAVING: SERIAL PHONOLOGY-MORPHOLOGY INTERACTION IN A
CONSTRAINT-BASED MODEL

SEPTEMBER 2008

MATTHEW ADAM WOLF, B.A., THE JOHNS HOPKINS UNIVERSITY

PH.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Professor John J. McCarthy

This dissertation proposes a novel theory of the phonology-morphology interface called Optimal Interleaving (OI). OI is based on Optimality Theory with Candidate Chains (OT-CC), which is proposed by McCarthy (2007a) as a serial architecture for Optimality Theory (Prince & Smolensky 2004 [1993]). OI adds to OT-CC the hypothesis that morphological spell-out (Halle & Marantz 1993's 'vocabulary insertion') occurs in the phonological component of the grammar. OI thus allows phonological and morphological operations to be interleaved in a fashion similar to that assumed in the theory of Lexical Phonology (Kiparsky 1982a,b, Mohanan 1982).

Chapters 2 and 3 argue that OI makes a number of correct predictions about phonologically-conditioned allomorph selection. Chiefly, OI derives the empirical generalization that allomorph selection is always opaque with respect to phonology conditioned by the competing allomorphs (Paster 2005, 2006, to appear). It does so while keeping phonologically-driven allomorphy in the phonology and governed by phonological constraints. OI therefore avoids a version of the Duplication Problem (Clayton 1976) which is faced by theories which derive the opacity generalization by

attributing all allomorph selection to subcategorization in the morphology (Paster 2005, 2006, to appear; Bye 2007).

Chapter 4 shows that OI, and more generally OT-CC, can be applied to non-derived environment blocking (NDEB: Kiparsky 1973a). It is shown that OI makes five correct predictions about NDEB which are not collectively predicted by any other theory of this phenomenon. OI achieves these results without having to make any special assumptions specific to NDEB. This places OT-CC at a considerable advantage as a theory of opacity relative to rule-based phonology, where NDEB requires stipulated restrictions on rule application like the Strict Cycle Condition (Kean 1974, Mascaró 1976).

Chapter 5 shows that OI also lends itself to the two other main types of serial phonology/morphology interactions: ‘cyclic’ overapplication of a process, and underapplication of a process in a morphologically-derived environment. The chapter also critiques existing theories of these effects, particularly OO-faithfulness (Benua 1997), Stratal OT (Kiparsky 2000), and the phonological application of the theory of phases (Marvin 2002).

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	iv
ABSTRACT	viii
LIST OF TABLES	xiv
CHAPTER	
1. INTRODUCTION	1
1.1 Desiderata for a theory of phonology-morphology interaction	1
1.2 Integrating phonology and morphology	12
1.2.1 The standard view: Morphology strictly precedes phonology	12
1.2.2 Realizational morphology	14
1.2.3 Allomorphy and the nature of the input to the phonology.....	20
1.2.4 Morphological constraints on morph selection	25
1.2.5 OI vs. declarative morphology.....	28
1.3 Implementing the serial realization of morphological structure.....	30
1.3.1 Opacity and OT	30
1.3.2 How OT-CC works	33
1.3.3 Chain merger and crucial interaction	41
1.3.4 MAX-M(F) constraints, harmonic improvement, and economy of lexical insertion	44
1.3.5 Extending OT-CC to opaque phonology/morphology ordering	45
1.3.6 Chain merger and morphological derived environment effects	50
1.4 Overview of the dissertation.....	57
2. SPELL-OUT WITHIN THE PHONOLOGY	59
2.1 Introduction	59
2.2 Faithfulness constraints on morpheme-morph correspondence.....	65
2.2.1 Defining morphemes, morphs, and features.....	65
2.2.2 MAX and DEP constraints in morphology	68
2.2.3 Beyond the Subset Principle: MAX-M(F) » DEP-M(F)	75
2.2.4 Faithfulness and morph order	79
2.3 Arbitrary preference and MAX-M(F) violation.....	84

2.3.1 Introduction	84
2.3.2 The need for arbitrary preference in Dyirbal	85
2.3.3 Analysis of the Dyirbal ergative	89
2.3.4 Problems with competing theories of arbitrary preference	94
2.3.5 Comparison with subcategorization approaches	101
2.3.6 MAX-M(FS) violation: When no morph is inserted	109
2.4 Phonologically-conditioned mismatches: DEP-M(F) violation	117
2.4.1 Gender discord in Spanish	117
2.4.2 Gender discord in Modern Hebrew.....	123
2.5 Phonological markedness and allomorphic economy	127
2.5.1 Blocking candidates with superfluous allomorphs	127
2.5.2 When extra morphs are inserted, part I: ‘Epenthetic’ morphs and DEP-M(FS) violation.....	135
2.5.3 When extra morphs are inserted, part II: Phonologically- conditioned violation of morphosyntactic constraints disfavoring spellout.....	139
2.6 Conclusion.....	145
3. THE SERIAL INSERTION OF MORPHS	146
3.1 Introduction	146
3.2 ‘Lookahead’ In phonology/allomorphy interactions.....	147
3.3 The order of spell-out	158
3.4 OI with root-outwards spellout assumed.....	160
3.4.1 On Local Optimality and the need to assume it	160
3.4.2 How Local Optimality prevents allomorphic lookahead.....	165
3.4.3 Local Optimality allows (some) do-something vs. do-nothing choices to look ahead.....	174
3.4.4 ‘Epenthetic’ morphs can look ahead	185
3.5 OI without stipulated root-outwards spellout	186
3.5.1 Introduction	186
3.5.1.1 Excursus: Additional motivations for abandoning root- outwards spellout	187

3.5.2	Deriving a violable preference for root-outwards spellout	189
3.5.3	Outwards-sensitive PCSA	193
3.5.3.1	Roots	194
3.5.3.2	Affixes	197
3.6	Lookahead to phonological effects: Possible examples	198
3.7	Local ordering of phonological and morphological processes	208
3.8	Infixation and morph placement in OI	219
3.9	Extending OI above the word level	233
3.10	Conclusion	242
4.	NONDERIVED ENVIRONMENT BLOCKING	244
4.1	The phenomenon	244
4.2	Predictions of the OI/OT-CC approach to NDEB	262
4.2.1	There are DEEs that occur in phonologically-derived environments	262
4.2.2	Vacuously-derived environments don't license application of DEEs	263
4.2.3	Environments can be derived via removal of a blocking condition	273
4.2.4	DEEs can apply in only one kind of derived environment	287
4.2.5	Once NDEBed, always NDEBed	303
4.3	Problems with competing theories of NDEB	310
4.3.1	Immunity-by-prespecification	311
4.3.2	Local conjunction	315
4.3.3	Contrast preservation	323
4.3.4	Faithfulness-based approaches	325
4.3.5	Stratal OT and OO-faithfulness	335
4.3.6	Rule-based approaches	340
4.4	On discarding the $F_2 \gg \text{PREC}(F_1, F_2)$ ranking metaconstraint	348
4.4.1	Obligatorially-counterbleeding processes	348
4.4.2	Spontaneous opacity in child language	353

5. CYCLIC OVERAPPLICATION AND DERIVED ENVIRONMENT BLOCKING	358
5.1 Introduction	358
5.2 Cyclic overapplication	361
5.2.1 The empirical domain	361
5.2.2 A prediction: One cycle of overapplication per word.....	363
5.2.3 Multiple cycles of overapplication from positive PREC(P,M) constraints	368
5.2.4 ‘Cyclicity’ from lexical insertion of stored surface forms.....	375
5.3 Derived Environment Blocking	385
5.3.1 DEB and its handling in OI.....	385
5.3.2 DEB can protect affixes from unfaithful mappings.....	390
5.3.3 Protection of affix-internal marked structure.....	394
5.4 Competing theories: Stratal OT	400
5.4.1 ‘Has a wider morphosyntactic domain’ does not imply ‘derivationally later’	401
5.4.2 Opacity within a stratum.....	404
5.4.3 Bracket erasure	411
5.5 Competing theories: Cyclicity from phases.....	415
5.6 Doing without root-outwards spellout.....	419
6. CONCLUSIONS AND FUTURE DIRECTIONS.....	423
6.1 Overview of results.....	423
6.2 Process morphology	426
6.3 Can phonology operate on morphs before they're ‘inserted’?	436
6.4 The treatment of exceptions.....	447
6.5 Reduplication	449
6.6 Envoi	450
REFERENCES.....	451

LIST OF TABLES

Table 1.1	Dutch number/gender agreement suffixes.....	19
Table 2.1	Dutch number/gender agreement suffixes.....	71
Table 2.2	Czech case paradigms	77
Table 2.3	Number and definiteness markers of Kõnni noun classes	103
Table 2.4	Syllable-counting allomorphy of person/number suffixes in Sami	106
Table 2.5	Distribution of [pa] in Pitjantjatjara	136
Table 3.1	Predictions of different theories regarding allomorphic lookahead	156
Table 3.2	Present tense paradigm of Italian ‘to finish’	179
Table 3.3	Paradigms of Western Armenian nouns with singular possessors.....	180
Table 3.4	Paradigms of Western Armenian nouns with plural possessors.....	181
Table 3.5	Portuguese plural/diminutive paradigms.....	188
Table 3.6	Present tense paradigm of Italian <i>rompere</i>	194
Table 3.7	Present tense paradigms of Italian <i>andare</i> and <i>uscire</i>	195
Table 3.8	Syllable-counting allomorphy of person/number suffixes in Sami.....	203
Table 3.9	Tigrinya 1st and 3rd person possessive suffixes.....	210
Table 3.10	Phonological tendencies on ordering of fixed expressions in English ..	230
Table 4.1	English vowel-shortening patterns as classified by Burzio (1994)	269
Table 4.2	[e]~[i] alternations in Finnish disyllabic noun stems	291
Table 4.3	Finnish partitive allomorphy.....	292
Table 4.4	Allomorphic split in Finnish disyllabic [i]-stems.....	292
Table 5.1	Token frequency and cyclic vs. non-cyclic stress in English.....	379

Table 5.2	Arammba third person absolutive singular verbal prefixes.....	395
Table 5.3	Structures for Seoul Korean ‘price-NOMINATIVE’ in phase-based analysis of cyclicity	418
Table 5.4	Portuguese plural/diminutive paradigms	419
Table 5.5	Vowel coalescence with Pashto negative and perfective markers.....	422
Table 5.6	Overapplication of Pashto vowel coalescence with clitics.....	422

CHAPTER 1

INTRODUCTION

1.1 Desiderata for a theory of phonology-morphology interaction

This dissertation is about the interplay of two aspects of natural language grammars: morphology and phonology. Specifically, I will be concerned with conflicts between phonological wellformedness requirements (phonological markedness) and certain kinds of morphological wellformedness requirements, and about how the operations that enforce both kinds of wellformedness requirements interact serially.

I will be assuming a model of morphology in which two distinct kinds of morphological wellformedness conditions exist. The conditions of the first kind are essentially syntactic in nature. These include things like the Righthand Head Rule (Williams 1981, Selkirk 1982), restrictions on the relative ordering of various functional categories, cross-linguistic differences with respect to which numbers, genders, persons and so forth are distinguished by the language, principles governing which inflectional features a word receives in different sentential contexts, and the like. These wellformedness conditions regulate how the abstract meaningful features of words are assembled into hierarchical structures. The abstract, feature-bearing terminal nodes of these tree structures are what I will henceforth be referring to with the word *morpheme*.

Morphological wellformedness conditions of the second type are responsible for selecting an overt phonological expression for the abstract morphemes which make up a word. These conditions will specify, for instance, that a morpheme containing a gender feature [masculine] should not be expressed using an affix that is specified with

a gender feature [feminine]. The lexically-listed, phonologically-contentful items which are used to express or ‘spell out’ morphemes are what I will call *morphs*. (More will be said later in this chapter about the theoretical justifications for assuming a separation between morphemes and morphs.)

I will be focused on morphological wellformedness conditions of the second type, and whenever I refer without qualification to ‘morphological’ constraints, I mean those which impose conditions on the choice or arrangement of morphs. These morphological wellformedness conditions, unlike those of the first kind, are directly concerned with phonology. This is because they make demands about which morphs—that is, which phonological strings—should appear in a given word. These morphological conditions therefore can directly come into conflict with phonological wellformedness conditions. It can happen that a morph which more faithfully expresses the abstract features of its corresponding morpheme will be more marked phonologically than a competing morph which expresses those features less faithfully.

Interestingly, conflicts of this sort between phonological and morphological demands are not always resolved in the same way. Sometimes one demand wins out, and sometimes the other does. A well-known case in which phonology has been argued to win is found in Spanish. The definite article in Spanish is generally *el* with masculine nouns and *la* with feminines. However, with certain exceptions, feminine nouns that begin with stressed [á] take *el* rather than *la*: *el arma* ‘the weapon’, *el agua* ‘the water’. Spanish generally fuses sequences of two identical vowels into one, but fusion is blocked if the second vowel is stressed (Cutillas 2003: 175-184). Therefore, using *el* instead of *la* with [á]-initial nouns allows the grammar to avoid an [a.á] hiatus which

could not be repaired using an unfaithful mapping. On this analysis, the phonological pressure to avoid hiatus—a phonologically marked configuration—trumps the morphological pressure to use lexical items whose gender matches that of the abstract morphemes that they spell out.

Not all phonological markedness preferences are able to compel a gender mismatch in the selection of morphs, however. For instance, using *el* before a C-initial masculine noun will cause the article's [l] to be syllabified as a coda. The resulting violation of the markedness constraint NoCODA could be avoided by using *la* instead. However, masculine nouns always take *el*, indicating that faithful expression of gender features is accorded higher priority than avoiding codas.

Of the two possible outcomes of phonology-morphology conflict, morphology beating phonology is by far the more prosaic of the two possible outcomes. If phonology always won, then the phonologically least-marked collection of roots and affixes that could be assembled from a language's lexical resources would be used to spell out every word of the language, regardless of what the word meant. The abundance of lexical contrasts in all human languages is thus in part a matter of faithful exponence of morphological features taking priority over phonological markedness. Still, the more exotic outcome, where phonology beats morphology, is attested in a number of languages. Examples like the Spanish one, where feature-mismatches are tolerated for phonological reasons, have also been argued for in Modern Hebrew (Berent, Pinker & Shimron 1999, 2002, Becker 2008), English (Dixon 1977, cf. Nathan 1981, Sparks 1984), French (Tranel 1996a,b, cf. Lamarche 1996, Mascaró 1996a, Lapointe & Sells 1997, Janda 1998), and Ondarroa Basque (Côté 1999, 2000). The

phonology arguably can also force a surface ordering of lexical items which fails to correspond to the hierarchical ordering of the word's tree structure, for instance in infixation (Prince & Smolensky 2004 [1993], McCarthy & Prince 1993a,b) and affixes which alternate between prefix- and suffix-hood (Fulmer 1991, Noyer 1994, Stemberger & Bernhardt 1999). Lastly, it's been argued that the phonology can compel the insertion of meaningless dummy affixes which serve to satisfy some phonological requirement but which simply aren't needed for purposes of feature spell-out. This has been suggested to occur in, among other languages, Nunggubuyu (Heath 1984), Alabama (Montler & Hardy 1991), Axininca Campa (Black 1993), Slavey (Howard 1990), Navajo (Young & Morgan 1987), Pitjantjatjara (Hale 1973), Spanish and French (Allen 1976), and Seri, Hungarian, and Icelandic (de Lacy 2002).

These examples motivate what we can regard as a first desideratum for a general theory of the phonology-morphology interface:

- (1) The phonology and morphology are sufficiently closely integrated that, when their demands come into conflict, languages may vary as to which is able to win.

In this dissertation, I will pursue desideratum (1) by assuming that constraints on morphological wellformedness and those on phonological wellformedness are enforced by a single module of the grammar, and that this grammar is an Optimality-Theoretic one (Prince & Smolensky 2004 [1993]). In Optimality Theory (OT), a grammar consists of a set of potentially conflicting constraints which are violable and ranked. If morphological and phonological wellformedness constraints occupy a single OT grammar, it comes as no surprise that wellformedness conditions of each type can be

violated for the sake of better satisfying some wellformedness condition of the other type.¹

In addition to interacting in the form of direct competition between their wellformedness demands, there is also reason to think that phonology and morphology interact in a serial fashion. That is, there is evidence that phonological and morphological steps can be interspersed with one another in the course of a single derivation. Such evidence arises when the application of a phonological process at a particular location is affected by where that location is within the word's morphological bracketing. There are several ways in which this can happen; perhaps the best-known situation where it does in cyclic effects (Chomsky, Halle & Lukoff 1956, Chomsky & Halle 1968). A classic example of phonological cyclicity involves the so-called initial-dactyl effect in English (Hammond 1989). Monomorphemic five-syllable words where the first three syllables are light get main stress on the penult and an initial secondary stress: *Tàtamagóuche*, *Wìnnepesáukee*, *Lòllapáloza*, *dèlicatéssen*, *àbracadábra*. Polymorphemic words like *imàginátion*—which is stressed thus, and not as **ìmaginátion*—are, however, able to deviate from this pattern.

A cyclic account of the stress pattern of *imagination* would assume that this word has the morphological bracketing [[*imagine*]ation], and that the stress rules of English begin by applying not to the whole word, but only to the inner constituent [*imagine*], yielding *imáginé*. Only then do the stress rules look at the entire word, at the next level of bracketing, at which point the primary stress on the second syllable of *imagine* is retained and surfaces as the second-syllable secondary stress of *imagination*. Effects like

¹ For several other models which integrate phonological and morphological constraints into a single OT grammar, Burzio (2002a,b, 2003, 2005a,b, 2006, 2007), Burzio & Tantalou (2007), Teeple (2006), and Fábregas (2007).

these—in which an affixed form inherits phonological properties from its unaffixed base—thus invite a serial theory of phonology-morphology interaction, in which words are built up one morph at a time. In this case, the serial process of word-building interacts with phonology by having the phonology apply and re-apply after the addition of each level of affixation.

Inheritance effects are not alone in providing motivation for a model where phonology interacts with a serial process of word-building. Another pattern that provides the same motivation is the morphological derived environment effect (also known as ‘non-derived environment blocking’ or NDEB). In a morphological DEE, a phonological rule applies if its structural description is created via morph concatenation, but does not apply morph-internally. The classic example is that of Finnish assibilation (Kiparsky 1973a): underlying /t/ becomes [s] if it is followed by an /i/ in a following morph, but [ti] sequences are allowed morph-internally:

- | | | |
|----------------|---|-----------------------------|
| (2) /halut-i/ | → | [halusi] ‘want-PAST’ |
| (cf. /halut-a/ | → | [haluta] ‘want-INFINITIVE’) |
| /koti/ | → | [koti], *[kosi] ‘home’ |

The reverse of a DEE is also attested: there are cases where a phonological rule applies morph-internally, but fails to apply just in case its structural description is created at (certain) morphological junctures. For example, in ancient Greek (Smyth 1956, Blumenfeld 2003b) morpheme-internal obstruent-obstruent clusters are allowed only if the second obstruent is a coronal. However, clusters with a non-coronal as the second member are allowed to surface if they are created through morph concatenation, as in e.g. /ek-bainō/ → [ekbainō] ‘walk out’.

If we assume that words are built in a serial fashion, then effects like these can be understood as ordering conditions on phonological processes, albeit ones which are more formally complex than the kind of ordering conditions on phonological rules which are assumed in classical generative phonology of the *SPE* tradition. Finnish assibilation can only apply if it is *crucially* preceded by morpheme concatenation. It is not simply the case that the rule of assibilation applies after affixation takes place, because root-internal /t/ does not undergo the rule, even if an affix has been added to the root:

(3) /vaati-vat/	→	[vaativat], *[vaasivat] ‘demand-3PL’
/tilat-i/	→	[tilasi], *[silasi] ‘order-PAST’
(Kiparsky 1993a)		

Examples like these show that the restriction on assibilation could not be accurately stated as ‘the rule applies only in affixed words’. Rather, the rule can only apply to a given /t/ if the rule *could not have applied* to that /t/ before affixation: assibilation affects only those /t/’s that didn’t have an /i/ after them until after affixation took place. This relation ‘crucially preceded by’ will play a significant role in the analysis of DEEs and related effects which I will be proposing. As we’ll see later in this chapter and in chapter 4, OT-CC has the formal resources to separate instances of crucial ordering from non-crucial ones, specifically via the mechanism of chain merger. This fact puts the OI/OT-CC account of DEEs at a considerable empirical advantage relative to competing theories.

Viewed in this light, the blocking of phonological processes in (non)-derived environments is clearly related to inheritance effects like that exhibited in the English stress example, since they all involve phonological rules being ordered in a particular

way with respect to the morphological steps by which words are built up. The examples from English, Finnish, and ancient Greek (as well as many others besides) together invite a second desideratum for a theory of phonology-morphology interaction:

- (4) Words are built serially, with one morph added at a time, and phonological processes can be required to be ordered in a particular way relative to the various stages in the process of word-building.

The assumption stated in desideratum (4) is the major premise of the theory of Lexical Phonology (Siegel 1974, Allen 1978, Pesetsky 1979, Kiparsky 1982a,b, 1983, 1984, 1985, 1993a, Mohanan 1982, Strauss 1982, Pulleyblank 1983, Mohanan & Mohanan 1984, Halle & Mohanan 1985; see also Kaisse & Shaw 1985, Kaisse & Hargus 1993, Rubach to appear for overviews), which was the main intellectual successor to the phonological cycle introduced by Chomsky, Halle & Lukoff (1956) and Chomsky & Halle (1968). In Lexical Phonology, the morphology of a language is assumed to be divided into a set of discrete, ordered levels, and that, after a word undergoes affixation associated with a given level, it makes a pass through a battery of phonological rules associated with that level. Morphologically-complex words therefore make multiple passes through the phonology, making it possible for them to exhibit cyclic effects like that seen in the *imagination* example.

The serial structure of Lexical Phonology likewise makes possible several strategies for dealing with derived environment effects like that seen in Finnish assibilation. Because concatenation of an affix is an identifiable step in a serial derivation, it is possible in LP to describe the triggering environment of a phonological rule as being 'derived' or not. One can then directly state a principle of grammar which bans certain kinds of rules from applying in underived environments, such as the Strict

Cycle Condition (Chomsky 1973, Kean 1974, Mascaró 1976).² Alternatively, nonderived environment blocking might be accounted for by assuming that cyclic rules cannot alter prespecified structures (Kiparsky 1993a, Inkelas & Cho 1993, Inkelas 2000). As for the failure of a rule to apply in environments that *are* derived, this can be handled by assuming that the rule is absent (or ‘turned off’) in the phonology corresponding to the level of affixation at which the derived environment in question arises (as in work on the Strong Domain Hypothesis: Selkirk 1982, Kiparsky 1984, Borowsky 1986, Myers 1991) or that phonology precedes morphology at the relevant level (as in work on the Word level, e.g. Borowsky 1993).

Desideratum (4)’s call for a serial model of phonology-morphology interaction is seemingly in conflict with my intention to deal with (1) by assuming an OT model. Most work in OT is nonserial, with just a single mapping from input to output and no intermediate derivational stages. This does not mean that a serial model satisfying desideratum (4) is impossible in OT; indeed there is one widely-used such model already, which is variously known as Stratal OT, Serial OT, Derivational OT, or LP-OT.³ As the last of these names implies, Stratal OT models seek to be updatings of Lexical Phonology, with the main change being that the phonology associated with each

² The SCC as applied to phonology also descends in part from the Alternation Condition (Kiparsky 1968) and the Revised Alternation Condition (Kiparsky 1973a).

³ Stratal OT models are proposed, advocated, or adopted by, among others, McCarthy & Prince (1993b), Orgun (1994, 1996a,b, 1999), Potter (1994), Kenstowicz (1995), Yearley (1995), Booij (1996, 1997), Kiparsky (1997, 2000, 2002, 2007a,b, 2008, to appear), Paradis (1997), Rubach (1997, 2000a,b, 2003a,b, 2004), Cohn & McCarthy (1998), Hale & Kisseck (1998), Hale, Kisseck & Reiss (1998), Bermúdez-Otero (1999, 2003, 2006a,b, 2007a,b,c,d, to appear, in prep.), Ito & Mester (2001, 2003a,b), Kim (2002), Blumenfeld (2003a), Bermúdez-Otero & Hogg (2003), Koontz-Garboden (2003), Anttila, Fong, Beňuš & Nycz (2004, to appear), Hyman & Orgun (2005), Anttila (2006), Colina (2006), Bermúdez-Otero & McMahon (2006), Meir (2006), Morén & Zsiga (2006), Collie (2007), Lesley-Neuman (2007), Orgun & Dolbey (2007), Gibson (2008), and Yun (2008).

morphological level is implemented in an OT grammar, rather than in an ordered-rule grammar *à la* Chomsky & Halle (1968).

In this dissertation, I will propose a different OT model which satisfies desideratum (4). My proposal will be cast within another serial architecture for OT, called OT with Candidate Chains, or OT-CC, which is proposed by McCarthy (2007a,b,d, to appear a,b), building on the foundation of Harmonic Serialism (Prince & Smolensky 2004 [1993]: §5.2.3.3, cf. McCarthy 2000).⁴ Whereas Stratal OT implements serial process-interaction by positing multiple OT grammars which apply in succession, OT-CC implements serialism by elaborating the structure of candidates. Instead of consisting of a direct mapping from input to output, in OT-CC (as the name implies) candidates are *chains* of intermediate forms by which the input is gradually converted into the output.

In the original OT-CC proposal (McCarthy 2007a), cyclic word-building is not assumed. The input to the grammar, which supplies the initial form of each chain, is simply a collection of the underlying forms of all of the roots and affixes making up the word in question. The gradual changes which can be performed upon the input are limited to familiar phonological operations like deletion or epenthesis of a single segment.

My main novel proposal is that insertion of a single morph also be treated as one of the basic derivational steps in OT-CC. Phonological processes then could be forced to apply in a particular order with respect to morph-insertions by OT constraints which evaluate the ordering of operations within chains. It is for this

⁴ See also Becker (2005) for a computational implementation of OT-CC, Shaw (2007) and Gouskova & Hall (to appear) for analyses cast in the theory, and Biró (2007) for some remarks on its learnability properties.

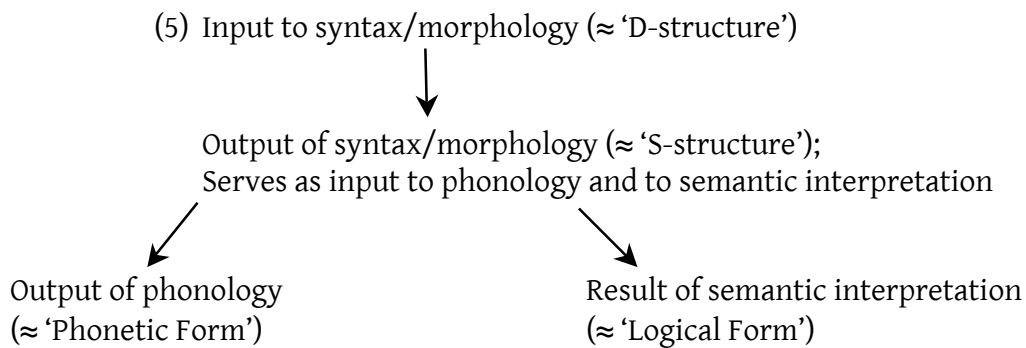
reason that I refer to the model of phonology-morphology interaction that I am proposing as *Optimal Interleaving*. In OI, the serial interleaving of morphological and phonological operations results not from the gross modular architecture of the grammar, as it does in LP or Stratal OT. Rather, crucial phonology/morphology orderings are the result of evaluation of candidates by constraints. The ordering exhibited by the winning candidate arises because that ordering is the most harmonic one that the grammar can use for the input in question. The grammar entertains all possible orderings of the basic operations available to it (subject to certain general wellformedness conditions on possible chains), and there are constraints which will penalize certain orderings. For example, in Finnish assibilation (which we will look at in more detail later) assibilation is blocked in words like /vaati-vat/ by a high-ranked constraint which has the effect of demanding that the /t/ → [s] mapping be crucially preceded by affixation.

The remainder of this introductory chapter will serve to flesh out the two major premises of OI theory, which correspond to the two desiderata adduced in this first section: that the morphology and the phonology are integrated into a single component of the grammar, and that phonological and morphological operations can interact in a serial fashion. Section 1.2 will present my basic assumptions about the nature of morphology and which of its functions are integrated into the phonology; section 1.3 will describe in more detail how OT-CC works and give a preliminary demonstration of how it can be used in the OI model to capture cyclic effects.

1.2 Integrating phonology and morphology

1.2.1 The standard view: Morphology strictly precedes phonology

Most generative linguists assume a model of grammar more or less along the lines of the famous Y-shaped diagram presented in Chomsky (1986):



On this view, syntax and morphology are separate grammatical modules from the phonology. Their outputs are tree structures with morphs decorating the terminal nodes. Each morph contains a (possibly empty) set of meaningful morphosyntactic features and a (possibly empty) set of phonological structures, the latter of which is called the morph’s underlying representation (UR). These tree structures then serve as inputs to the phonology, which assigns a surface phonological shape to the string of morphs that can then be phonetically realized by the articulators, and to the semantics, which computes the meaning of the abstract tree structure. With respect to phonology and morphology, this traditional view that the morphology is done by the time that the phonology gets underway has been explicitly defended in a number of works, including Sproat (1985), Halle & Vergnaud (1987a,b), Szpyra (1987, 1989), Halle & Kenstowicz (1989), Halle, Harris & Vergnaud (1991), and Paster (2005, 2006, to appear). Even in Lexical Phonology and kindred theories, in which the phonology and morphology are serially interleaved, the standard assumption is that morphology strictly precedes

phonology at each level (though see in particular Odden 1990, 1993 for a ‘noninteractionist’ version of LP where all morphology precedes all phonology).⁵

It has also been argued (albeit less frequently) that the grammar defers at least some morphological decisions to be made by the phonology. For example, the linear order of morphs (Prince & Smolensky 2004 [1993]) or the choice of which morph to associate with a certain morpheme (Mester 1994, Kager 1996, Mascaró 1996a,b, Tranel 1996a,b, Dolbey 1997, Yip 1998, Zuraw 2000, Teeple 2006, Bonet, Lloret & Mascaró to appear) might be left fully or partially unspecified in the output of the morphology. These matters would then be settled by the phonology, on phonological grounds.

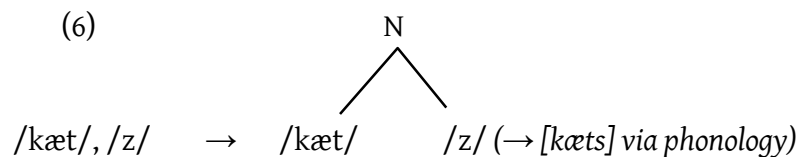
In this dissertation, I propose that this latter view be carried to the logical limit. The output of the morphology, I argue, contains only morphemes arranged in an unlinearized tree structure. All morph selection, and all linearization of morphs, takes place in the same grammatical module as the phonology. In the next two subsections, I explore the existing precedents for this kind of move. Section 1.2.2 ties my proposal to existing arguments that the morphology is ‘realizational’ in character, and section 1.2.3 introduces the motivation for thinking that at least some cases of morph choice are left up to the phonology to decide.

⁵ In versions of LP that incorporate a Word level (Borowsky 1993), phonology is assumed to precede morphology at that level, but the two remain strictly separate grammatical modules.

1.2.2 Realizational morphology

As alluded to in the first paragraph of this chapter, the theory of morphology that I assume in this dissertation separates word-building into two distinct stages: first morphemes (bundles of morphosyntactic features) are assembled into a tree structure, and then morphs are drawn from the lexicon⁶ and associated with the various morphemes. In his taxonomy of morphological theories, Stump (2001) refers to morphological theories of this kind as *realizational*. (The terms ‘separationist’ and ‘late insertion’ are also used to mean more or less the same thing.) Stump contrasts realizational theories with *incremental* ones. Since not all morphologists share the realizationalist view, it will be useful at this stage to review the nature of the realizational/incremental distinction, and some of the arguments that have been adduced in favor of the realizational view.

In incremental theories, morphemes are regarded as meaningful phonological strings, and words are built by directly assembling these strings into larger constituent structures:



In realizational theories, on the other hand, word-building is divided into two stages. For English *cats*, for instance, the morphology begins by assembling not the phonological strings /kæt/ and /z/, but instead abstract morphemes corresponding to the meanings ‘cat’ and ‘plural’:

⁶ A point of terminology: unless otherwise indicated, I am using the word ‘lexicon’ to mean simply the list of morphs that exists in the language—the same thing that the Distributed Morphologists call the ‘Vocabulary’—and not to mean a module of the grammar where (some) morphology takes place (as in ‘lexicalist’ theories such as Lieber 1980).

(7)

$$\sqrt{\text{CAT}}, [+plural] \quad \rightarrow \quad \begin{array}{c} \text{N} \\ \diagup \quad \diagdown \\ \sqrt{\text{CAT}} \quad [+plural] \end{array}$$

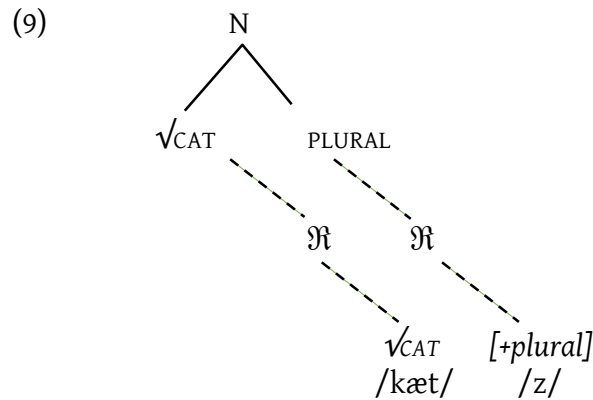
Having now assembled a morphological tree structure with bundles of meaningful features on its terminals, the morphology now proceeds to *realize* these abstract morphemes—that is, to associate phonological material with them in some systematic way. In Distributed Morphology (or DM: Halle 1990, 1997, Bonet 1991, Noyer 1992, Halle & Marantz 1993, 1994, Marantz 1997, 2001), which is probably the best-known item-based realizational theory,⁷ a language possesses a lexical list of *vocabulary items*, which are the same kind of objects as I am referring to as ‘morphs’. Each vocabulary item is, formally, an ordered pair consisting of a (possibly null) bundle of morphosyntactic features and a (possibly null) bundle of phonological material:

(8) $\langle \sqrt{\text{CAT}}, /kæt/ \rangle$
 $\langle [+plural], /z/ \rangle$

By contrast, a morpheme consists only of a (possibly null) bundle of morphosyntactic features. Before going further, some terminology: following Trommer (2001), I will refer to the morphosyntactic feature bundles of morphemes and of morphs as ‘feature structures’, or FSES. The phonological part of a morph will be referred to as the morph’s underlying representation or underlying form.

⁷ Other notable theories of this sort include Lexeme-Morpheme Base Morphology (Beard 1995) and Minimalist Morphology (Wunderlich & Fabri 1995, Wunderlich 1996, 2000, 2001, 2003). Rule-based models of realizational morphology are represented by the Word-and-Paradigm theory (Matthews 1965, 1967, 1972a,b, 1974) and various models descended from it (Anderson 1977, 1982, 1992, Janda 1983, Zwicky 1985a, Stump 1993, 2001, *inter alia*).

In OI, I will be assuming that when a morph is inserted, a correspondence relation (McCarthy & Prince 1995, 1999) is established between the FS of a morpheme and the FS of the morph:⁸



Separating morphology into a tree-building stage and a spell-out stage has been argued to have a number of attractive consequences. One of these is that the rules or constraints of syntax proper (the module which builds the trees) will necessarily have no access to the phonological content of morphs (a prediction dubbed ‘Feature Disjointness’ in DM: Marantz 1995a,b). This derives the fact that most types of syntactic phenomena are insensitive to the phonological make-up of the words which participate in the syntactic tree in question. (Basically the same conclusion, dubbed the Principle of Phonology-Free Syntax, is argued for within different theoretical premises from DM’s by Zwicky 1969, Zwicky & Pullum 1986a,b, 1988, and Miller, Pullum & Zwicky 1992, 1997).

There is also evidence from speech errors that morphosyntactic features, but not their phonological realizations, are present in the syntax (Pfau 2000; see also Albright 2007 for discussion). In a corpus of German data, Pfau found that gender

⁸ For other Correspondence-theoretic models of realizational morphology, see Donohue (1998), Curnow (1999), Wunderlich (2000, 2001, 2003), and Teeple (2006).

mismatches involving mistaken selection of a semantic relative of a target root were accommodated in the gender agreement system, but that mismatches involving phonological relatives of the target were not. This result is consistent with the view that abstract roots are not endowed with phonological content until after syntax (and hence gender agreement) is over.⁹

There are several additional lines of psycholinguistic evidence which indicate that there is a separation in the mental lexicon between, on the one hand, the semantic and morphosyntactic properties of words and, on the other hand, their phonological properties (see e.g. Levelt et al. 1999 for an overview). For example, anomic aphasic patients (Henaff Gonon et al. 1989, Badecker et al. 1995) and unimpaired speakers in a tip-of-the-tongue state (Levelt 1993, Caramazza & Miozzo 1997, Vigliocco et al. 1997) can often accurately report the grammatical gender of the word they are looking for, even if they can't retrieve the word's pronunciation. Likewise, there is evidence that impaired speakers can know that a word is a compound despite being unable to access its phonological shape (Hittmair-Delazer et al. 1994, Semenza et al. 1997). Findings like these suggest the psychological reality of a level of linguistic representation at which a word's abstract morphosyntactic properties are present, but at which its phonological properties have not yet been introduced. In psycholinguistic models that incorporate this idea, the two levels of lexical nodes known as 'lemmas' and 'lexemes' more or less correspond to the distinction that I assume between 'morphemes' and 'morphs'.

Evidence from lateralized readiness potentials studies using a go/no-go paradigm (van Turenhout et al. 1997, 1998, Rodriguez-Fornells et al. 2002, Jescheniak et

⁹ However, for some arguments that pronouns can be selected on the basis of agreement with the phonological properties of nouns they agree with, see Kaye (1981) and Bing (1987).

al. 2003, Guo & Peng 2007; cf. Abdel Rahman & Sommer 2003, Friedmann & Biran 2003) also indicates that morphosyntactic properties are accessed earlier than phonological ones during the actual timecourse of lexical access. The studies by van Turennout et al. (1997, 1998) used a classification task in which, in one condition, subjects had to signal the grammatical gender of an object (e.g. push the lefthand button if the object's name is masculine and the righthand button if it's feminine) together with a go/no-go decision based on phonological classification (e.g. signal the object's gender only if its name begins with [b]). In this condition, lateralized readiness potentials (LRPs) indicated that subjects had decided which button to push (i.e. accessed the gender of the object's name) even in the 'no-go' trials where the answer to the phonological question indicated that they were to not respond to the gender question. However, in another condition in which the role of the morphosyntactic and phonological decisions was reversed (e.g. push the lefthand button if the word begins with [b] and the righthand button if it doesn't, but only respond if the word is feminine), LRPs indicated that subjects had decided which button to press only in the go trials, and not in the no-go trials. This asymmetry indicates that subjects accessed the gender of a word before accessing its phonology.

A final advantage is that realizational theories but not incremental ones offer a straightforward means of expressing at least some morphological syncretisms as non-accidental, psychologically real parts of the grammar (e.g., Embick & Noyer 2007). For a simple example, consider the inflectional morphology of Dutch strong adjectives (Sauerland 1995). Neuter singular strong adjectives in Dutch have no overt number or gender inflection, and all other strong adjectives have a suffix -ə. Using two binary

morphosyntactic features [\pm neuter] and [\pm plural], the distribution of these two inflectional shapes are therefore as follows:

	[-neuter]	[+neuter]
[-plural]	-ə	∅
[+plural]	-ə	-ə

Table 1.1. Dutch number/gender agreement suffixes

If morphology operates in an incremental fashion, then an analysis of these facts would have to assume that the Dutch lexicon contained three accidentally-homophonous -ə suffixes: one that meant ‘neuter plural’, one that meant ‘nonneuter singular’ and a third that meant ‘nonneuter plural’. The fact that all three of these number-gender combinations received phonologically-identical inflectional marking would be a lexical coincidence. In a realizational theory, on the other hand, we can posit a *single* morph which is used in all three situations. In order to see how this could be done, we need to first consider what kinds of principles might govern morph selection. In principle, any morph might be inserted on any abstract morpheme. There must therefore be one or more criteria which govern the choice of which morph is chosen for which morpheme. The typical assumption in DM is that the main operative criterion for all languages is the Subset Principle, as formulated by Halle (1997):

- (10) The phonological exponent of a Vocabulary item is inserted into a morpheme in the terminal string if the item matches all or a subset of the grammatical features specified in the terminal morpheme. Insertion does not take place if the vocabulary item contains features not present in the morpheme. Where several Vocabulary items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen.

If morph choice is governed by principle (10), then the syncretism in Dutch strong adjectives can be captured by positing the following two vocabulary items (Sauerland 1995):

- (11) a. <[+neuter, -plural], \emptyset >
b. < \emptyset , /ə />

For any given combination of [\pm neuter] and [\pm plural], the morphology has the choice of using either (11)a or (11)b to spell out the abstract inflectional morpheme in question. If the abstract morpheme contains the features [+neuter, -plural], then the Subset Principle will dictate the use of (11)a, since it spells out both of these features, whereas (11)b spells out neither of them. For any other combination of [\pm neuter] and [\pm plural], however, using (11)a would incur at least one mismatch of morphosyntactic features, and so (11)b will have to be used instead. The fact that (11)b is used for all number and gender combinations besides [+neuter, -plural] is then actually expressed as a generalization within the grammar, rather than resulting solely from accidental homophony.

1.2.3 Allomorphy and the nature of the input to the phonology

If, as I will be arguing, all morph insertion takes place within the phonology, the conventional understanding of what the input to the phonology looks like will have to be changed. Specifically, if no morphs have been inserted prior to the phonology

getting underway, then the input to the phonology will consist of just a morphological tree with abstract morphemes on its terminal nodes, but no phonological material of any kind.¹⁰

This is, naturally, in stark contrast to the standard view of the input. There are many schools of generative phonology, both rule-based and constraint-based, but most of them share a view of the input to the phonology which corresponds to the picture in (5). In this standard view, the input for some word *W* consists of the phonological underlying representations of the various morphs making up *W*, arranged in the linear order dictated by *W*'s constituent structure. The grammar can then make various changes to this collection of underlying forms, producing the phonological surface form which is the output of the phonology.

The task of choosing the underlying representations, though, is not up to the phonology, but to the morphology (on the standard view). Clearly UR choice must not solely be the province of phonological markedness constraints, given the existence of meaning-based suppletive alternations like English *go*~*went*. The choice between *go* and *went* is not governed by any phonological criterion, and there is clearly no hope of deriving them from a common UR without recourse to highly parochial, lexically-restricted rules. Therefore they have to be regarded as separate lexical items (separate morphs), each with its own phonological UR. The morphology, on the standard view, chooses between the morphs as appropriate, and the URs of the chosen morphs are then used as the input to the phonology.

¹⁰ A similar view of the input is proposed by Zuraw (2000), who refers to the collection of semantic and morphosyntactic features which make up the input to the phonology as the *intent*.

Even within this standard view, where the input to the phonology consists of URs, there is reason to believe that at least some cases of UR choice *do* happen within the phonology. The phenomenon that motivates this is what I will refer to (following Paster 2005, 2006, to appear) as phonologically-conditioned suppletive allomorphy, or PCSA. In a system of PCSA, a given morpheme is associated with two or more suppletive alternants whose distributions (unlike those of *go* and *went*) are phonologically defined. For example, in Moroccan Arabic (Harrell 1962), there are two listed allomorphs of the 3rd person masculine singular enclitic: it appears as [-u] following a consonant-final stem, and as [-h] following a vowel-final stem:

- | | | |
|------|---------------------|-------------|
| (12) | xt ^ʃ a-h | 'his error' |
| | ktab-u | 'his book' |


There are at least three reasons to think that the choice of allomorphs in PCSA systems is handed by the phonology, and not by a separate, pre-phonological morphology module. The first is simple parsimony: PCSA involves generalizations that are storable in phonological terms, and Occam's Razor would lead us to assume as the null hypothesis that only the phonology is responsible for linguistic patterns that involve phonological generalizations.

The second reason concerns the (in)-ability of PCSA to 'look ahead' to the outcome of phonological processes which are conditioned by the allomorphs themselves or which involve the phonological content of subsequent affixes. Paster (2005, 2006, to appear) has recently argued that PCSA can never look ahead. She captures this prediction by placing PCSA in a separate morphological module, which

precedes the phonology.¹¹ In chapter 3, I argue that OI theory has an edge on this model in two respects. First, even with PCSA in the phonology, OI is able to derive the general absence of lookahead effects using assumptions that are independently called for in McCarthy’s (2007a) analyses of phonological opacity in OT-CC. Second, OI theory permits attested look-ahead effects in certain tightly-defined circumstances, which I’ll argue are in fact attested.





The third reason to place PCSA in the phonology is that, in very many cases, it is straightforward to model the choice of allomorphs in OT using independently-required markedness constraints. For example, Mascaró (1996b) shows that the Moroccan Arabic PCSA system mentioned above can be analyzed by assuming a ranking of ONSET » NoCODA. For vowel-final stems, using the /-u/ allomorph creates an additional onsetless syllable, while using the /-h/ allomorph creates an additional coda. If lacking an onset is worse than having a coda, use of /-h/ will prevail:

(13) Moroccan Arabic: ‘his error’¹²


/xt ^s a – {h, u}/		ONSET	NoCODA
<i>Inputs:</i>	<i>Outputs:</i>		
/xt ^s a-h/	a.  [xt ^s ah]		1
/xt ^s a-u/	b. [xt ^s a.u]	W ₁	L

On the other hand, when the stem is consonant-final, use of /-u/ will prevail, since this produces a reduction in the number of codas:

¹¹ A related view is advocated in Bye (2007).

¹² I will be using comparative tableaux (Prince 2002, 2003) throughout. The integer in each cell is the number of violation-marks received by the candidate from the relevant constraint. The manicule () indicates the winner; for each losing candidate, a W under a constraint indicates that that constraint prefers the winner over that losing candidate; an L indicates that that constraint prefers that loser over the winner. In tableaux depicting faulty analyses, ‘' indicates the candidate incorrectly predicted to win, and ‘' indicates the attested winner. The symbol ‘' is used to indicate harmonically-bounded candidates (following de Lacy 2002).

(14) Moroccan Arabic: 'his book'

/ktab - {h, u}/		ONSET	NoCODA
<i>Inputs:</i>	<i>Outputs:</i>		
/ktab-u/	a.  [kta.bu]		
/ktab-h/	b. [ktabh]		W ₁

A number of analyses along these same lines have been offered (see Mester 1994, Kager 1996, Mascaró 1996a,b, Tranel 1996a,b, Dolbey 1997, Perlmutter 1998 for the original proposals), and the straightforward way in which an OT grammar is able to model them using only independently-motivated constraints suggests that this mode of analysis is on the right track. If it is, then PCSA must take place within the phonology.

Allowing the phonology to select which of two suppletive allomorphs to use does, however, force the addition of some unattractive complications to the standard view that morphs are selected before the phonology begins. It would be necessary for Moroccan Arabic to have a single morph meaning “3rd person masculine singular” which has *two underlying representations*, and that each candidate output of the phonology gets to pick one or the other of these to be faithful to (this is the approach depicted in (14)-(15) above). Alternatively, but only somewhat differently, we could assume that the morphology narrows the choice of morphs down to either /-u/ or /-h/ but for some reason can't decide between them, and passes this choice on to the phonology. Either way, though, the phonology needs to be accorded some measure of free choice over which UR (which morph) to use in a given morphological context, which means that the input to the phonology is sometimes less than fully determined with respect to which URs (which morphs) the phonology is to use.

As stated earlier, I will be arguing in this dissertation that *all* morph selection takes place within the phonology, which means that the input to the phonology

contains no morphs and no URs, but only abstract morphemes arranged in a tree structure. Intuitively, this may seem obviously implausible, but all it amounts to is assuming that the input to the phonology is *fully* undetermined with respect to which morphs to use. We've just seen that PCSA supplies independent reasons to think that the input to the phonology can be at least *partly* undetermined with respect to morph choice, so allowing the input to the phonology to be entirely indeterminate with respect to these matters is not as radical a move as it may seem.

1.2.4 Morphological constraints on morph selection

Even if all morph selection takes place in the same tableau as the phonology, we will still need that tableau to include some constraints of a morphological nature. Leaving morph choice solely up to the phonology would mean that every configuration of abstract morphemes, regardless of its meaning, would be spelled out using the least-marked collocation of morphs available to the language—perhaps [ba] (Chomsky 1995)—or, more threateningly yet, with no morphs at all, given that a candidate with no surface phonological structure is guaranteed to violate no markedness constraints (Wolf & McCarthy to appear).

Clearly, the phonology needs to incorporate constraints which do work like that which the Subset Principle (11) is meant to. That is, the OT grammar which includes phonological markedness and faithfulness constraints must also include constraints which will penalize various kinds of possible mismatches between the FS of an abstract morpheme and the FS of the morph that's associated with it. Given the assumption mentioned earlier that the association between a morpheme's FS and a morph's FS

takes the form of a Correspondence relation, we can assume that the constraints in question are analogous to the Correspondence-based faithfulness constraints used in phonology (McCarthy & Prince 1995, 1999 *et seq.*)

I will be assuming that not only whole FSes, but also the individual features that make them up, can bear Correspondence relations. In phonology, the analogous idea is that not just segments, but also individual distinctive features, can stand in Correspondence (McCarthy & Prince 1995, Zoll 1996, Causley 1997, Walker 1997, Lombardi 1998, 2001, Zhang 2000, Wolf 2007a). This assumption lets us state a constraint which discourages the use of morphs whose FSes contain features that are absent from the FS of the corresponding morpheme. (The need for such a pressure arose in the context of the Spanish gender-mismatch phenomenon mentioned earlier, and is also stated as an inviolable requirement as part of DM's Subset Principle (11)). Such a constraint might be formulated as follows:

- (15) DEP-M(F): For every instance φ' of the feature F at the morph level, assign a violation-mark if there is not an instance φ of F at the morpheme level, such that $\varphi \mathfrak{R} \varphi'$.

Likewise, for Dutch example, we will need a constraint that favors the use of morphs which spell out more features over the use of morphs which spell out fewer features.

This might take the form of one of a family of constraints defined thus:

- (16) MAX-M(F): For every instance φ of the feature F at the morpheme level, assign a violation-mark if there is not an instance φ' of F at the morph level, such that $\varphi \mathfrak{R} \varphi'$.

It is constraints like (15)-(16) which will be responsible for suppletive alternations like English *go~went* which show no evidence of being phonologically conditioned.¹³

If morphological constraints like (15)-(16) occupy the same OT grammar as the phonological markedness constraints, we will expect to find cases where the morphological constraints are violated for the sake of satisfying higher-ranked phonological markedness constraints. We've already seen one example which seems to have this character, namely that of Spanish *el/la* suppletion. There, a morph which fails to match the gender features of its corresponding abstract morpheme is nevertheless used, because it affords the opportunity of avoiding hiatus. In terms of the constraints presented above, this could be analyzed by assuming that DEP-M(masculine) and MAX-M(feminine) are dominated by ONSET. Chapters 2 and 3 of this dissertation will review a range of examples from a number of languages which show that many kinds of morphological wellformedness conditions can be overridden on phonological grounds:

¹³ Similar constraints can be found in previous work on morphology in OT, a non-exhaustive list of which include Noyer (1993), Bonet (1994), Donohue (1998), Curnow (1999), Wunderlich (2000, 2001, 2003), Trommer (2001), Ackema & Neeleman (2004, 2005), Teeple (2006), Strigin (2007), and Xu (2007).

(17) *Types of morphological mismatches that can be phonologically triggered*

•Non-maximal spellout of features: A morph which contains a smaller subset of a morpheme's features is used instead of one which contains a larger subset of the morpheme's features. In the extreme case, a morpheme receives no correspondent morph at all.

(i.e., MAX-M(F) violation)

•Feature-mismatch: A morph is used which contains features other than those which are present in the morpheme it's associated with

(i.e., DEP-M(F) violation)

•Superfluous morph insertion: Morphs appear in the output which are not needed for any morphological reason, and which don't stand in correspondence with any morpheme.

•Linear misordering: The surface order of morphs does not reflect the underlying constituent order of the morphemes they're associated with.

The existence of effects like these strongly vouches for a model like the one I am advocating, in which phonological and morphological wellformedness conditions occupy a single OT grammar.

1.2.5 OI vs. declarative morphology

Before concluding this section, a brief remark is in order regarding what I am *not* proposing. There is an existing body of work in OT (Russell 1993, 1997, 1999, Hammond 2000, Bat-El 2003, MacBride 2004, Adam & Bat-El to appear) which also assumes that morph choice happens in the phonology, but which implements it in a manner very different from what I assume in OI. In these works, the morphology is *declarative* in that the phonological shapes which are to be associated with various abstract morphemes are specified by output constraints, e.g. in English 'Assign a violation-mark if a [+plural] noun does not end in a coronal sibilant', rather than by having morphs (underlying representations) be stored in some lexical list. In

declarative theories, there are no underlying forms, and all output structure is actually epenthetic. For example, in the English word *cats*, the final [s] will be inserted to satisfy a constraint like the one just mentioned.¹⁴

Declarative theories of morphology face a number of problems, but perhaps the most serious is that the nonexistence of underlying forms entails the nonexistence of input-output faithfulness.¹⁵ As Bonet (2004) points out, this is a major drawback given that many accounts of language typology rely crucially on faithfulness. For example, Lombardi (2001) has argued that certain positional neutralization effects can be given typologically-accurate analyses using positional faithfulness (Beckman 1998) but not using positional markedness (Zoll 1998). In OI, on the other hand, faithfulness still exists because there are still underlying forms. Morphs are lexically listed, and the phonology selects which ones to use to spell out the abstract morphemes in question. If changes are made to URs of the selected morphs, faithfulness violations are incurred.

This situation, wherein the phonology chooses at least some of the URs but can also perform unfaithful mappings on them, also holds of classic OT analyses of PCSA like the Moroccan Arabic example in (14)-(15), where certain lexical items are assumed to have more than one UR. In OI, the possibility of being unfaithful to the chosen URs is perhaps more intuitively clear, since OI uses the serial architecture of OT-CC: a morph is inserted at one point in the derivation, and then at some later point its phonological contents may be changed, resulting in faithfulness violation. In the next section, I

¹⁴ These declarative theories can be regarded as the constraint-based equivalents of process-based (as opposed to item-based) realizational theories, such as those cited in footnote 10.

¹⁵ We could, of course, avoid this problem by pursuing the option of having separate morphology and phonology components, and assuming that declarative constraints in the morphology generate inputs for the phonology (see Xu 2007 for discussion of this possibility).

present the core properties of OT-CC, and give a preliminary illustration of how OI recruits them for the analysis of phonology-morphology interaction.

1.3 Implementing the serial realization of morphological structure

1.3.1 Opacity and OT

As described in the previous subsection, the theory proposed in this dissertation will exploit the constraint violability inherent in Optimality Theory in order to implement our first desideratum, that phonological and morphological pressures directly conflict and vary from one language to another with regard to which pressures win. Adopting a constraint-based theory, however, makes the implementation of our second desideratum, namely that phonological and morphological operations are serially interspersed, somewhat less than straightforward.

In an OT grammar, a function GEN produces a set of candidate outputs for each input. An evaluative function EVAL then determines which of those candidates least seriously violates the ranking of the constraint set CON which prevails in the language in question. This candidate is chosen to be the actual output.¹⁶ In the most basic possible version of OT, the mapping from input to output takes place in one step. There are, consequently, no intermediate derivational stages in the standard version: the input and output are the only levels of representation posited. The lack of intermediate stages is the source of OT's well-known difficulties in modeling opaque process-interaction (see, *inter alia*, Chomsky 1995, Jensen 1995, Goldsmith 1996, Clements 1997,

¹⁶ However, see Coetzee (2006) for an account of linguistic variation in OT based on the idea that candidates other than the most harmonic one are sometimes used as the output.

Halle & Idsardi 1997, Idsardi 1998 for criticisms of OT in relation to this problem, and McCarthy 2007a: ch. 2 for a survey of various proposed solutions).

A straightforward illustration of OT's opacity problem is furnished by a counterbleeding interaction in Bedouin Hijazi Arabic (Al-Mozainy 1981, McCarthy 1999, 2007a). In this dialect, high vowels are deleted in nonfinal open syllables, and velars are palatalized when they precede a front vowel. Velars will appear as palatalized on the surface even when the front vowel triggering the palatalization process deletes. In a theory with ordered rules, we could model this system by assuming that the rule of palatalization is ordered before the rule of deletion:

(18)	Underlying forms	/ħa:kim-i:n/	
	Palatalization	ħa:k ^ʲ imi:n	
	Deletion	ħa:k ^ʲ mi:n	
	Surface form	[ħa:k ^ʲ mi:n]	'ruling-MASC.PL'

This system is challenging for OT, because in classic OT, processes (= unfaithful mappings) will only occur if they help to decrease the markedness of the surface form. EVAL seeks to minimize constraint violation, so faithfulness violations will be avoided if they don't bring with them a lesser degree of violation of higher-ranked markedness constraints (Moreton 1999). Since there is presumably no markedness constraint which will prefer [k^ʲ] over [k] in the absence of an adjacent [i], the palatalization seen in (19) is impossible to explain in classic OT. Faithfulness will prefer *[ħa:kmi:n], with no palatalization, over attested [ħa:k^ʲmi:n], with palatalization, and there is no markedness constraint which can be called on instead to exert the desired preference for [ħa:k^ʲmi:n]:

(19)

/ħa:kim-i:n/	*ki	IDENT(palatal)
a. \bullet^* [ħa:kmi:n]		
b. ☞ [ħa:k ^j mi:n]		W ₁

The attested winner status of the candidate [ħa:k^jmi:n] therefore cannot be explained absent some elaboration of the theory.

There have been many proposals about how to accommodate opacity in OT, but two general strategies are especially relevant to this dissertation. One approach is to create intermediate derivational stages by having multiple passes of constraint evaluation, with the output of one pass serving as the input (or part of the input) to the next pass. This is approach taken in Harmonic Serialism and in Stratal OT. Stratal OT posits the existence of multiple serially linked OT grammars corresponding the strata of Lexical Phonology. Processes can be made to apply in counterfeeding or counterbleeding order by assigning them to different strata, with the order of the strata then causing the processes belonging to them to apply in that same order. One might, for example, model the interaction in (18) by assuming that the stem-level stratum has a ranking such that palatalization (but not deletion) applies there, and that the later word-level stratum has a ranking which allows deletion to take place.

A different approach is to have only a single pass of constraint evaluation, but to elaborate the structure of candidates so that they contain more than just the overt surface form. This is the approach taken in, most notably, Turbidity theory (Goldrick & Smolensky 1998, Goldrick 2000), which posits that certain kinds of hidden structure can exist in output forms. This hidden structure helps to condition opaque process-applications which cannot be motivated on the basis of overt surface structure only. A

Turbidity analysis of the facts in (18) would assume that the palatalization-triggering [i] is not literally deleted in the surface form, but is latently present and merely unpronounced. Its presence in the segmental string, however, means that a markedness constraint disfavoring unpalatalized velars before front vowels will be violated unless the /k/ undergoes palatalization.

A more radical move in the same spirit would be to assume that candidates are themselves something like derivations.¹⁷ When selecting the winning candidate, an OT grammar would not simply be selecting the best surface form—it would be selecting the best derivation that could be undertaken beginning from the input in question. Given the right constraints, it could well be the case that the optimal derivation might involve processes applying in counterfeeding or counterbleeding order. This is the approach taken by OT-CC (McCarthy 2007a,b,d, to appear a,b), the framework in which the OI model proposed in this dissertation is couched. Before outlining how OI applies OT-CC to serial phonology-morphology interaction, it will be helpful to give an overview of OT-CC's architecture, and of how it deals with opaque interactions between phonological processes.

1.3.2 How OT-CC works

As its name implies, candidates in OT-CC are chains of intermediate forms. The input (or perhaps a fully-faithful prosodification of it) serves as the first link in every chain. In between these may be intermediate forms which are the steps of a derivation

¹⁷ Earlier proposals for integrating derivations into OT are made by (in phonology) Prince & Smolensky (2004 [1993]: §5.2.3.3), Black (1993), Chen (1999), Jun (1999), Norton (2003), Wilson (2004), Chen-Main (2007), and the various proponents of Stratal OT cited in footnote 6; (in syntax) Broekhuis & Dekkers (2000), Broekhuis (2006, to appear), and a number of the contributors to Broekhuis & Vogel (2006).

by which the first link is incrementally converted into the last link. The last link is the potential surface form proffered to EVAL by each chain, and when chains are compared in order to determine the winner, markedness constraints evaluate only the last link of each chain.

There are two key inviolable wellformedness conditions on these chains:

- (20) a. *Gradualism*: Each link of the chain must differ from the previous link by only a single step.
- b. *Harmonic improvement*: Each noninitial link of the chain must be more harmonic than the immediately preceding link.

The gradualism requirement limits how much one link of the chain can differ from the preceding one. In the original version of OT-CC (McCarthy 2007a), the changes that count as ‘one step’ are familiar phonological operations:¹⁸

- (21) a. Deletion of a single segment
- b. Epenthesis of a single segment
- c. Changing a single feature-specification of one segment
- d. Reversing the linear order of two adjacent segments

The gradualness requirement means that the *n*th link of any chain can differ from the (*n*-1)th link only by the performing of exactly one of the specified set of changes. Thus, for example, if the changes that count as ‘one step’ are as in (21), <tapk, tap, ta> is a valid chain given the gradualness requirement, since each step differs from the previous one by the deletion of only a single segment, but **<tapk, ta>**¹⁹ is not a valid chain, since the second link differs from the first by the deletion of two segments.

¹⁸ The idea that phonological derivations proceed via a series of elementary operations has precedents in proposals by Prince (1983) and Archangeli & Pulleyblank (1994); OT proposals with similar properties include Prince & Smolensky’s (2004 [1993]: §5.2.3.3) harmonic serialism, and Tesar’s (1995) directional syllabic parsing algorithm.

¹⁹ I will adopt McCarthy’s (2007a) notational convention of using a single asterisk to mark valid but losing candidate chains, and a double asterisk to mark chains which are invalid by virtue of violating one or both of the requirements in (20).

The harmonic improvement requirement²⁰ imposes an additional condition on when each of the specified series of ‘single steps’ can be used in the construction of a valid chain: each link must be more harmonic than the previous one, given the ranking of CON that prevails in the language in question. Since each of the operations in (21) will incur a violation of one or more faithfulness constraints, they can be used in a chain only if doing so will reduce markedness.

Together, the two requirements in (20) invite a recursive model of how GEN constructs candidates in OT-CC (Becker 2005). Starting with the input form, GEN attempts to apply every operation in its list to the input form, and checks if doing so would be harmonically improving. If it does, GEN then stores the result as a chain of length 2. Once all possible 2-link chains have been conducted, GEN then proceeds to try out every operation in its list on the second form in each of these chains, and, if harmonic improvement obtains, the result is stored as a candidate chain of length 3. This recursive procedure continues until none of GEN’s operations can be applied in a harmonically-improving fashion, as is guaranteed to happen sooner or later by Moreton’s (1999) proof that an OT grammar (provided it contains only markedness and faithfulness constraints) is ‘eventually idempotent’.

To make these abstract matters more concrete, let’s now consider what the requirements in (20) would mean for a chain like <tapk, tap, ta>. The mapping from the first link to the second one involves deleting a segment and hence worsening performance on the faithfulness constraint MAX. However, the first link /tapk/ violates the markedness constraint *COMPLEXCODA, whereas the second link /tap/ does not. In

²⁰ OT-CC’s concept of harmonic improvement also finds parallels in Harmonic Phonology (Goldsmith 1993) and, in OT syntax, the Derivations and Evaluations model (Broekhuis & Dekkers 2000, Broekhuis 2006, to appear).

order for <tapk, tap> to be a valid subchain, then, *COMPLEXCODA must be ranked above

MAX:

(22)

/tapk/	*COMPLEXCODA	MAX
a. [tapk] <i>Is less harmonic than:</i>	1	
b. [tap]		1

Likewise, the deletion of /p/ in the mapping from the second link /tap/ to the third link [ta] also worsens performance on MAX, but betters performance on the markedness constraint NoCODA. Therefore, <tap, ta> is a valid subchain only if NoCODA outranks MAX:

(23)

/tap/	NoCODA	MAX
a. /tap/ <i>Is less harmonic than:</i>	1	
b. /ta/		1

One consequence of the gradualness and harmonic improvement requirements that bears remarking on is that in OT-CC, certain constraint rankings become crucial which would not be crucial in a standard OT analysis of the same facts. Consider our example of the mapping from underlying /tapk/ to surface [ta]. In standard OT, it would suffice to assume the ranking NoCODA » MAX for a language that exhibited this mapping; no particular ranking of *COMPLEXCODA would be required. (I'm assuming here that NoCODA assigns one mark for every syllable that has a coda, regardless of how many segments are in coda position):

(24)

/tapk/	NoCODA	MAX
a. ta [ta]		2
b. [tap]	W ₁	L ₁
c. [tapk]	W ₁	L

In OT-CC, the situation is a bit more complicated. The gradualness requirement on chains means that /tapk/ must pass through an intermediate form like /tap/ on the way to [ta]. Since /tapk/ and /tap/ both contain syllable codas, the ranking NoCODA » MAX is insufficient to guarantee that /tap/ is more harmonic than /tapk/:

(25)

/tapk/	NoCODA	MAX
a. /tap/ <i>Is less harmonic than:</i>	1	1
b. /tapk/	1	

Because of this, in order to make the subchain <tapk, tap> harmonically improving, we must assume that *COMPLEXCODA (or some other markedness constraint which preferred /tap/ over /tapk/) is also ranked over MAX:

(26)

/tapk/	*COMPLEXCODA	NoCODA	MAX
a. /tap/ <i>Is more harmonic than:</i>		1	1
b. /tapk/	1	1	

Once chains have been built, they compete against each other as candidates. In OT-CC as originally conceived, and as it will be used in this dissertation, phonological markedness constraints evaluate only the last form in the chain (the candidate surface form) when choosing the winning candidate. In this regard, OT-CC is no different than classic OT, so even with the representation of intermediate derivational steps inside each candidate, no gain is achieved in the ability to account for opacity unless we introduce new constraints. What we can do is to introduce constraints that make demands about the order in which the various operations available to GEN were applied

in the process of chain construction. In McCarthy (2007a), the proposed order-governing constraints take the following form:

- (27) $PREC(A,B)$
 Assign a violation-mark to a candidate for each time that:
- a. A process that violates faithfulness constraint *B* applies without having been preceded by a process that violates faithfulness constraint *A*
 - b. A process that violates faithfulness constraint *B* applies and is followed by a process that violates faithfulness constraint *A*.

The constraint $PREC(A,B)$ is analogous to an extrinsic rule-ordering statement in rule-based phonology, in this case stating that rule *A* precedes rule *B*.

To illustrate how $PREC$ constraints can be used to get candidate chains with opaque ordering to win, let's consider the Bedouin Hijazi Arabic example from (19). (The analysis which follows is based on that in McCarthy 2007a). Underlying velars followed by a front vowel palatalize, which we can attribute to a markedness constraint against plain-velar/front-vowel sequences outranking a faithfulness constraint protecting the nonpalatality of underlying plain velars: $*ki \gg IDENT(\text{palatal})$:

- (28)
 $*ki$: Assign a violation-mark for every nonpalatalized velar which is followed by a front vowel

$IDENT(\text{palatal})$: Assign a violation-mark for every output segment whose palatality or non-palatality differs from that of its input correspondent

/ki/	$*ki$	$IDENT(\text{palatal})$
a. k^i <i>Is more harmonic than:</i>		1
b. ki	1	

Likewise, high vowels delete in nonfinal open syllables, which we can attribute to a markedness constraint against syllable-final high vowels—call it $*i]_{\sigma}$ —dominating the anti-deletion constraint MAX:

(29)

$*i]_{\sigma}$: Assign a violation-mark for every high vowel that ends an open syllable

MAX: Assign a violation-mark for every input segment which lacks an output correspondent

/patika/	$*i]_{\sigma}$	MAX
a. pat.ka <i>Is more harmonic than:</i>		1
b. pa.ti.ka	1	

Given these two markedness-over-faithfulness rankings, the following chains will be harmonically-improving, beginning with input /ħa:kimi:n/:

- (30)
- a. <ħa:.ki.mi:n>
 - b. <ħa:.ki.mi:n, ħa:k.mi:n>
 - c. <ħa:.ki.mi:n, ħa:kⁱ.mi:n>
 - d. <ħa:.ki.mi:n, ħa:kⁱ.mi:n, ħa:k^l.mi:n >

Chain (30)a performs no operations on the underlying forms, and hence is vacuously harmonically improving, since it has only one link. Chain (30)c palatalizes the /k/, which is harmonically improving given the ranking $*ki \gg \text{IDENT}(\text{palatal})$. However, while both of these are valid candidate chains, they have no hope of winning, since each violates a markedness constraint which we have every reason to believe is undominated in Bedouin Hijazi Arabic. Candidate (30)a violates both $*i]_{\sigma}$, because its second syllable is open and ends in a high vowel, and $*ki$, because that same syllable contains an unpalatalized velar followed by a high vowel. Candidate (30)c satisfies $*ki$, because the underlying /k/ has been palatalized, but still violates $*i]_{\sigma}$.

More interesting are chains (30)b and (30)d. Chain (30)b exhibits transparent interaction of palatalization and high-vowel deletion. It deletes the first underlying /i/, which is harmonically improving because it brings about full satisfaction of both of our two markedness constraints. There are no longer any open syllables headed by high vowels, so $*i]_{\sigma}$ is satisfied, and there are no longer any plain velars immediately preceding front vowels, so $*ki$ is satisfied.

The attested winning candidate, with opaque interaction, is (30)d. In this candidate chain, palatalization occurs first. This step is harmonically improving given the ranking $*ki \gg \text{IDENT}(\text{palatal})$: the first link of the chain, /ħa:.ki.mi:n/, violates $*ki$ but satisfies $\text{IDENT}(\text{palatal})$; the second link, /ħa:.k^ji.mi:n/, violates $\text{IDENT}(\text{palatal})$ but satisfies $*ki$. The change from the second link to the third link is also harmonically improving, given the ranking $*i]_{\sigma} \gg \text{MAX}$: /ħa:.k^ji.mi:n/ satisfies MAX but violates $*i]_{\sigma}$; it is therefore less harmonic than the third link /ħa:k^j.mi:n/, which violates MAX but satisfies $*i]_{\sigma}$. The candidate surface form for (30)d is then [ħa:k^j.mi:n], which satisfies both $*i]_{\sigma}$ and $*ki$.

Clearly we need (30)d to beat (30)b. Neither markedness nor faithfulness constraints will be up to the task of exerting the required preference for (30)d. The observed winner has palatalized an underlying segment, but (30)b hasn't, meaning that $\text{IDENT}(\text{palatal})$ prefers (30)d. Likewise, (30)d contains a palatalized velar segment [k^j], but (30)b doesn't, and so (30)b is also preferred by any markedness constraint which dislikes such segments.

This means that the task of preferring (30)d over (30)b falls to a PREC constraint. In our example, the relevant one will be the following:

- (31) $\text{PREC}(\text{IDENT}(\text{palatal}), \text{MAX})$
 Assign a violation-mark to a candidate for each time that:
 a. Deletion occurs without being preceded by palatalization
 b. Deletion occurs and is followed by palatalization

As we saw earlier, counterbleeding interaction between the processes of deletion and palatalization results from having palatalization apply first. The constraint $\text{PREC}(\text{IDENT}(\text{palatal}), \text{MAX})$ enforces a preference for this ordering by penalizing candidates in which the two operations are not used in that order in chain construction.

In candidate (30)b, deletion occurs, but it is not preceded by palatalization (in fact, palatalization does not take place at all). This candidate therefore incurs a violation of $\text{PREC}(\text{IDENT}(\text{palatal}), \text{MAX})$. By contrast, in candidate (30)d, deletion occurs, but is preceded by (and isn't followed by) palatalization. Candidate (30)d therefore does not violate $\text{PREC}(\text{IDENT}(\text{palatal}), \text{MAX})$. If $\text{PREC}(\text{IDENT}(\text{palatal}), \text{MAX})$ is ranked above $\text{IDENT}(\text{palatal})$ and any markedness constraints against $[k^j]$, (30)d will beat (30)b:

(32)

$/\text{ħa:kim-i:n}/$	$\text{PREC}(\text{IDENT}(\text{palatal}), \text{MAX})$	*ki	$\text{IDENT}(\text{palatal})$	*k ^j
a. $\langle \text{ħa:.ki.mi:n}, \text{ħa:.kji.mi:n}, \text{ħa:kj.mi:n} \rangle$			1	1
b. $\langle \text{ħa:.ki.mi:n}, \text{ħa:k.mi:n} \rangle$	W_1		L	L

1.3.3 Chain merger and crucial interaction

In order to complete this short introduction to OT-CC, we will need to add a couple of formal elaborations to the picture presented so far. The first concerns the ordering relations in the chains. In the example that we've just finished considering, the ordering relation between palatalization and vowel deletion is a *crucial* ordering:

it's not possible, with input /ħa:kim-i:n/, for palatalization to apply after vowel deletion. However, there will be very many occasions when two phonological processes do not interact, and there will be valid chains where they apply in one order, and other valid chains where they apply in the opposite other. For example, if a language has coda devoicing and intervocalic spirantization, an input like /apad/ will undergo both processes, but since they don't interact it will make no difference which happens first. There will be two chains, both with [a.fat] as their last link, which differ only in the order of spirantization and devoicing:

- (33) <a.pad, a.fad, a.fat>
 <a.pad, a.pat, a.fat>

In OT-CC, it's assumed that PREC constraints evaluate only the ordering relations between processes that crucially interact. McCarthy (2007a) proposes to ensure this by making the following assumptions. First, PREC constraints access not the sequence of intermediate forms *per se*, but rather the order of the faithfulness-violating operations that take place in the chain. This order is called a LUMSeq, for 'localized unfaithful mapping sequence'. (A localized unfaithful mapping is simply an instance of one of the primitive operations in GEN). Second, when there are two or more chains that converge on the same output via the application of the same LUMs, such as [a.fat] in the example above, these chains are merged into a single candidate. This merged candidate preserves only the pairwise ordering relations that are shared by all of candidates that were combined into it. This means that the merged candidate with [a.fat] as its surface form will assert no ordering relation between the operations of devoicing and

spirantization, since the two chains from which this merged chain was formed asserted different pairwise orders of those two processes.

The mechanism of chain merger serves to filter out ordering relations that don't matter—that is, ordering relations between processes that don't interact. The partial order of operations left after chain merger is called an rLUMSeq ('r' for 'reduced'). Doing this makes it possible to derive a final assumption made in OT-CC about chain structure. That is that PREC constraints are ignored during chain construction, when it needs to be determined whether or not a given operation would be harmonically improving. This can be derived by assuming that PREC constraints actually evaluate not even the LUMSeq, but instead the rLUMSeqs. If so, then PREC constraints are always vacuously satisfied during chain construction, since chain merger cannot have happened yet, and as a result there are not yet any rLUMSeqs.

Having presented the key properties of OT-CC and demonstrated its application to the analysis of phonological opacity, we are now ready to turn in the following sections to the matter of how OT-CC can be used to deal with opaque interleaving of phonology and morphology. As we'll see, chain merger's ability to filter out non-crucial orderings is relevant not only to phonological opacity, but will also be helpful when it comes to crucial phonology/morphology ordering like that shown by the Finnish assibilation DEE.

1.3.4 MAX-M(F) constraints, harmonic improvement, and economy of lexical insertion

One of the core requirements that OT-CC makes regarding chain wellformedness is that every step in the chain be harmonically-improving. When the step in question is a phonological process, it is easy to understand how it could increase harmony, since being unfaithful for the sake of reducing markedness is a core OT notion. However, it is not necessarily so obvious how morph insertion can be counted on to be harmonically improving. This is because inserting a morph whose UR is nonempty introduces additional phonological structure, and more structure will often (though not always) mean more markedness violations. How can we obtain valid chains that feature morph-insertions if morph insertion increases markedness? The answer is that morph insertion is favored by constraints of the MAX-M(F) family introduced in (17). Provided that the relevant MAX-M(F) constraints dominate the relevant markedness constraints, inserting a morph will be harmonically improving.

Still, however, it remains true that markedness constraints will, in general, countervail against insertion of phonologically overt morphs. As we will see in Chapter 2, this fact can be put to good analytic use. Specifically, the markedness of additional morphs means that the phonology will insert only the morphs it needs for the sake of satisfying higher-ranked constraints, and no more. Therefore, unlike multiple-UR analyses of PCSA in (13)-(14) or the Subset Principle in (10), OI theory does not need to stipulate any independent principle requiring the use of only one morph per abstract morpheme. A preference for fewer allomorphs instead can be derived from the pressure for minimal violation of markedness constraints. These results of OI theory

are convergent with other work in OT (Trommer 2001 on morphology, Gouskova 2003 on phonology, Grimshaw 2003 on syntax) arguing that economy effects can and should be derived from general, independently-needed markedness constraints, rather than being treated as grammatical principles in their own right.

1.3.5 Extending OT-CC to opaque phonology/morphology ordering

As we saw earlier, there are several kinds of phonology/morphology interactions which can be understood as involving a crucial ordering relation between phonological operations and the insertion of particular morphs. In the cyclic inheritance effect seen in the stress pattern of *imagination*, the phonological process of stress-placement must crucially occur prior to the insertion of *-ation*. That is, concatenating *-ation* counterbleeds the stressing of the second syllable of *imagine*. In the case of derived environment blocking seen in the Ancient Greek example, the process of cluster-reduction is prevented from applying when its application would crucially be preceded by insertion of an affixal morph. That is, affix-concatenation counterfeeds cluster reduction.

As the terminology of the previous paragraph shows, affix-insertions and phonological processes can be regarded as standing in the same kind of counterbleeding and counterfeeding relations that two phonological processes can.²¹ This is the key intuition behind the OI research program: opaque phonology/morphology interactions and opaque phonology/phonology interactions

²¹ This application of the terms ‘counterfeeding’ and ‘counterbleeding’ to phonology/morphology interactions is due to Blumenfeld (2003b).

are fundamentally the same, and should be analyzed using the same theoretical machinery.²²

As a first illustration, let's consider a simple example of cyclicity from a variety of Korean (Kenstowicz 1996, Kim 2005, Yun 2008). Korean does not allow complex onsets or codas, and in the standard variety this restriction results in alternating noun paradigms like the following:

- (34) a. /kaps/ → [kap] 'price'
 b. /kaps-i/ → [kap.si] 'price-NOMINATIVE'

In (34)a, the underlying root-final /s/ is deleted, because a markedness constraint against complex codas dominates the anti-deletion constraint MAX. However, in (34)b, the /s/ need not delete, because the presence of the nominative suffix /-i/ allows the /s/ to be syllabified as an onset:

(35)

a.	/kaps/	*COMPLEX	MAX
a. [kap]			1
b. [kaps]		W ₁	L

b.	/kaps-i/	*COMPLEX	MAX
a. [kap.si]			
b. [ka.si]			W ₁

Kenstowicz (1996) reports that younger speakers in Seoul have leveled the alternating noun paradigms like those in (34): they have [kap] ~ [ka.pi] rather than [kap] ~ [kap.si]. For these speakers, noun roots never end in more than a single consonant, even when there is a vowel-initial suffix which would allow the second consonant of an underlying root-final cluster to be syllabified as an onset, as in (35)b.

Even if we assumed that the younger Seoul speakers have reanalyzed the root meaning 'price' as being underlyingly /kap/, Richness of the Base (Prince & Smolensky

²² This is also an objective of Stratal OT, in which cyclic opacity and opaque interaction of phonological processes are both attributed to the serial ordering of strata.

2004 [1993]) requires us to contemplate the possibility of underlying forms like /kaps/ for these speakers, and to account for the failure of the second consonant in such a UR to surface even when followed by a vowel-initial suffix.

The problem these facts pose for a strictly surface-oriented view is that, as can be seen in (35)b, there is no reason for the /s/ to delete when a vowel-initial affix follows, since syllabifying it as an onset lets us satisfy *COMPLEX without being unfaithful. Deletion of the final /s/ of /kaps/ is, however, motivated by *COMPLEX when no affix is present. Thus, affixation destroys the motivation for cluster reduction in /kaps-i/ → [ka.pi]. Put in the terms we were entertaining earlier, affixation counterbleeds cluster reduction, which would mean (in rule-based terms) that cluster-reduction applied prior to affixation.

In OI, we can enforce this ordering relation using the following PREC constraint:

- (36) PREC(MAX, affixation)
 Assign a violation-mark to a candidate for each time that:
 a. An affixal morph is inserted, and this is not preceded by deletion
 b. An affixal morph is inserted, and this is followed by deletion

Given a ranking of *COMPLEX » MAX, the following chains will be harmonically improving:

- (37) a. <ROOT-AF, kaps-AF, kap-AF, kap-i>
 LUMSeq: <Insert-root, MAX, insert-affix>
 b. <ROOT-AF, kaps-AF, kaps-i>
 LUMSeq: <insert-root, insert-affix>

In the chains above, ‘ROOT’ and ‘AF’ denote, respectively, an abstract root morpheme and an abstract affix morpheme. Additionally, as reflected in (37), I will assume in the following discussion that in valid chains, morph insertion must proceed from the root outwards. That is, I will ignore the possibility of chains in which the affix

morph is inserted before the root morph is. There will be more to say about this assumption later on in this thesis. Lastly, a point of notation: because morph-insertion doesn't violate any phonological faithfulness constraints, OI requires a relaxation of McCarthy's (2007a) assumption that LUMs are noted in the LUMSeqs and rLUMSeqs via the 'basic faithfulness constraints' which they violate. I will therefore notate morph-insertion LUMs via a label for the operation itself, e.g. 'insert-root'. In most cases in this dissertation, the precise theory of how morph-insertion LUMs are referenced will be left tacit, as not much will hinge on the details; an intuitive notation will suffice. In chapter 4, there will be some remarks on the details of this matter in connection with the analysis of DEEs.

Neither of the chains in (37) are convergent with another chain, so each undergoes chain merger vacuously, leaving an rLUMSeq identical to that of the LUMSeq of each unmerged chain. We can now consider how these competing chains fare when their rLUMSeqs are evaluated by $\text{PREC}(\text{MAX}, \text{insert-affix})$. Chain (37)a deletes the root-final /s/ prior to inserting the suffix /-i/, and it does not delete any segments after affixation; this candidate therefore satisfies both clauses of $\text{PREC}(\text{MAX}, \text{insert-affix})$. Chain (37)b, on the other hand, inserts the suffix /-i/ but does not precede suffixation with deletion. This violates the first clause of $\text{PREC}(\text{MAX}, \text{affixation})$. Therefore, if we rank that constraint above MAX, the attested winner (37)a will be chosen as the optimum:

(38)

/ROOT-AF/	PREC(MAX, insert-affix)	*COMPLEX	MAX
a. [ka.pi] rLUMSeq: <Insert-root, MAX, insert-affix>			1
b. [kap.si] rLUMSeq: <Insert-root, insert-affix>	W_1		L

A word is in order at this point about how IO-faithfulness constraints like MAX are evaluated. In standard OT-CC, the first link of each chain is identical to the input, plus syllable and foot structure that can be added at no faithfulness cost. Therefore, the faithfulness status of a given form later in the chain can be evaluated by assuming that all links of the chain stand in Input-Output correspondence with the first link in the chain. Because the first link does not include underlying forms in OI, we have to assume instead that the form of a morph at some point in the chain stands in correspondence with the underlying form of that morph in the lexicon.

This preliminary example of an OI analysis of cyclicity serves to illustrate a central idea of the theory: if insertion of a morph is treated as an operation available to the phonological grammar alongside phonological operations like vowel lengthening, then cyclic inheritance effects, as seen in young-generation Seoul Korean, and the counterbleeding interaction of two phonological processes like that seen in Bedouin Hijazi Arabic, can be analyzed in exactly the same way. In each case, a process A (cluster reduction; palatalization) occurs, despite the fact that another process B (affix-insertion; high-vowel deletion) would take away the markedness motivation for doing process A. Process A is made to apply by ranking a constraint PREC(A,B) above the faithfulness constraint violated by process A.

In OI theory, then, cyclic opacity is no different from any other kind of phonological opacity. Both result from high-ranked PREC constraints requiring the interacting processes to apply in an opaque order. This unification means that OI enjoys an advantage of parsimony over theories which propose a mechanism which is meant to deal with cyclic effects only, e.g. Output-Output Faithfulness (Burzio 1994, Benua 1995, 1997, Duanmu 1997). These theories must assume the existence of some independent mechanism to deal with non-morphological opacity like the Bedouin Arabic counterfeeding scenario. In OI, on the other hand, all forms of opacity receive the same OT-CC-based analysis.

There are, to be sure, many more details still to be discussed with regard to the handling of cyclicity and other phonology-morphology interleaving effects in OI theory. Still, the forgoing discussion will hopefully suffice to make the basic analytic strategy clear. In the next subsection, I look at the role played by another core aspect of the OT-CC architecture for OI theory, namely chain merger.

1.3.6 Chain merger and morphological derived environment effects

Earlier, in discussing the morphological DEE at work in Finnish assibilation, we noted that underlying /t/ will not assilate in an affixed word unless it has an /i/ following it as a result of the affixation. This is illustrated by examples like the following, which are repeated from (3):

- (39) /vaati-vat/ → [vaativat], *[vaasivat] ‘demand-3PL’
 /tilat-i/ → [tilasi], *[silasi] ‘order-PAST’
 (Kiparsky 1993a)

In the case of /vaati-vat/, the underlying /t/ of the root does not assibilate, despite being immediately followed by an /i/. In a rule-based model of DEEs, we would say that the rule of assibilation can't apply to this /ti/ sequence because, even though that sequence constitutes the structural description of the rule, it wasn't created through morpheme concatenation (or the application of a prior rule). In OI/OT-CC terms, we could say that, even though assibilating this /t/ would be harmonically improving, chains which perform the assibilation are ruled out by a high-ranked PREC constraint, because the assibilation isn't crucially preceded by affixation.

We can give such an analysis of the Finnish data as follows. First, in order to ensure that the mapping /ti/ → [si] is harmonically improving, we can assume that a markedness constraint *ti dominates the faithfulness constraint IDENT(continuant):

(40)

/ti/	*ti	IDENT(contin)
a. [si] <i>Is more harmonic than:</i>		1
b. [ti]	1	

If, as before, we represent the input to the OI grammar for [vaativat] as //ROOT-AF//, the following will be valid harmonically-improving chains and their corresponding LUMSeqs:

- (41)
- a. <ROOT-AF, vaati-AF, vaasi-AF, vaasi-vat>
LUMSeq: <insert-root, IDENT(contin), insert-affix>
 - b. <ROOT-AF, vaati-AF, vaati-vat, vaasi-vat>
LUMSeq: <insert-root, insert-affix, IDENT(contin)>
 - c. <ROOT-AF, vaati-AF, vaati-vat>
LUMSeq: <insert-root, insert-affix>

In chain (41)a, the root-internal /t/ undergoes assibilation prior to affixation occurring, while in chain (41)b, the affix is added, and then assibilation takes place. Insertion of

/-vat/ does nothing to create the marked /ti/ sequence which is capable of undergoing a harmonically-improving assibilation. As a result, when chains are being constructed, assibilation is just as possible before affix-insertion as it is after. The LUMSeqs for these chains therefore assert different pairwise orderings of affix-insertion and the IDENT(contin)-violating LUM. However, these two chains are also convergent, because both have [vaasivat] as their final form. Chains (41)a-b will therefore undergo chain merger. The rLUMSeq of the merged chain that results will retain only the pairwise ordering relations that are common to both chains:

(42) <insert-root, IDENT(contin); insert-root, insert-affix>

Chain (41)c, on the other hand, forgoes the opportunity to assibilate the /t/. Its final link is [vaativat], and it converges with no other chain. Therefore, chain merger applies to it vacuously, and its rLUMSeq is the same as its LUMSeq: <Insert-root, insert-affix>.

The markedness constraint *ti will prefer the merged chain ending in *[vaasivat] over the attested winner (41)c, ending in [vaativat]. That markedness constraint therefore must be dominated by some constraint with the opposite preference. That preference is exerted by the following PREC constraint:

(43) PREC(insert-affix, IDENT(contin))
 Assign a violation mark if:
 a. An IDENT(contin)-violating LUM occurs and is not preceded by affixation
 b. An IDENT(contin)-violating LUM occurs and is followed by affixation

The following tableau illustrates how this constraint ensures the victory of the chain with no assibilation over the merged chain with assibilation:

(44)

//ROOT-AF//	PREC (insert-affix, IDENT(contin))	*ti	IDENT (contin)
a. [vaativat] rLUMSeq: <Insert-root, affixation>		1	
b. [vaasivat] rLUMSeq: <Insert-root, IDENT(contin); Insert- root, affixation>	W ₁	L	W ₁

Candidate (45)b assibilates the /t/ and therefore contains an IDENT(contin)-violating LUM. However, as a result of chain merger, candidate (44)b's rLUMSeq does not assert that this LUM is ordered after affixation. That state of affairs violates the first clause of PREC(insert-affix, IDENT(contin)). In candidate (44)a, on the other hand, there is no IDENT(contin)-violating LUM, and hence PREC(insert-affix, IDENT(contin)) is vacuously satisfied. As that constraint is top-ranked, (44)a is the winner.

To summarize, then: when a /ti/ sequence is not created through affixation, there will be some chains where the /t/ assibilates before affixation, and some chains where it assibilates after affixation. These chains' LUMSeqs will assert different orders between IDENT(contin)-violation and affixation. When these chains are merged, the resulting rLUMSeq will assert no pairwise order between IDENT(contin)-violation and affixation, resulting in violation of PREC(affixation, IDENT(contin)), which demands that assibilation be preceded by affixation. Ranking that PREC constraint above the assibilation-favoring markedness constraint *ti ensures that /ti/s will not assibilate in root-internal position, even in affixed words.

For monomorphemic words like [koti] 'home', the reason for the failure of assibilation is related, but even simpler. There are no affixal morphemes in such a word, and so no chain's LUMSeq or rLUMSeq will include an operation of affixation.

Therefore, no rLUMSeq that includes the IDENT(contin)-violating assibilation LUM will assert that it is preceded by affixation. Every chain that assibilates /koti/'s /t/ will therefore violate the first clause of PREC(affixation, IDENT(contin)).

To complete the picture, we need to look at cases where assibilation is able to apply, such as /halut-i/ → [halusi] 'want-PAST'. Here, the chains that we need to consider are:

- (45) a. <ROOT-AF, halut-AF, haluti, halusi>
 LUMSeq: <Insert-root, affixation, IDENT(contin)>
 b. <ROOT-AF, halut-AF, haluti>
 LUMSeq: <Insert-root, affixation>

In chain (45)a, the root is inserted, then the affix /-i/ is inserted, and finally the /t/ assibilates. In chain (45)b, the root is inserted, followed by affixation, but assibilation is forgone. Crucially, there is no chain **< ROOT-AF, halut-AF, halus-AF, halusi>, which is identical to (45)a but for reversing the pairwise order of affixation and assibilation. There is no such valid chain because the mapping /halut/ → [halus] is not harmonically improving in Finnish. There may well be markedness constraints which prefer [halus] over [halut], but in Finnish these are all ranked below IDENT(continuant).

Because there is no chain **< ROOT-AF, halut-AF, halus-AF, halus-i>, neither of the chains in (45) is convergent with any other chain. Chain merger therefore applies vacuously to both of these chains, yielding rLUMSeqs which are identical to the LUMSeqs in (45). Given these rLUMSeqs, the candidate with assibilation is now able to win:

(46)

//ROOT-AF//	PREC (insert-affix, IDENT(contin))	*ti	IDENT (contin)
a. [haluti] rLUMSeq: <Insert-root, insert- affix>		W_1	L
b. ¹ [halusi] rLUMSeq: <Insert-root, insert- affix, IDENT(contin)>			1

In this case, both candidates satisfy $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$. Candidate (47)b, with assibilation, satisfies the PREC constraint because the $\text{IDENT}(\text{contin})$ -violating LUM is preceded and not followed by affixation. Candidate (46)a, with no assibilation, vacuously satisfies the PREC constraint because it has no $\text{IDENT}(\text{contin})$ -violating LUM. Because the PREC constraint is indifferent between these two candidates, the choice is passed down to the markedness constraint *ti, which picks (47)b, with assibilation, over (46)a, with no assibilation.

In summary, then, for words like /halut-i/ → [halusi] where /ti/ sequences do arise through morph concatenation, it is not harmonically improving to assibilate the /t/ until after it's followed by an /i/—that is, until after affixation happens. Therefore, there are chains which assibilate the /t/ after affixation, but none where assibilation happens before affixation. The pairwise precedence relation <insert-affix, IDENT(contin)> therefore survives chain merger. The presence of this pairwise relation in the rLUMSeq of the chain with assibilation now allows that chain to satisfy $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$, which in turn allows *ti to exert the crucial preference in favor of the chain with assibilation over its non-assibilating competitors. The contrast between [halusi] on the one hand vs. [vaativat] and [koti] on the other thus illustrates how OT-CC's mechanism of chain merger lets OI correctly capture the

distribution of Finnish assibilation. Assibilation only happens when its crucially preceded by affixation, and chain merger provides a formally explicit tool for separating crucial from non-crucial orderings of affixation and assibilation.

This demonstration of how OI can accommodate DEEs also shows that OT-CC enjoys an advantage of parsimony over rule-based phonology with respect to how it models opaque effects. Rule-based phonology of the *SPE* tradition (Chomsky & Halle 1968) can easily account for counterbleeding and counterfeeding interactions by assuming that the rules apply in the order required. Rule ordering, however, is unable by itself to give a proper account for DEEs (Kiparsky 1968, 1973a, Kenstowicz & Kisseberth 1970, 1977). Simply assuming that assibilation is ordered after affixation in Finnish gives us the wrong result, because this doesn't stop the assibilation rule from applying to morpheme-internal /ti/ sequences:

(47)	Underlying	/vaati/	/tilat/
	Affixation	vaativat	tilati
	Assibilation	vaasivat	silasi
	Surface	*[vaasivat]	*[silasi]
		(cf. attested [vaativat], [tilasi])	

Because of this problem, rule-based phonology needs to assume that rule application is subject to some global requirement like the Strict Cycle Condition to prevent rule application in underived environments. This means that different kinds of process interaction are accounted for using different formal devices: counterfeeding and counterbleeding are modeled using rule ordering, whereas DEEs are modeled using the SCC. In OT-CC and OI, on the other hand, the need for two separate mechanisms goes away. As we've seen, *PREC* constraints can be used to model both counterbleeding interactions (Bedouin Hijazi Arabic, Seoul Korean) and DEEs (Finnish).

1.4 Overview of the dissertation

Chapters 2 and 3 deal with the topic of allomorphy—that is, selection of morphs. In Chapter 2, I introduce the faithfulness constraints which I will assume to be at work in morpheme-morph correspondence, including the MAX-M(F) and DEP-M(F) families. I will present evidence that these constraints can be violated for the sake of better satisfying phonological constraints, furnishing support for OI theory’s premise that morph insertion occurs in the phonology. I also address the question of economy in morph selection—which means, roughly, a preference for fewer morphs, and the fact that different morphs expressing the same features are usually mutually exclusive. I argue that OI theory can derive economy effects, and therefore has no need to stipulate economy of morph insertion as a separate grammatical principle.

Chapter 3 examines allomorphy and related effects which have to do with the order in which morphs are inserted. Here, I will show that OI derives Paster’s (2005, 2006, to appear) generalization that phonologically-conditioned allomorph selection is universally opaque with respect to any phonological processes which would be conditioned by one of the competing allomorphs. I also show that OI, if accompanied by the assumption that morph-insertion must begin at the root and proceed from there outwards (which is also stipulated in Lexical Phonology), derives the generalization that phonologically-driven allomorphy is (almost) always inwards-looking rather than outwards-looking. However, I show that OI nevertheless permits a specific, attested exception to the generalization that allomorphy can only look inwards. Following this, I show that OI allows the for the pairwise order of allomorph selection and a

phonological process to be ‘locally ordered’ as well as subject to variable ordering. Both of these effects are inconsistent with Lexical Phonology and Stratal OT, despite being attested in Tigrinya. Finally, I demonstrate that OI’s assumptions make it possible to reconcile OT-CC’s assumption of gradualness in chain construction with Horwood’s (2002) faithfulness-based account of affix order. As McCarthy (2007b) notes, these two proposals are in conflict with respect to the analysis of infixation.

In Chapters 4 and 5 I turn to interleaving effects proper, showing how DEEs (blocking in nonderived environments), cyclic inheritance, and blocking in derived environments can be handled in an OT-CC-based model of opacity. I also show how OI’s typological predictions with regard to these kinds of effects are more accurate than those of competing theories like Stratal OT, OO-Faithfulness, and rule-based Lexical Phonology. Finally, Chapter 6 offers concluding remarks.

CHAPTER 2

SPELL-OUT WITHIN THE PHONOLOGY

2.1 Introduction


Chapter 1 presented the two main premises of the research program of this dissertation: first, that morph insertion occurs in the phonology, and second, that phonology and morph insertion are interleaved serially. This chapter makes the case in detail for the first premise, by examining various ways in which phonological constraints can exercise control over which and how many morphs are used to spell out a given word's abstract morphemes. The serial aspect of OI theory will not play a key role in this chapter; arguments for the serially-interleaved character of phonology and morphology and for the advantages of implementing this seriality in OI will be the focus of chapters 3, 4 and 5.

A given abstract morpheme will not always be phonologically expressed using the same morph. This is the phenomenon known as suppletion. In some systems of suppletion, the distribution of the various morphs is entirely morphological in character, with no evidence of phonological conditioning. This is the case, for example, in the alternation between *go* and *went* in English. The generalization is that *went* is used in past-tense contexts, and *go* is used otherwise. Descriptively at least, nothing about phonology needs to be mentioned.


On the other hand, there are other cases of listed allomorphy which show every sign of being purely phonological in character. (Following Paster 2005, 2006, to appear, I refer to these cases as “Phonologically-Conditioned Suppletive Allomorphy”, or PCSA). An example of this is the Moroccan Arabic 3rd person masculine singular enclitic

described in the previous chapter. This clitic appears as /-u/ following a consonant-final stem and as /-h/ following a vowel-final stem. Here, the descriptive generalization is entirely phonological: nothing about the abstract morphological features of either the clitic itself or of the stem it attaches to needs to be said. Moreover, as we also saw in the preceding chapter, it is possible to give a straightforward OT analysis of this system of allomorphy using standard, independently-motivated markedness constraints (Mascaró 1996b):

(1) Moroccan Arabic: 'his error'

/xt ^s a - {h, u}/		ONSET	NoCODA
<i>Inputs:</i>	<i>Outputs:</i>		
/xt ^s a-h/	a.  [xt ^s ah]		₁
/xt ^s a-u/	b. [xt ^s a.u]	W ₁	L

(2) Moroccan Arabic: 'his book'

/ktab - {h, u}/		ONSET	NoCODA
<i>Inputs:</i>	<i>Outputs:</i>		
/ktab-u/	a.  [kta.bu]		
/ktab-h/	b. [ktabh]		W ₁

I henceforth refer to the mode of analysis presented in these tableaux as the 'multiple-UR' approach. This is due to its assumption that '3rd person masculine singular' is expressed by a lexical item which has two phonological underlying forms.

Not all systems of suppletion, however, fall at one of the poles of purely-morphological (like *go* ~ *went*) or purely-phonological (like /-u/ ~ /-h/), but instead are somewhere in between. These hybrid systems fall into two kinds. In the first kind, the distribution of allomorphs normally reflects a morphological, meaning-based generalization, but this generalization is overridden in phonologically-defined contexts. An example, also introduced in the previous chapter, is that of *el* ~ *la*

suppletion in Spanish. The form *el* is used in grammatically masculine contexts and *la* in grammatically feminine contexts, except when the feminine noun begins with stressed [á], in which case *el* can be used instead.

In the second type of hybrid allomorphy system, the distribution of allomorphs can be described in terms that are strictly phonological, but it is not possible to analyze the distribution using non-*ad hoc* markedness constraints as it was in the Moroccan Arabic example. In these kinds of allomorphy systems, it seems to be necessary to assume that phonological pressures interact with an arbitrary preference among the allomorphs.

The most widely-discussed allomorphy system which requires an arbitrary preference is found in the Pama-Nyungan language Dyirbal (Dixon 1972, McCarthy & Prince 1990, 1993a: ch. 7, Bonet 2004, Paster 2005, 2006, to appear, Bye 2007, Trommer 2008). In this language, the ergative is marked by [-ŋku] on disyllabic vowel-final noun stems, and [-ku] on longer vowel-final stems:²³

- (3) *Dyirbal ergative*²⁴
- | | |
|-------------|---------------|
| jaɾa-ŋku | ‘man-ERG’ |
| jamani-ku | ‘rainbow-ERG’ |
| palakara-ku | ‘they-ERG’ |

In order to analyze the Dyirbal ergative in an OT system, we would have to find some constraint which preferred [-ŋku] over [-ku], either in general or just in the context of being attached to a disyllabic stem. Given the great similarity of [-ŋku]’s and [-ku]’s

²³ Stems ending in a nasal or [j] mark the ergative with a stop homorganic to the stem-final consonant, followed by [u]; when the stem ends in [l], [r], or [ɾ], the ergative is marked by deletion of that consonant, plus suffixation of [-ɾu].

²⁴ A note on orthography: Dyirbal has only a single (voiceless unaspirated) stop series; for the sake of minimizing confusion, I use IPA [p t k ...] for Dyirbal stops rather than the [b d g ...] orthography employed by Dixon (1972). For consistency with the rest of the thesis, I also use [j] rather than [y] in Dyirbal examples to represent a glide.

phonological shapes—as well as the marked status of nasality, of consonant clusters, and of NÇ sequences—it is far from clear that we could find a markedness constraint which would do this. Therefore, it appears that [-ŋku] must be the beneficiary of an arbitrary preference.

Various proposals exist about how to model this kind of arbitrary preference in OT (McCarthy & Prince 1993a: Ch. 7, Kager 1996, Picanço 2002, Bonet 2004, Bonet, Lloret & Mascaró 2005, Kikuchi 2006, Teeple 2006, Bradley 2007, Mascaró 2007). In OI theory, as I will show in this chapter, an arbitrary preference for (say) [-ŋku] over [-ku] can be modeled by assuming that [-ŋku] more faithfully expresses the morphosyntactic features of the abstract morpheme *ERGATIVE* than [-ku] does. Under this mode of analysis, allomorphy systems involving arbitrary preference have the same character as the *el-la* example. In both cases, a morphological constraint demanding faithful feature expression is sometimes overridden under the compulsion of a higher-ranking phonological constraint. The ability to give a unified analysis of these two kinds of allomorphy systems—which appear to be partly phonological and partly morphological or lexically arbitrary—thus represents a powerful argument in favor of one of OI’s main premises: that morph selection occurs in the same OT grammar as the phonology does. OI theory posits that morphological and phonological requirements take the form of violable constraints which interact with one another, and allomorphy systems like those seen in Spanish and Dyirbal call for just this kind of interaction.

Having a satisfactory way to model Dyirbal-type arbitrary preference within the phonological component of the grammar is a desirable goal. This is because the alternative is to assume that PCSA is not part of the phonology at all, and is instead

enforced in the morphology via subcategorization requirements (as argued by Lapointe & Sells 1996, Dolbey 1997, Lapointe 1999 to be the case for some PCSA systems, and Paster 2005, 2006, to appear, Bye 2007 to be the case for *all* PCSA). The subcategorization alternative is undesirable for at least two reasons. First, it is unparsimonious in that it requires the phonological generalizations at work in PCSA systems to be handled outside of the phonology. All else being equal, we should prefer a theory in which all phonological generalizations belong to a single module of the grammar. Second, a subcategorization analysis of PCSA very frequently misses salient generalizations, because the phonological conditions regulating the distribution of allomorphs often duplicate generalizations about the phonotactics of the language. Similarly, different pairs of competing allomorphs in the same language may be distributed according to the same phonological generalizations. The subcategorization approach therefore requires the subcategorization frames of multiple affixes of the same language to conspiratorially aim at the same phonological outcomes. Both kinds of duplication can be avoided if PCSA occurs in the phonology: the same markedness constraints can be called on to drive phonotactic restrictions and the distribution of allomorphs (potentially of more than one morpheme).

This chapter will, therefore, focus on making the argument that phonological constraints can over-ride morphological constraints on morph selection. In order to do this, we first need to explicitly state some of the constraints of the latter kind. This is the topic of section 2.2. This section will explore and justify the formulations of MAX-M(F) and DEP-M(F) introduced in Chapter 1, as well as introducing the topic of how faithfulness regulates the relationship between the hierarchical arrangement of

morphemes in the syntactic tree and the linear arrangement of morphs in the phonology.

Once the relevant constraints on morph selection have been presented, I will show in turn that each of them can be violated on phonological grounds. Section 2.3 covers MAX-M(F) violation. I argue that MAX-M(F) is violated under pressure from phonological constraints in arbitrary-preference systems, such as that of the Dyirbal ergative. In these systems, a morph which expresses fewer features is chosen at the expense of a morph which expresses more features. I will first justify in detail the need for arbitrary preference in Dyirbal, and then present the OI analysis. Next, I will review the empirical problems facing other, competing theories of arbitrary preference. Finally, I will review the arguments against the subcategorization approach, specifically looking at languages in which a subcategorization model would require the morphology to duplicate the language's phonotactic restrictions.

Section 2.4 turns to phonologically triggered DEP-M(F) violation. Here, the phonology forces selection of a morph which includes morphosyntactic features which are not present in the associated abstract morpheme. I'll focus on the two empirically best-supported examples in the literature: Spanish 'feminine *el*' and Modern Hebrew [im]~[ot] plural allomorphy.

In section 2.5, I discuss economy effects in spell-out, specifically the fact that languages will use only those morphs which are necessary for feature spell-out, and no more. In the case of Moroccan Arabic, for example, something has to rule out candidates like [xt^sa.hu] which use *both* allomorphs of the 3rd.masc.sg. clitic. The crux of the argument is that using a greater number of phonologically-overt morphs will in

general result in more violations of phonological markedness constraints. Economization of morphs based upon the need to minimize phonological markedness violations is only possible if those phonological markedness constraints are in the same OT grammar responsible for morph choice. The possibility of deriving economy of morph insertion is thus another strong argument for OI, and against other models in which the economy effect must be stipulated. I will show that multiple-UR OT analyses of phonologically-conditioned suppletion, such as that shown in (1)-(2) for Moroccan Arabic, require such a stipulation. OI is able to dispense with such assumptions, letting it avoid the typological problems inherent in theories where economy is posited as a grammatical constraint in its own right (see Gouskova 2003 and Grimshaw 2003 for similar arguments about economy effects in phonology and in syntax, respectively). Section 2.6 offers concluding remarks.

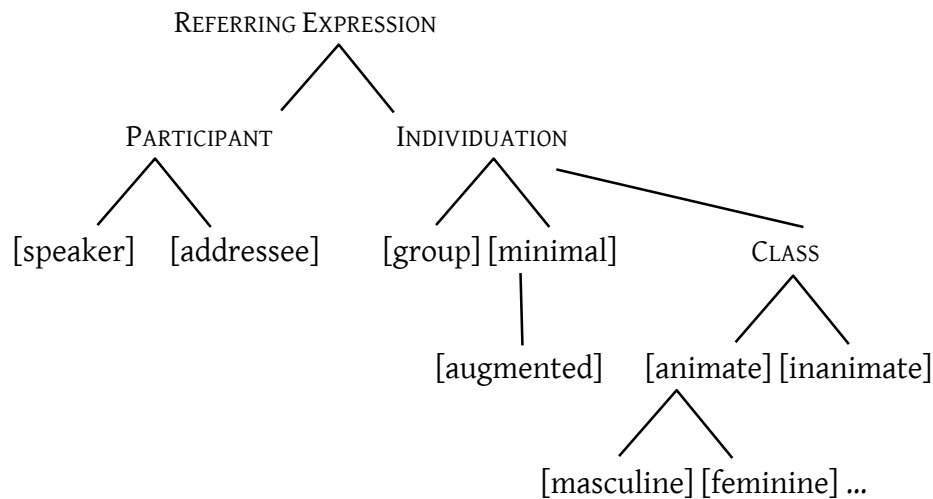
2.2 Faithfulness constraints on morpheme-morph correspondence

2.2.1 Defining morphemes, morphs, and features

In chapter 1 I suggested that the relationship between abstract morphemes and the morphs which express them be regarded as a Correspondence relation in the sense of McCarthy & Prince (1995, 1999):

Thinking of an FS as a root node is compatible with (though by no means requires) the assumption that morphosyntactic features are organized in a feature geometry. This assumption has been argued for by, most notably, Harley & Ritter (2002); their proposed system of featural organization for nominals is shown below:

(5) *Morphosyntactic feature geometry per Harley & Ritter (2002)*

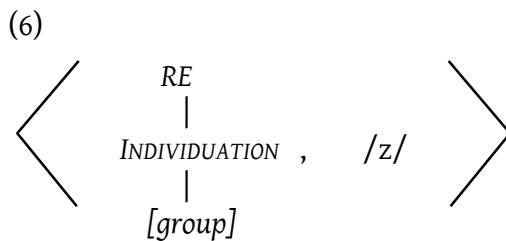


For my purposes, it will be unimportant whether morphosyntactic features all attach directly to the root node or are arranged in a more elaborate feature-geometric structure; what is important is that FSes (root nodes) and the individual features are both genuine representational primes and therefore are both capable of standing in Correspondence.

A morph, as mentioned in chapter 1, is an ordered pair consisting of an FS and a phonological UR.²⁵ For instance—if we adopt, for illustration, the model of number

²⁵ For now, in the interest of expositional simplicity, I'm assuming that each morph has only one FS. However, it would be entirely possible to assume that morphs can have multiple FSes, as a strategy for analyzing portmanteau morphology (Trommer 2000); similar ideas are also found in Mascaró (1996a), Teeple (2006), Caha (2007), and Abels & Muriungi (2007). If we adopt this assumption, then a morph will formally be an ordered pair consisting of a set of FSes and a phonological UR.

features shown in (5) above—the English plural morph whose phonological UR is /z/ would look like this:



The FS of a morpheme—a morphological root node—can stand in Correspondence with a morph’s feature structure. Likewise, the individual features of a morpheme’s FS can stand in Correspondence with the individual features of a morph’s FS. Just as in phonology, these Correspondence relations will be regulated by faithfulness constraints. Having laid down the formal assumptions of OI theory about just what morphemes and morphs are, we can begin to define faithfulness constraints on FS/FS and feature/feature correspondence.

2.2.2 MAX and DEP constraints in morphology

Most work in Distributed Morphology assumes that selection of morphs (‘Vocabulary Items’) is governed by the Subset Principle, which is stated below as formulated in Halle (1997):

(7) *Subset Principle*

The phonological exponent of a Vocabulary item is inserted into a morpheme in the terminal string if the item matches all or a subset of the grammatical features specified in the terminal morpheme. Insertion does not take place if the vocabulary item contains features not present in the morpheme. Where several Vocabulary items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen.

Within the assumptions about morphemes and morphs that I presented in the previous subsection, the Subset Principle can be restated as follows:

- (8) *Subset Principle restated as ranked constraints*
- a. If F is a feature-structure of a morpheme and F' is a feature structure of a morph that it corresponds to, F' must not contain any features which are not present in F .
 - b. If F is a feature-structure of a morpheme and F' is a feature-structure of a morph that it corresponds to, F' must contain as many of F 's features as possible.
 - c. In case of conflict between them, satisfying requirement (a) takes priority over satisfying requirement (b). However, requirement (b) must still be satisfied to the fullest extent possible, without violating requirement (a).

Once it's rephrased in this way, it becomes clearer that the Subset Principle contains a kind of implicit OT-type constraint ranking: constraint (8)a dominates (8)b. That ranking means that (8)a will be obeyed in case of conflict, but even then (8)b is satisfied to the fullest extent that it can be. The minimal violation of disobeyed constraints forms the core argument for OT's assumption that constraints are ranked, rather than being parameterized as on or off (Prince & Smolensky 2004 [1993], McCarthy & Prince 1994). Therefore, it seems fruitful to reformulate (8)a-b as OT constraints. We will also want to check what predictions would be made if the ranking of (8)a » (8)b were reversed, and to see if the predicted languages are attested. It turns out that this ranking corresponds to the effects of the 'Superset Principle' proposed by Caha (2007) as a replacement for the Subset Principle, motivated by data from English and Czech. First, however, we need to show how the Subset Principle's two clauses (8)a-b can be restated as OT constraints.

In analyses which assume the existence of a Correspondence relation between two levels of linguistic representation (McCarthy & Prince 1995, 1999), MAX and DEP

constraints are used to demand that structures at one of the levels of representation have correspondents at the other level.

For input-output correspondence in phonology, MAX constraints demand that elements in the input have corresponding elements in the output. As such, MAX's role on that dimension of correspondence is to prevent the deletion of underlying phonological structures. Likewise, in the correspondence relations that hold between morphemes and morphs, MAX constraints will demand that structures at the morpheme level have correspondents at the morph level.

DEP performs the inverse role. In phonological input-output correspondence, DEP constraints require that elements in the output have correspondents in the input. That is, they serve to militate against epenthesis. For morpheme-morph correspondence, DEP constraints will demand that structures at the morph level have correspondents at the morpheme level.

MAX and DEP constraints for individual features and for FSes can be formally defined as follows:

- (9) MAX-M(F): For every instance φ of the feature F at the morpheme level, assign a violation-mark if there is not an instance φ' of F at the morph level, such that $\varphi \mathfrak{R} \varphi'$.²⁶
- (10) DEP-M(F): For every instance φ' of the feature F at the morph level, assign a violation-mark if there is not an instance φ of F at the morpheme level, such that $\varphi \mathfrak{R} \varphi'$.²⁷
- (11) MAX-M(FS): For every FS Φ at the morpheme level, assign a violation-mark if there is not an FS Φ' at the morph level, such that $\Phi \mathfrak{R} \Phi'$.

²⁶ A non-exhaustive list of similar constraints includes Noyer's (1993) PARSE-PROPERTY, Bonet's (1994) ELSEWHERE, Kiparsky's (1997) MAX-CAT and (2005) EXPRESSIVENESS, Selkirk's (2001) REALIZE constraints, Trommer's (2001) PARSE constraints, Wunderlich's (2001) MAX constraints, Ackema & Neeleman's (2004, 2005) PARSE, Teeple's (2006) FAITH-SM and EXPRESSIVENESS, and Strigin's (2007) MAX-STRUCT.

²⁷ A non-exhaustive list of similar constraints includes Ackema & Neeleman's (2004, 2005) FAITHFULNESS and Wunderlich's (2001) IDENT constraints.

- (12) DEP-M(FS): For every FS Φ' at the morph level, assign a violation-mark if there is not an FS Φ at the morpheme level, such that $\Phi \mathfrak{R} \Phi'$.

A constraint MAX-M(feminine), for instance, will demand that a token of [feminine] contained within a morpheme have a corresponding token of [feminine] contained within a morph. That constraint, therefore, will favor the use of morphs containing a [feminine] token over morphs lacking a [feminine] token (provided that a token of [feminine] is present at the morpheme level).

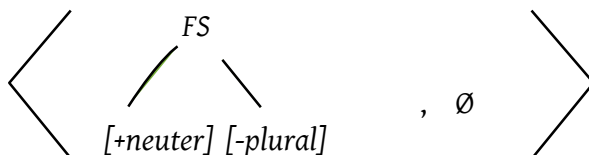
To illustrate concretely how constraints of the families defined in (9)-(12) work, let's consider how Sauerland's (1995) DM analysis of the syncretism in the inflectional paradigm of Dutch strong adjectives can be translated into OI terms. As mentioned in chapter 1, neuter singular adjectives have no overt inflection, while all other number-gender combinations take a suffix $-\partial$:

	[-neuter]	[+neuter]
[-plural]	$-\partial$	\emptyset
[+plural]	$-\partial$	$-\partial$

Table 2.1. Dutch number/gender agreement suffixes

Sauerland (1995) proposes that the syncretism in this paradigm be accounted for by positing a pair of vocabulary items equivalent to the following two morphs:

(13)a.



b. $\langle FS, / \partial / \rangle$

Morph (13)a consists of a feature-structure bearing the features [+neuter, -plural], and an empty phonological UR; morph (13)b consists of a feature-structure node with no dependent features, and the phonological UR /ə/.

The MAX-M(F) and DEP-M(F) constraints that we need to take into account are MAX-M(-plural), MAX-M(+neuter), DEP-M(-plural), and DEP-M(+neuter). When the input consists of a morph bearing the features [+neuter, -plural], morph (13)a will be chosen, regardless of how these constraints are ranked, since it violates none of them:

(14)

	MAX-M (-plural)	MAX-M (+neuter)	DEP-M (-plural)	MAX-M (+neuter)
a.				
b.	W ₁	W ₁		

In tableau (14) above, subscripts are used to represent pairs of elements at the morpheme level and at the morph level which stand in correspondence. In candidate (14)a, morph (13)a is used, which supplies correspondents for both of the feature-tokens [+neuter] and [-plural]. Candidate (14)a therefore satisfies the MAX-M(F) constraints relevant to these features. Candidate (14)b, on the other hand, uses morph (13)b. The FS of this morph has no dependent features, and using it therefore supplies no correspondents for either of the feature-tokens at the morpheme level. This results in violation of MAX-M(+neuter) and MAX-M(-plural). The two DEP-M(F) constraints, meanwhile, are not violated by either candidate, since neither has features at the morph level which lack correspondents at the morpheme level.

We begin to be able to adduce rankings for our constraints when we consider morphemes with other feature combinations. Let's look first at ones which have [+neuter, +plural]. Here, we need morph (14)b to be chosen. It will win if we assume the ranking DEP-M(-plural) » MAX-M(+neuter):

(15)

	DEP-M (-plural)	MAX-M (+neuter)
<div style="text-align: center;"> FS_1 $[+neuter]_2$ $[+plural]_3$ </div>		
a. <div style="text-align: center;"> FS_1 \emptyset $[-plural]_4$ </div>	W_1	L
b. FS_1 /ə/		₁

Candidate (15)a contains a token of [-plural] at the morph level which has no correspondent at the morpheme level. It therefore violates DEP-M(-plural). Candidate (15)b contains no such token, and therefore does not violate DEP-M(-plural). Ranking DEP-M(-plural) over MAX-M(+neuter) (which prefers (15)a because it assigns a correspondent to the morpheme's token of [+neuter]) therefore gives the desired result.

By the same token, the ranking DEP-M(+neuter) » MAX-M(-plural) will give the desired result for [-neuter, -plural] morphemes:

(16)

	DEP-M (+neuter)	MAX-M (-plural)
a.	W ₁	L
b.		1

MAX-M(FS) becomes relevant to the picture if we add one additional consideration. One of the main premises of OI theory is that morph-insertion and the phonology occur in the same component of the grammar. This means that candidates like those depicted in tableaux (14)-(16) will be evaluated by phonological markedness constraints. Because markedness constraints against schwa will exert a dispreference for using morph (13)b, we need to call on MAX-M(FS) in order to prefer using (13)b over using no morph at all:

(17)

	MAX-M(Rt)	*ə
a. (i.e., use of no morph)	W ₁	L
b.		1

Phonological markedness constraints like *ə will, in general, disfavor the insertion of phonologically overt morphs. If the only incentive to insert morphs comes from MAX-M(F) constraints, then it is mysterious why languages would ever insert a morph like (13)b which is phonologically overt, but which also contains no morphosyntactic features and therefore contributes nothing to the satisfaction of MAX-M(F) constraints. The solution to this problem is to assume the existence of MAX-M(FS), which demands

that every FS of a morpheme correspond to some FS of a morph, even if the morph doesn't furnish correspondents for any of the morpheme's features.

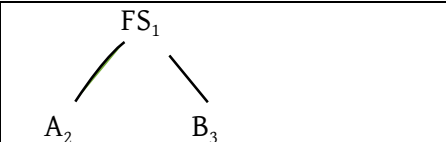
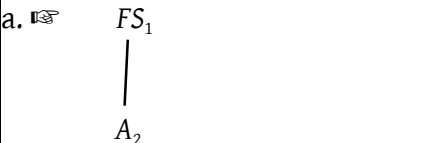
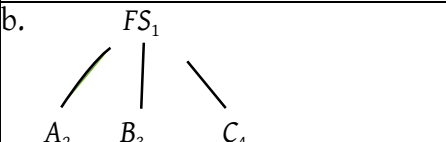
2.2.3 Beyond the Subset Principle: MAX-M(F) » DEP-M(F)

As we saw in the previous subsection, rankings of the form DEP-M(F) » MAX-M(F) derive the effects of Halle's (1997) Subset Principle. Under such rankings, the morph which contains the greatest possible number of the morpheme's features will be chosen, subject to the restriction that a morph cannot be used if it contains features not present in the morpheme. Notably, in an OT analysis like the one I presented, the Subset Principle's demand to match as many features as possible translates into minimal violation of MAX-M(F). The general OT model of minimal constraint violation obviates the need for a grammatical constraint like the Subset Principle to independently specify that something be done as much (or as little) as possible.

Matters are not quite done if we leave it there, however. Given the standard hypothesis in OT that constraints are freely re-rankable, we also need to consider the predictions made by the opposite ranking: MAX-M(F) » DEP-M(F).

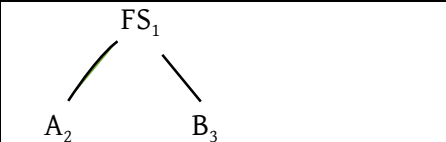
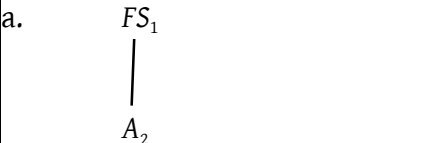
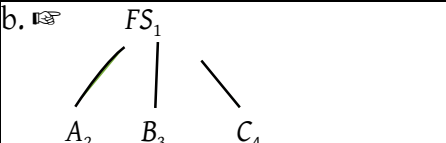
Suppose that we have a morpheme whose feature-structure contains the two features {A, B}, and that we have two morphs: one whose feature-structure contains {A} and one whose feature-structure contains three features {A, B, C}. Under the Subset Principle ranking of DEP-M(F) » MAX-M(F), the morph {A} will be chosen:

(18)

	DEP-M(C)	MAX-M(B)
a. 		1
b. 	W ₁	L

On the other hand, if we reverse the ranking, maximal spell-out of the morpheme's features will be prized over avoiding morphs which contain features that the morpheme lacks. Under that ranking, {A, B, C} will win:

(19)

	MAX-M(B)	DEP-M(C)
a. 	W ₁	L
b. 		1

The scenario in (19), where expression of all the morpheme's features is the top priority, and avoiding morphs that contain features not present in the morphemes is a secondary concern, has been argued by Caha (2007) to be attested in English and Czech.

Caha's argument is based on collections of paradigmatic cells which normally all use the same affix, but in which some roots idiosyncratically select a different affix to use in some of the cells. The Czech example involves case-marking:

	<i>hrad</i> 'castle.pl'	<i>kuře</i> 'chicken.pl'
Nominative	hrad-y	kuřat-a
Accusative	hrad-y	kuřat-a
Instrumental	hrad-y	kuřat-y

Table 2.2. Czech case paradigms

If, as Caha argues, <Nominative, Accusative, Instrumental> represents a scale of increasing complexity in terms of feature-structure, then the Subset Principle is unable to account for the distribution of case-markers in the paradigm of *kuře*. Let's suppose for the sake of illustrating this example that the Nominative case morpheme has the featural content {N}, Accusative the content {N, A}, and Instrumental {N, A, I}.

If the Subset Principle prevailed in Czech, then the default syncretism exhibited by nouns like *hrad* would be modeled by positing a morph /i/ (orthographic y) with the FS {N}, since this is the feature that's shared by the three cases. Now let's consider *kuře*. This root idiosyncratically subcategorizes for a different morph /a/ which is used to spell out the Nominative and Accusative. However, since {N} is the only feature shared by Nominative and Accusative, this means that the FS of /a/ would also be just {N}. If the competing morphs /i/ and /a/ have the same FS, then it is mysterious why the /a/ morph selected for by *kuře* should not best /i/ everywhere in *kuře*'s case paradigm. This is simply because /a/ and /i/ would have the same featural content, so there is nowhere in the case paradigm of *kuře* where /i/ should have an advantage (since /i/ never succeeds in spelling out more features than /a/ does).

If, however, we permit MAX-M constraints to dominate DEP-M constraints (the approximate equivalent of Caha's 'Superset Principle'), the Czech situation becomes

analyzable. Suppose instead that the morph /i/ had the FS {N, A, I}. If Czech has the ranking MAX-M(N) » DEP-M(A), DEP-M(I), then /i/ will be used to spell out all of the cases in question, even when this involves inserting a morph which contains features absent in the morpheme that it spells out:

(20)

	CASE ₁ N ₂	MAX-M(N)	DEP-M(A)	DEP-M(I)
a.	(no morph)	W ₁	L	L
b.		/i/	1	1

For *kuře*, we can assume that this root induces exceptionality in the selection of its case-markers by percolating a diacritic feature {R} onto its associated case morpheme. Suppose now that the morph /a/ has an FS {N, R}. The case morpheme associated with the nominative form of *kuře* will have the FS {N, R}. Because /a/ has an identical FS, using /a/ will perfectly satisfy all of the MAX-M(F) and DEP-M(F) constraints, and so there is no reason to use anything else in the nominative.

The instrumental of *kuře* is a different story. In the instrumental, the case morpheme has the FS {N, A, I, R}. The two relevant morphs available for spelling it out are /i/, with the FS {N, A, I}, and /a/, with the FS {N, R}. Neither morph's FS perfectly matches the FS of the morpheme, so either is a potential winner, depending on what the constraint ranking happens to be. If MAX-M(I) dominates MAX-M(R), use of /i/ will prevail:

(21)

	CASE ₁	MAX-M(I)	MAX-M(R)
a.		/a/	W ₁ L
b.		/i/	1

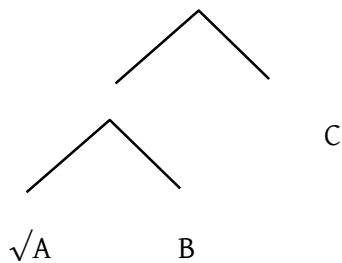
Dispensing with a universal Subset Principle, then—which, in OI terms, corresponds to allowing MAX-M(F) constraints to dominate DEP-M(F) ones—thus allows us to model systems like the case paradigm of *kuře*, where an idiosyncratically-chosen morph displaces the default affix only in the featurally-simplest cells of an otherwise uniform paradigm. This result suggests that decomposing the Subset Principle into separate constraints which are freely re-rankable with respect to each other is a correct move.

2.2.4. Faithfulness and morph order

So far in this section we have been looking at faithfulness constraints to the featural content of morphemes. Another kind of morpheme-morph faithfulness will have to be added to the picture, however. Specifically, we need constraints which will pressure the linear order of morphs to reflect the hierarchical arrangement of the morphemes to which they correspond.

Since at least Baker's (1985) Mirror Principle, it has been widely assumed that the surface order of the morphs making up a word must recapitulate the structural positions that their corresponding morphemes occupy in the syntactic tree. Specifically, a more deeply embedded morpheme must correspond to a linearly more inner morph, and a less deeply embedded morpheme to a linearly less inner morph:

(22) *Mirror Principle effects on morph order*



→

*Depending on prefix vs. suffix status of morphs B and C:
 ABC, CAB, CBA, BAC: ✓ OK
 ACB, BCA: ✗ not OK*

I will be assuming that the morphosyntactic trees which are the input to the phonology are unlinearized. This means that the tree in (22) contains information about the relative depth of embedding of A, B, and C, but makes no assertions regarding their linear order. In this tree, morpheme B is more deeply embedded than morpheme C. The Mirror Principle therefore requires that morph C not be linearly closer to the root A than morph B is. Assuming that the syntactic tree is unlinearized, though, the Mirror Principle leaves open the possibility that B and C may be equally linearly close to A, as happens in cases like CAB and BAC where one is a prefix and the other a suffix.

Ackema & Neeleman (2004, 2005) propose the following OT constraint to enforce the Mirror Principle:

- (23) LINEARCORRESPONDENCE
 If X is structurally external to Y,
 X is phonologically realized as /x/, and
 Y is phonologically realized as /y/,
 then /x/ is linearly external to /y/.

This is the intuitive effect that we want a constraint enforcing the Mirror Principle to have. However, the constraint LINEARCORRESPONDENCE is not sufficiently formalized as to allow us to define exactly what counts as linear externality, or to distinguish between different degrees of it. Within the assumptions of OI theory, LINEARCORRESPONDENCE can be restated in an explicit fashion as follows²⁸:

- (24) MIRROR
- a. Let M_1 be a morpheme and μ be a morphosyntactic constituent sister to M_1 , where μ dominates the morphemes M_2, \dots, M_n .
 - b. Let M_1', \dots, M_n' be morphs (if any) whose feature-structures correspond, respectively, to those of M_1, \dots, M_n .
 - c. Let p_1, \dots, p_m be the phonological exponents (if any) of all of the morphs M_2', \dots, M_n' . (A phonological exponent of a morph M means any piece of output phonological structure which has a correspondent in M 's underlying form.)
 - d. If morph M_1' is a prefix, assign a violation-mark for every p_i which linearly precedes some exponent of M_1' .
 - e. If morph M_1' is a suffix, assign a violation-mark for every p_i which linearly follows some exponent of M_1' .

The constraint MIRROR will be responsible for militating against two kinds of effects. First, it serves to enforce Mirror Principle effects of the typical sense, as depicted in (22). Suppose that we have the morphosyntactic tree in (22), and the following three morphs:

²⁸ This constraint is different from the constraint called MIRROR proposed by Kabak & Revithiadou (2007), which requires recursive syntactic structures to correspond to recursive prosodic structures (and vice versa).

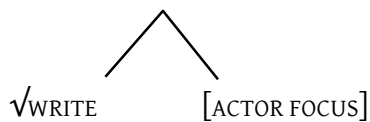
- (25) <A, /a/> (root morph)
 <B, /b/> (prefix)
 <C, /c/> (prefix)

Consider a candidate with the phonological surface form [bca]. This candidate violates MIRROR, and in order to explicate the working of this constraint we can run through exactly why. The problem with [bca] arises from the morpheme C. Morpheme C is a sister to a constituent [AB], which is our μ . Morphemes M_2, \dots, M_n are A and B, and so morphs M_2', \dots, M_n' are <A, /a/> and <B, /b/>. The phonological exponents p_1, \dots, p_m of these morphs are the two segments [a] and [b]. Morpheme C is structurally external to $\mu = [AB]$, and so, as a prefix, the exponents of its correspondent morph <C, /c/>—which is our M_1' —must not linearly follow any of p_1, \dots, p_m . However, in candidate [bca], segment [c] linearly follows segment [b], resulting in a violation of MIRROR.

MIRROR's second function is to militate against infixation. Infixation occurs when the phonological exponents of one morph linearly intervene between the phonological exponents of a second morph, as in the Tagalog word [s-um-ulat] 'write-ACTOR FOCUS', which consists of a root morph /sulat/ and an affixal morph /um/. OT analyses of infixation (Prince & Smolensky 2004 [1993], McCarthy & Prince 1993a,b, Horwood 2002, McCarthy 2003d) typically regard infixes like /um/ as failed prefixes or suffixes. These morphs 'want' to appear before or after the root, but some higher-ranked pressure compels them to appear inside the root. Still, even when infixes appear inside the root, these affixes appear as close to their preferred edge as possible, presumably because the further into the root the affix migrates from its preferred edge, the more violations are incurred from the constraint responsible for preferring the affix's presence at the designated edge.

In OI theory, the constraint responsible for the edge-tropism of affixes is MIRROR. To illustrate, let's consider the case of [sumulat]. We may assume that this word is bi-morphemic and has the following morphosyntactic tree structure:

(26)



The morpheme which contains the feature [ACTOR FOCUS] is a sister to a constituent consisting of the single morpheme $\sqrt{\text{WRITE}}$. This means that [ACTOR FOCUS] is our M_1 , and $\sqrt{\text{WRITE}}$ our M_2 . The morphs whose URs are /um/ and /sulat/ are, respectively, M_1' and M_2' . The morph whose UR is /um/ is a prefix, so MIRROR will be violated once for every segment of /sulat/ which precedes a segment of /um/. In the attested winning candidate [s-um-ulat], there is one such segment, and so one violation of MIRROR is incurred. By contrast, a rival candidate like *[sul-um-at], which infixes /um/ further to the right within the root, will incur three violations of MIRROR, because there are three segments of /sulat/ which are to the left of /um/.

We have now completed our presentation of the morpheme/morph faithfulness constraints which will be employed in this dissertation. We are now ready to begin examining in depth the variety of attested examples in which these morphological faithfulness constraints are violated for the sake of better satisfying phonological constraints. These examples will serve to justify OI theory's first main premise, namely that phonology and morph selection occur in a single OT grammar. The next subsections look at phonologically-induced violation of MAX-M and DEP-M constraints; phonologically-motivated MIRROR violation is discussed in Chapter 3.

2.3 Arbitrary preference and MAX-M(F) violation

2.3.1 Introduction

Suppose that a morpheme is realized, depending on its context, by one of two morphs X and Y , which appear respectively in the phonological contexts A_B and C_D . If the choice between X and Y is made by an OT grammar (Mester 1994, Tranel 1994a,b, Drachman, Kager, & Malikouti-Drachman 1996, Mascaró 1996a,b, Kager 1996, *et seq.*), then two things must hold:

- (27) a. Some (markedness) constraint M_1 that exerts the preference $AXB \succ AYB$ must dominate all constraints that exert the preference $AYB \succ AXB$.
- b. Some other (markedness) constraint M_2 that exerts the preference $CYD \succ CXD$ must dominate all constraints that exert the preference $CXD \succ CYD$.

These requirements result directly from the basic logic of constraint ranking in OT. For a pair of competing options like AXB and AYB , the highest-ranked constraint which prefers one over the other must prefer AXB , since otherwise unattested $*AYB$ would be chosen instead.²⁹ In some allomorphy systems, like $/-h/ \sim /-u/$ in Moroccan Arabic, it is easy to find the required M_1 and M_2 among markedness constraints which are well motivated by phonological typology. In Mascaró's (1996b) analysis of Moroccan Arabic depicted in (1)-(2), for instance, we can call on standard, widely-used, not-especially-controversial constraints like $ONSET$ and $NOCODA$.

For other allomorphy systems, it is not apparent that the required M_1 and M_2 can be found. As mentioned earlier, the system that arises most frequently in

²⁹ See Prince (2002, 2003) for formal discussion in relation to this. The formulation that the highest-ranked constraint which distinguishes between a winning and a losing candidate must prefer the winner is originally due to Jane Grimshaw.

discussions of this issue involves the marking of Ergative case on vowel-final stems in Dyirbal. The pertinent data are repeated below:

- (28) *Dyirbal ergative*
jaɾa-ŋku ‘man-ERG’
jamani-ku ‘rainbow-ERG’
palakara-ku ‘they-ERG’

As the data show, disyllabic vowel-final stems take /ŋku/, while longer ones take /ku/. It is reasonably clear that there will be constraints that prefer /ku/ over /ŋku/, regardless of context, since the nasals, velars, and consonant clusters are all marked. However, given that /ku/ and /ŋku/ resemble each other so much, we would be hard-pressed to find any typologically-plausible universal constraint which could prefer /ŋku/ over /ku/ just in case the stem was disyllabic. In the next subsection, the case for the unavailability of such a constraint will be made in detail; this will motivate the OI-based analysis to be presented in subsection 2.3.3.

2.3.2 The need for arbitrary preference in Dyirbal

In order to show that no plausible universal markedness constraint could be called on to prefer /ŋku/ over /ku/, let’s first consider the possibility that the surface forms [ŋku] and [ku] are derived from a single underlying form. This is not an altogether implausible idea, given that they are so phonologically similar. Suppose first that the shared UR were /ku/. This would have to be transformed via epenthesis into [ŋku] just in case the ergative marker were suffixed to a disyllabic stem.

Such epenthesis would be hard to phonologically motivate. Dyirbal has trochaic feet constructed from the left (Dixon 1972, McCarthy & Prince 1993a: main stress is on

the initial syllable, with secondary stress on all non-final odd-numbered syllables). It is unclear whether the [ŋ] of [-ŋku] is syllabified as a coda or a part of an onset cluster, but either way there's no reason to expect that it would be epenthesized after the head foot. In particular, if the [ŋ] is a coda, epenthesizing it would add a coda to an unstressed syllable, which will actually be disfavored by constraints like the Weight-to-Stress Principle (much as observed by Paster 2005, 2006, to appear), as well as the general NoCODA constraint. Moreover, even if there were a constraint that favored adding codas to unstressed syllables, calling on it for Dyirbal would incorrectly predict that the same epenthesis would occur when /ku/ was attached to a four-syllable stem like /palakara/ 'they', resulting in unattested *[$(pá.la)_{\text{HeadFt}}(kà.ra)_{\text{Ft}}-ku$]. Likewise, if the [ŋ] were syllabified as an onset, there is no reason at all to think that there is any markedness constraint which would demand that the syllable immediately following the head foot begin with a nasal or a cluster.

Now suppose instead that the shared UR of the ergative suffix were /-ŋku/. The /ŋ/ would have to delete whenever /-ŋku/ were attached to a greater-than-disyllabic stem. If the [ŋ] would be syllabified as a coda (were it retained), the problem here would be to explain why the /ŋ/ would delete to avoid adding a coda to the unstressed second syllable of a non-head foot, as in [$(pá.la)_{\text{HeadFt}}(kà.ra)_{\text{Ft}}-ku$]_{Wd} 'they-ERG', but not to avoid adding a coda to the unstressed second syllable of a head foot, as in [$(já.ɽaŋ)_{\text{HeadFt}}-ku$]_{Wd} 'man-ERG'. Conceivably, one might suggest that /ŋ/ escapes deletion only when it is a coda of a syllable in the head foot, due to positional faithfulness (Beckman 1998). This, however, cannot be the case in Dyirbal, since the language has numerous suffixes that contain coda segments which are not subject to deletion, even outside of the head

foot. For instance, the transitive verbalization of [wa.ɾu] ‘bend’ is [(wá.ɾu)_{HeadFt}-mal] ‘make bendy’ (Dixon 1972: 86), and not *[wá.ɾu]_{HeadFt}-ma], as we would expect if affix segments in coda position were only exempt from deletion inside the head foot. We do no better if the [ɾ] is assumed to be syllabified as an onset, as there is no reason to think that onset [ɾ] will delete only when it is not immediately preceded by the head foot.

In sum, then, regardless of how the [ɾ] of [-ɾku] is syllabified, there is little hope of giving an analysis of the [-ɾku]~[-ku] allomorphy of the Dyirbal ergative which derives the two surface allomorphs from some common underlying form. We now turn to consider whether a multiple-UR analysis like the one given for Moroccan Arabic would be possible. Such an analysis would presumably take the ergative suffix to have the two underlying forms {/-ɾku/, /-ku/}. Because these two forms are quite similar to one another, relatively few markedness constraints will distinguish between them. It is reasonably clear, though, that those markedness constraints that do will reliably prefer [ku] over [ɾku]. One such constraint would be *[nasal]; *N_ɕ (‘No sequences of a nasal followed by a voiceless segment’: Pater 1999) would be another. In the case of greater-than-disyllabic stems, these constraints would be assumed to be responsible for the observed victory of a /-ku/-selecting candidate over a /-ɾku/-selecting one:

(29) *Dyirbal*: ‘rainbow-ERG’

jamani + {/-ɾku/, /-ku/}		M	*[nasal]	*N _ɕ
Inputs:	Outputs:			
jamani + ku	a. [jamaniku]		₂	
jamani + ɾku	b. [jamaniɾku]		W ₃	W ₁

Candidate (29)a, by virtue of choosing the underlying form /-ŋku/, has one more nasal consonant and one more NÇ sequence than does the winner, which chooses /-ku/. Since the two candidates are identical but for the presence of the [ŋ], it would be reasonable to assume that no other markedness constraints distinguish between them, and hence the /ku/-selecting candidate wins, as we in fact observe in Dyirbal.

Meanwhile, there is a passive onlooker in tableau (29): the constraint I have labeled M. This is the constraint that will have to prefer [-ŋku] over [-ku] when the stem is disyllabic, and which will have to dominate constraints like *[nasal] and NoCODA, in order to override those constraints' preference for [-ku] regardless of the length of the stem. The problem is that there likely is no such constraint. As we have noted, CON is unlikely to contain any universal markedness constraint that would prefer [-ŋku] over [-ku] in general—and certainly not any markedness constraint that would exert that preference just in case the preceding stem were disyllabic.

There is one conceivable markedness-based strategy for enforcing a preference for [-ŋku] over [-ku]. This would be to assume that [-ku] is indexed to an Alignment constraint (McCarthy & Prince 1993b) which forbids it to be affixed to a disyllabic stem. As mentioned, a disyllabic stem in Dyirbal will be co-extensive with the head foot of the prosodic word. The requisite Alignment constraint would then require that [-ku] not have the head foot immediately to its left. Such an Alignment constraint, stated in negative terms, goes outside the schema of Generalized Alignment constraints as they are proposed in McCarthy & Prince (1993b), wherein these constraints are always stated in positive terms. There is probably good reason for not expanding the possible form of Alignment constraints in this manner: negative alignment constraints (e.g. 'the

{L, R} edge of morpheme X must not be aligned with the {L, R} edge of a stressed syllable’) would predict, among other things, systems of infixation where infixes target the edgemo**st** *unstressed* syllable/foot/etc. Such systems do not seem to be attested (Yu 2003, Fitzpatrick to appear).

In sum then, there is clearly no hope for an analysis of the allomorphy of the Dyrbal ergative based solely on phonological markedness. This is because there is no plausibly-extant markedness constraint that will exert the required preference for [-ŋku] in the contexts where it appears. Therefore, if we are to have the choice of [-ŋku] vs. [-ku] take place within the phonological component of the grammar, we will require some mechanism for exercising an arbitrary preference in favor of [-ŋku]. The next section will lay out the particulars of how this is accomplished in OI theory.

2.3.3 Analysis of the Dyrbal ergative³⁰

The competing morphs /-ŋku/ and /-ku/ stand in a special-general relationship: /ŋku/ appears in one specific context (after a disyllabic stem), and /ku/ appears elsewhere. In this case, the context of the special morph is phonologically defined. As we have already seen, special-general relations of the same sort also exist in systems of suppletive allomorphy in which there is no evidence of phonological conditioning. The inflection of Dutch strong adjectives discussed earlier in this chapter is just such an example: null inflection is used with neuter singular adjectives (the special case) and -ə is used otherwise (the general case).

³⁰ An analysis similar to the one in this section is independently proposed by Trommer (2008).

In the analysis of Dutch presented in section 2.2, the preference for the special case \emptyset is exerted by MAX-M(F) constraints. The FS of \emptyset contains the features [+neuter, -plural], while the FS of $-\text{ə}$ contains no features. Thus, whenever the case morpheme being spelled out contains either of the features [+neuter] or [-plural], the MAX-M(F) constraint for that feature will prefer the use of \emptyset over the use of $-\text{ə}$. This preference can be regarded as arbitrary in the sense that it is a lexical accident that \emptyset 's FS contains more features than $-\text{ə}$'s.

In order for the general case to emerge, the preference for the special case has to be overruled in certain contexts. In OT terms, this means that in the contexts where the general case appears, the relevant MAX-M(F) constraints are dominated by a constraint which, in just those contexts, prefers the use of the general case over the use of the special case. As we saw in (16), in the case of Dutch, the relevant constraints are DEP-M(+neuter) and DEP-M(-plural).

For Dyirbal, the analytic strategy will be the same. The arbitrary preference for /ŋku/ over /ku/ can be derived from the assumption that /ŋku/ spells out more features than /ku/ does. The main difference between Dutch and Dyirbal will be in the nature of the constraint that dominates MAX-M(F) and which triggers use of the general case. For Dutch, these were morpheme/morph faithfulness constraints, but for Dyirbal, the constraint will have to involve phonology, since a phonological generalization is at work.

In order to justify the particular assumptions that I'll make about the morphosyntax of /ŋku/ and /ku/, we need to consider one further fact about the Dyirbal case system. This is that Locative case shows a pattern of allomorphy which is

identical to that of that of the Ergative, except that the Locative has [a] where the Ergative has [u]. So, among V-final stems, disyllabic stems take [ŋka] in the Locative, whereas longer stems take [ka] (Dixon 1972):

- (30) jaɕa-ŋka ‘man-LOC’
 jamani-ka ‘rainbow-LOC’

That there should be this kind of partial syncretism between the Ergative and Locative is unsurprising in light of proposals about case features. Specifically, Halle & Vaux (1998) have proposed that Ergative and Locative share a feature [-free], which designates ‘nominals with a consistent role in argument structure.’ The other two cases which have this feature in the Halle/Vaux feature system are the Instrumental (whose phonological realization is identical to that of Ergative in Dyirbal) and Accusative, which Dyirbal doesn’t have. We can therefore make the following generalization about Dyirbal:

- (31) The feature [-free] is marked by /ŋ/ on disyllabic roots, but receives no overt phonological realization with longer roots.

In the [-free] cases, the other case features besides [-free] may be spelled out by other morphs, i.e. /ku/ in the Ergative and Instrumental or /ka/ in the Locative.

Assuming, then, that Dyirbal has a morph <[-free], /ŋ/>, this morph will appear in nouns carrying a [-free] case morpheme just in case MAX-M(-free) dominates any phonological markedness constraints which disprefer the presence of the segment [ŋ]:

(32) /-ŋ/ used with disyllabic ergative nouns

[MAN]—[-obl, +str, +sup, -fr]	MAX-M(-free)	*[nasal]
a. man^{E} ‘man’ {-fr} {-obl, +str, +sup} jaɕa ŋ ku		1
b. ‘man’ {-obl, +str, +sup} jaɕa ku	W ₁	L

In tableau (32), I'm assuming (for the sake of illustration) Halle & Vaux's (1998) proposal that the full featural make-up of Ergative is [-oblique, +structural, +superior, -free]. On the reanalysis motivated by the partial syncretism between Ergative and Locative, the apparent Ergative marker /ŋku/ in fact consists of two morphs: <[-free], /ŋ/> and <[-oblique, +structural, +superior], ku>.

As we've noted, there are many phonological markedness constraints which will prefer having just /ku/ over having /ŋ+ku/; in tableau (32) *[nasal] is chosen as a representative example. In order for /-ŋ+ku/ to ever be able to win, the preferences of these constraints must be overridden by the preference of some higher-ranked constraint. MAX-M(-free) is just such a constraint: it assigns one violation-mark to the candidate (32)b, because /-ku/ does not supply a correspondent for the morpheme's token of [-free], but no violation-marks to the winning candidate, with /-ŋ+ku/, because /-ŋ/ does provide a correspondent for [-free].

This much will give us the correct result for the contexts in which /-ŋ+ku/ is used. To complete the analysis of Dyirbal, we will need to add a constraint, ranked above MAX-M(-free), which will penalize the use of /-ŋ/ with longer-than-disyllabic stems. I will follow McCarthy & Prince (1993a) in invoking the following constraint to disprefer the use of /-ŋ/ with longer stems:

- (33) AFFIX-TO-FOOT
 The affix /-ŋ/ must coincide with the right edge of the head foot.

As mentioned in the previous section, Dyirbal has trochaic stress with main stress on the initial syllable, and therefore a disyllabic stem will be co-extensive with the head foot. When the stem is disyllabic, /-ŋ/-using candidates will satisfy AFFIX-TO-FOOT,

because /-ŋ/ appears immediately after the head foot, as in [(yá.ɾa)_{HeadFt}ŋku]. Candidates that omit /-ŋ/ will also satisfy AFFIX-TO-FOOT, albeit vacuously, because the morph /-ŋ/ on which AFFIX-TO-FOOT imposes a condition is not present. As such, AFFIX-TO-FOOT exerts no preference between using vs. omitting /-ŋ/ when the stem has two syllables. This allows the the preferences of MAX-M(-free) to become decisive for such stems.

By contrast, when the stem has more than two syllables, AFFIX-TO-FOOT will disprefer the use of /-ŋ/, and the optimal choice will be to use /-ku/ only:

(34) /ŋ/ omitted with longer ergative nouns

[ROOT]—[-obl, +str, +sup, -fr]	AFFIX-TO-FOOT	MAX-M(-free)
a. ʔə 'rainbow' {-obl, +str, +sup} [(já.ma) _{HeadFt} (ní.ku) _{Ft}]		1
b. 'rainbow' {-fr} ₁ {-obl, +str, +sup} ₂ [(já.ma) _{HeadFt} (níŋ ₁ .k ₂ u ₂) _{Ft}]	W ₁	L

As before, omitting /-ŋ/ results in violation of MAX-M(-free), but this is tolerated for the sake of avoiding instances of /-ŋ/ that are not suffixed to the the head foot.

Before going further, some remarks are in order about the constraint AFFIX-TO-FOOT. To invoke a morpheme-specific alignment constraint may appear to be a concession to a subcategorization-based theory of phonology. However, such constraints may not be entirely arbitrary, as they can be regarded as having a substantive motivation:³¹ the perceptual salience of a morph like Dyirbal /ŋ/ can be increased by placing it near to a position of prosodic prominence like the head foot. If MCat/PCat alignment constraints like AFFIX-TO-FOOT are regarded as being functionally grounded in this way, some explanation may be had of why (as mentioned earlier)

³¹ For a proposal that the surface forms of affixes are influenced by constraints requiring them to be perceptually noticeable, see Löfstedt (to appear).

infixes can target strong positions like the edgmost stressed syllable but not weak positions like the edgmost unstressed syllable.³²

2.3.4 Problems with competing theories of arbitrary preference

The first OT-based proposal for implementing an arbitrary preference among allomorphs is found in the analysis of the Dyirbal ergative in McCarthy & Prince (1993a: ch. 7). They argue for a serial analysis in which the privileged allomorph /-ŋku/ is ‘tried’ first. That is, in the first pass of constraint evaluation, the input contains only the allomorph /-ŋku/ rather than the pair of underlying forms {/-ŋku/, /-ku/}. They further assume that the allomorph /-ŋku/ is indexed to the constraint AFFIX-TO-FOOT. If the constraint AFFIX-TO-FOOT, along with ALIGN([ŋku],R, PWD, R), which will militate against infixing /-ŋku/, are ranked above the anti-null-parse constraint MPARSE (Prince & Smolensky 2004 [1993], Wolf & McCarthy to appear), the null parse will win on the first pass of constraint evaluation if the stem involved is greater than disyllabic:

(35) /jamani-ŋku/ leads to null parse

/jamani-ŋku/	AFFIX-TO-FOOT	ALIGN([ŋku],R, PWD,R)	MPARSE
a. \emptyset null parse			1
b. [(já.ma) _{HeadFt} (ni.ŋku) _{Ft}] _{Wd}	W ₁		L
c. [(já.ma) _{HeadFt} (ŋkù.ni) _{Ft}] _{Wd}		W ₁	L

The fully-faithful candidate (35)a violates AFFIX-TO-FOOT because the suffix /-ŋku/ is not adjacent to the head foot. AFFIX-TO-FOOT is satisfied in (35)c, which infixes /-ŋku/ so as to place it immediately to the right of the head foot, but this involves displacing /ŋku/ from the right edge of the PWD, and hence violating ALIGN([ŋku],R, PWD, R). Both

³² A system of infixation driven by AFFIX-TO-FOOT is found in Ulwa (Hale & Lacayo Blanco 1989, McCarthy & Prince 1993b): the possessive markers always appear immediately to the right of the head foot.

of these constraints are ranked above MPARSE, and so the null parse (which, by hypothesis, violates no constraint but MPARSE) is the winner.

Because the pass of constraint evaluation with /-ŋku/ in the input fails to produce any output, the grammar then tries again with the elsewhere allomorph /-ku/ in the input instead. Because /-ku/ is not indexed to AFFIX-TO-FOOT, that constraint can no longer be violated, and the fully-faithful candidate now defeats the null parse:

(36) *Use of /ku/ beats null parse*

/jamani-ku/	AFFIX-TO-FOOT	ALIGN([ŋku],R, PWd)	MPARSE
a. $\text{[}(j\acute{a}.ma)_{\text{Ft}}(n\grave{i}.ku)_{\text{Ft}}\text{]}_{\text{Wd}}$			
b. <i>null parse</i>			W_1

While this approach does work, it suffers from the conceptual drawback of having to impose an external mechanism of ‘order of trying’ to get the desired result. Since competition is the essence of OT, we would prefer on grounds of parsimony for competition like that between /-ŋku/ and /-ku/ in Dyirbal to be hashed out *within* an OT grammar.³³

The MPARSE approach also suffers from a second, more serious drawback: it is unable to account for systems of allomorphy in which some realization (whether faithful or unfaithful) of both allomorphs would be more harmonic than the null parse. Consider, as an example, the indefinite article in English, which is a ([eɪ]~[ə]) before a following consonant-initial word and *an* ([æn]) before a following vowel-initial word. If there were an arbitrary preference between these two allomorphs, then one of them

³³ The MPARSE approach to arbitrary preference does have the possible advantage of being able to accommodate competition between synthetic and periphrastic expressions with the same meaning, where the two competing forms might not plausibly belong to the same candidate set, at least not at the level of the phonology. The question of whether competition between synthesis and periphrasis exists is a controversial one; Embick & Marantz (2008) is a recent entry denying that there is such competition, which cites a number of works taking the opposite view.

would have to yield the null parse as winner when it was ‘tried’ in the environment where it does not appear. If *a* were the special case, the null parse would have to be the optimal output for an input like *a apple*, and likewise if *an* were the special case, the null parse would have to be the optimal output for an input like *an duck*. The problem here is that there is no reason to think that either of these inputs would map to the null parse. This is because *an* can perfectly well be used with words containing a coda (*an end*) and *a* can equally well be used with words containing an underlying internal hiatus (*a sambaing* [i.e., an instance of someone dancing the samba]), which might be repaired by one of various processes (e.g. *r*-insertion), depending on the dialect. This means that, in English, neither NOCODA nor ONSET can dominate MPARSE (or MPARSE_{indefinite}, if we posit morphologically-specific versions of the constraint, as in Wolf & McCarthy to appear).

Given this, the MPARSE approach would require that systems of listed allomorphy which involve arbitrary preference have a fundamentally different architecture from at least some systems that do not. In the former case, there would be only one allomorph in the input at a time, with allomorphs being tried in the requisite order, whereas in the latter case, both allomorphs would have to be present in the input simultaneously, as in the analysis given for Moroccan Arabic in (1)-(2).

This situation stands in contrast to that of the lexical-insertion-in-the-phonology view adopted in OI theory. In OI, systems that involve arbitrary preference and those that do not can be analyzed using exactly the same architecture. For a case like that of the Moroccan Arabic 3rd person masculine singular clitic, where there is no arbitrary preference, we simply need to assume that the two morphs /h/ and /u/ have identical FSES. This means that all constraints of the MAX-M(F) and DEP-M(F) families


will be indifferent as to whether to use /h/ or /u/, and the choice will be left entirely up to the phonological constraints.

The second existing proposal about arbitrary preference is advanced by Bonet, Lloret, and Mascaró (2005) and Mascaró (2007), and also is used in Bonet (2004), Kikuchi (2006), and Bradley (2007)³⁴. It involves the following constraint:

- (37) **PRIORITY**. Respect lexical priority (ordering) of allomorphs.
 Given an input containing allomorphs m_1, m_2, \dots, m_n , and a candidate m_i' , where m_i' is in correspondence with m_i , **PRIORITY** assigns as many violation marks as the depth of ordering between m_i and the highest dominating morph(s).
(Definition from Mascaró 2007)

PRIORITY-based analyses are architecturally identical in form to multiple-underlying-form analyses like the one presented earlier for Moroccan Arabic: there is only one pass of constraint evaluation, and all of the competing allomorphs are in the input at once. The following tableaux, adapted from Bonet (2004), illustrate how the **PRIORITY** approach handles the Dyirbal facts:

(38) *Dyirbal 'man.ERG' with PRIORITY*

/ jaɾa -{ŋku, ku}/	AFFIX-TO-FOOT	PRIORITY
a.  [(já.ɾa) _{HeadFt} ŋku] _{Wd}		
b. [(já.ɾa) _{HeadFt} ku _{Ft}] _{Wd}		W ₁

With a disyllabic stem, as in (38), [-ŋku] and [-ku] can both be suffixed to the head foot. Candidate (38)a thus satisfies **AFFIX-TO-FOOT**, because [-ŋku] is so suffixed, and (38)b satisfies the same constraint, vacuously because /-ku/ is not indexed to **AFFIX-TO-FOOT**. Since **AFFIX-TO-FOOT** is indifferent as to the choice of allomorphs, the choice is made by the lower-ranked constraint **PRIORITY**. The winning candidate chooses the first-listed underlying form /-ŋku/ and thus gets no marks from **PRIORITY**. By contrast, candidate

³⁴ Similar constraints demanding the use of privileged allomorphs are invoked by Kager (1996), van Oostendorp (1998), and Kenstowicz (2005).

(38)a chooses the second-listed underlying form /-ku/. It therefore gets one mark from PRIORITY, and thus loses.

Now consider what happens with a greater-than-disyllabic stem:

(39) *Dyirbal* 'rainbow.ERG' with PRIORITY

/jamani-{ŋku, ku}/	AFFIX-TO-FOOT	PRIORITY
a. $\text{[(j}\acute{\text{a}}.\text{ma)}_{\text{HdFt}}(\text{n}\grave{\text{i}}.\text{ku)}_{\text{Ft}}]_{\text{Wd}}]$		1
b. $\text{[(j}\acute{\text{a}}.\text{ma)}_{\text{HdFt}}(\text{n}\grave{\text{i}}.\text{ŋku)}_{\text{Ft}}]_{\text{Wd}}]$	W_1	L

Because, when the stem is more than two syllables long, the head foot is no longer at the right edge of the Prosodic Word, neither allomorph of the ergative suffix can be suffixed to the head foot. As a result, the candidate that chooses the first-listed underlying form /-ŋku/ incurs a violation from AFFIX-TO-FOOT. The candidate that chooses /-ku/ gets no such violation (again vacuously because /-ku/ is not indexed to AFFIX-TO-FOOT), and so the /-ku/-selecting candidate now emerges as the winner, because AFFIX-TO-FOOT is higher-ranked than PRIORITY.

The PRIORITY approach is thus able to get the desired results because the constraint PRIORITY can exert whatever pairwise preferences are needed: we simply list the desired preference-order among allomorphs in the lexicon, and PRIORITY does the rest. This approach is not without its problems, though. The main one is that, unless we stipulate a universal upper bound on the number of underlying forms that a single lexeme can have, PRIORITY will have to evaluate candidates gradiently, since it assigns $(n-1)$ violation-marks to candidates that pick the n th highest-priority allomorph. For example, Bonet, Lloret, & Mascaró (2005) propose that the masculine gender suffix in Catalan has three underlying forms, which are ordered in the preference hierarchy

$\{\emptyset > u > ə\}$ ³⁵. To give the desired effects, PRIORITY needs to assign one violation-mark to candidates that pick /-u/ and two violation-marks to candidates that pick /-ə/. Given that, outside of suppletive allomorphy, gradient evaluation is never necessary and is frequently empirically undesirable (McCarthy 2003a, 2004), we have good reason to look for an alternative to PRIORITY which requires only categorical evaluation. MAX-M(F) constraints are just such an alternative: they assess categorically, assigning a single violation mark for each instance of the feature F at the morpheme level which is not spelled out at the morph level.

Mascaró (2007: fn. 13) suggests that PRIORITY could be regarded as categorical, if it is thought of as assigning a violation-mark for every pairwise preference among allomorphs that is not respected by a given candidate. For example, a candidate in Catalan which used [ə] as the masculine marker would get two marks because it disregards two preference statements: ‘ $\emptyset > ə$ ’ and ‘ $u > ə$ ’. However, since \emptyset and [-u] are not present in the output of a [ə]-selecting candidate, it is unclear how PRIORITY could judge that both preference statements had been disrespected, absent giving it the power to compare [ə]-selecting candidates with \emptyset -selecting and [u]-selecting alternatives within the candidate set, or something equivalent to this. Cross-candidate comparison by the constraints themselves is a major departure from standard OT assumptions about how constraints work,³⁶ and so eschewing a constraint like PRIORITY, which may require such a device, is probably well-motivated.

³⁵ There are other analyses which posit the existence of more than two allomorphs of a single affix: Mascaró (2007) argues that the infinitive marker in Baix Empordà Catalan has six and that the Classical Arabic definite article has fourteen, while Wolf (2007) proposes that morphemes that trigger the ‘mixed mutation’ in Breton have four.

³⁶ Cross-candidate comparison is employed in the Sympathy theory of phonological opacity (McCarthy 1999, 2003a); objections to Sympathy are raised or discussed by, among others, Idsardi (1997), Kiparsky

The third and final existing proposal about arbitrary preference uses categorical constraints. Picanço (2002) proposes that, when a lexeme has multiple allomorphs, each allomorph is indexed to a PARSE-MORPH constraint (Akinlabi 1996). The constraint PARSE-MORPH(X) is violated by a given candidate if that candidate fails to pick allomorph X, so the ranking of the various PARSE-MORPH constraints will determine the order of (arbitrary) preference among the allomorphs.³⁷ For instance, in Dyirbal, for input /jaɾa-{/ŋku/, /ku/}/, the candidate [jaɾa-ŋku] violates PARSE-MORPH(ku), while *[jaɾa-ku] violates PARSE-MORPH(ŋku). If PARSE-MORPH(ŋku) is higher-ranked, then [jaɾa-ŋku] will be preferred over *[jaɾa-ku]. There is a problem, though: there is no clear reason why both of these candidates should not be bested by *[jaɾa-ŋku-ku], which satisfies *both* PARSE-MORPH constraints by virtue of preserving both allomorphs in the output. The architecture of the PARSE-MORPH approach requires candidates to stand in correspondence with *all* of the underlying forms of a given morpheme in order for the PARSE-MORPH constraint relevant to each of the unused allomorphs to be violated. Perversely, however, this allows candidates like *[jaɾa-ŋku-ku] to arise, which the PARSE-MORPH constraints (as well as MAX) will allow to win.

The problem with the PARSE-MORPH approach, then, boils down to its inability to rule out candidates where multiple morphs competing to express the same morpheme all pile up in the output. As we will see later in section 2.6.1, this is a problem for

(2000, 2001), McMahon (2000), Bye (2001), Ito & Mester (2001), Potts & Pullum (2002), Bermúdez-Otero (2003), and McCarthy (2007: §2.3.4.3). A different sort of cross-candidate comparison is found in Blumenfeld's (2006) approach to the 'too-many-repairs' problem; see McCarthy (to appear a) for a different approach to the same problem which does not involve cross-candidate comparison.

³⁷ PARSE-MORPH constraints as used by Picanço (2002) seem to be equivalent to the 'lexical' constraints used in Escudero (2005), Apoussidou (2006), Boersma (2006) and related works. These authors propose that each UR available in the language for some meaning is hypothesized to be associated with a constraint demanding that that UR be used to express that meaning.

multiple-underlying-forms theories, even if PARSE-MORPH constraints are not assumed. These theories must stipulate that each candidate picks one and only one of the competing underlying forms.³⁸ By contrast, as alluded to earlier, OI's assumption that lexical insertion occurs in the phonology approach is able to derive the required economy of allomorphs from the effect of phonological markedness constraints.

2.3.5 Comparison with subcategorization-only approaches

PCSA systems like the Dyrbal ergative respect generalizations that can be stated in phonological terms, but which cannot be rationalized in terms of typologically well-supported markedness constraints. In OI, as well as in the PRIORITY and PARSE-MORPH theories, the response to this problem is to fit these PCSA systems into the phonology. This is done by incorporating into the phonology constraints which enforce arbitrary preferences.

Another response is possible, though. This is to argue that the lack of markedness conditioning in PCSA systems like the Dyrbal ergative is evidence that those systems are not part of the phonology. Instead, one can assume that the allomorphs /-ŋku/ and /-ku/ compete before the phonology gets underway, in the morphology, and that /-ŋku/ subcategorizes for a disyllabic stem:

³⁸ Steriade (2000b), however, proposes that properties of different allomorphs can be combined in the output. For a critique of PARSE-MORPH constraints as an approach to consonant mutation and other 'process' morphology (the purpose for which Akinlabi 1996 proposes them), see Wolf (2007a).

- (40) Subcategorization frames for Dyirbal ergative³⁹
Use /-ŋku/ if the stem is disyllabic
Use /-ku/ otherwise

Lapointe & Sells (1996), Dolbey (1997), and Lapointe (1999) have argued that some PCSA systems—the ones that resist a purely markedness-based analysis, like the Dyirbal ergative—should be handled through some sort of extra-phonological subcategorization mechanism. Paster (2005, 2006, to appear) and Bye (2007) go further, arguing that, if PCSA systems like the Dyirbal ergative need to be treated as extra-phonological, it is more economical to assume that *all* PCSA is extra-phonological. That is, there is no reason for some PCSA to be handled with subcategorization in the morphology and some with markedness constraints in the phonology if subcategorization will suffice for both.⁴⁰

While this may be true, it can also be argued that the subcategorization model suffers from a defect of unparsimoniousness *vis à vis* a model that places PCSA in the phonology. This is because there are many languages in which a phonological condition on allomorph distribution exactly matches a generalization about the language's phonotactics. In such cases, a subcategorization-only approach would require the morphology and the phonology, as separate components of the grammar, to redundantly enforce exactly the same phonological restriction on what would be a possible word of the language.

³⁹ Notice that these subcategorization frames must refer to a derived property of the stem, namely its syllable count. This is not a problem for a subcategorization model if it's coupled with a Lexical Phonology-type model of phonology/morphology interleaving. First, the level *n* phonology for Dyirbal would syllabify the stem; then, the ergative suffix would be added in the level (*n* +1) morphology, subject to the subcategorization frames in (41).

⁴⁰ Beyond economy, there is actually a second argument for the subcategorization-only approach, namely that PCSA arguably is always opaque with respect to phonological processes. In chapter 3, I will show that OI fares better than the subcategorization-only model on this front as well.

A straightforward example is found in the Gur language Kɔnni (Cahill 2007; also Struijke & de Lacy 2000). This language has five noun classes, which are distinguished from one another by the number and definiteness suffixes that they take. (Following Cahill’s (2007) notation, I use capital letters for segments whose underlying [ATR] value is undeterminable because they undergo allophonic alternations in that feature.):

	Class 1	Class 2	Class 3	Class 4	Class 5
Singular	-ɲ	-ɲ	-ɲ	-ɲ	∅
Singular definite	-rÍ	-kÚ	-kÁ	-bÚ	-wÁ
Plural	-A	-tÍ	-sÍ	-tÍ	(irregular)
Plural definite	-A-hÁ	-tÍ-tÍ	-sÍ-sÍ	-tÍ-tÍ	(irregular)
% of nouns	26	12	31	7	13

Table 2.3. Number and definiteness markers of Kɔnni noun classes

The remaining 11% of nouns are ‘mixed’: they take singular and plural markers from different classes.

Kɔnni exhibits several patterns involving avoidance of flaps in consecutive syllables. The sequences [rɾ] and [rVɾ] are never found on the surface in the language, either within a single morph or through the concatenation of two morphs. These sequences are avoided in part through allomorph selection. Cahill (2007: 125, fn. 15) reports that there are “many” [r]-final stems in noun classes 2 and 3, and “a few” in class 4, but none in class 1. (There are no [r]-final stems in class 5 because this class contains almost exclusively vowel-final stems.) This asymmetry can be attributed to the fact that class 1 is the only one whose members take an [r]-initial suffix, namely the singular definite /-rÍ/. Similarly, there are several [r]-final mixed-class nouns which

take a class 1 plural suffix, but these nouns “without exception” (Cahill 2007: 125) take a non-class-1 singular definite suffix.

The class 1 singular definite marker /-ŕ/ is thus systematically banned from being used with [r]-final nouns. This is a matter of allomorph selection. But because [r(V)r] sequences are never found in the language in any context we can infer that the language’s phonotactics contain an active constraint against such sequences. The effects of this constraint can be seen in the two [r]-initial suffixes of the language which undergo a dissimilatory alternation when attached to a base whose rightmost consonant is [r]. One is the agentive, which is normally [-ŕ], but which changes to [-t́] if the rightmost consonant in the base is [r] (as well as if the rightmost root consonant is [l], if the last segment of the base is [n], and optionally if the last consonant in the root is [ŋ] (p. 145):

- (41) [r]~[t] alternation in agentive suffix
 [bóntò:-jì:-ŕ] ‘hoodless cobra’ (lit. ‘toad-swallower’)
 [dì-dà:-ŕ] ‘buyer’
 but:
 [bò-bòrì-t́] ‘sower’
 [gbì-gbàrì-t́] ‘watcher’

Similarly, the masculine suffix on nouns is normally [-ra:ŋ], but appears instead as [-da:ŋ] with noun roots whose rightmost consonant is [r] or [n] (p. 147):

- (42) [r]~[d] alternation in masculine suffix
 [kpá-¹rán] ‘male guinea fowl’
 but:
 [gàjìàrà-dàán] ‘male weaver bird’

If PCSA is handled wholly through subcategorization frames, then the avoidance of /-ŕ/ in favor of other singular definite markers would have to be attributed to a

subcategorization frame dictating some other singular definite suffix be used with /r/-final roots. But on this analysis there would be no connection between the distribution of /-rɪ/ and the phonotactic constraint which ruled out [r(V)r] sequences across the board in the language, and which triggered the dissimilations undergone by the agentive and masculine suffixes. The subcategorization frame associated with /-rɪ/ would be part of the morphology, while the phonotactic constraint (and associated dissimilation processes) would be part of the phonology.

A subcategorization-only model of allomorphy thus suffers from a version of the Duplication Problem (Clayton 1976, Kenstowicz & Kisseberth 1977, Prince & Smolensky 2004 [1993]) faced by theories of phonology which incorporate morpheme structure constraints on underlying forms. What is descriptively the same well-formedness condition (e.g., [r(V)r] sequences aren't allowed) would be enforced at multiple points in the linguistic system, but via different formal mechanisms that have no connection to one another. In OI, duplication between phonotactics and allomorphy can be eliminated by placing both of these things within the purview of a single OT grammar, enabling a single markedness constraint to enforce the requirement with respect to both areas.⁴¹

Duplication in a subcategorization-only approach would not only occur between allomorphy and 'real' phonology, but also between allomorphy of different morphemes in the same language. An example: in Sami (Dolbey 1997) there are several person/number suffixes which appear as an even-syllabled allomorph with even-parity bases and as an odd-syllabled allomorph with odd-parity bases:

⁴¹ For another example, see Kiparsky (1972: 216) on an allomorphy/phonology conspiracy involving liquid dissimilation in English.

		<i>Even-σ root:</i>	<i>Odd-σ root:</i>
	<i>even ~ odd</i>	<i>/jearra-/ ‘ask’</i>	<i>/veahkehea-/ ‘help’</i>
1du:	∅ ~ -tne	[je:r.re]	[veah.ke.he:t.ne]
2du:	-beahtti ~ -hppi	[jear.ra.-beah.ti]	[veah.ke.heah.hp.pi]
2pl:	-behtet ~ -hpet	[jear.ra.-beh.tet]	[veah.ke.he:-h.pet]
3pl. preterit:	∅ ~ -dje	[je:r.re]	[veah.ke.he:-d.je]

Table 2.4. Syllable-counting allomorphy of person/number suffixes in Sami

For all of these suffixes, the observed distribution of allomorphs results in the root+suffix combination having an even number of syllables, which allows it to be exhaustively parsed into disyllabic feet. On an OT analysis, like that of Dolbey (1997), we can then account for the observed allomorphy of all four suffixes using the constraint *PARSE-σ*, which demands that all syllables be parsed into feet.

On a subcategorization analysis, on the other hand, the behavior of one of the affixes has nothing to do with the behavior of any of the others. For the 2nd person plural, the grammar would contain subcategorization statements to the effect that */-behtet/* is to be used with even-parity bases and */-hpet/* with odd-parity bases. Likewise, for the 2nd person dual, there would simply be subcategorization statements that */-beahtti/* is to be used with even-parity bases and */-hppi/* with odd-parity bases. But on such an analysis, the fact that both 2nd person plural and 2nd person dual use even with even and odd with odd is a total coincidence. No connection between these facts is expressed anywhere in the grammar.

The problems faced by a subcategorization-only theory go beyond simple duplication. In Kõnni, */-rí/* systematically avoids [r]-final stems. For a subcategorization-only model, this would mean that */-rí/* has a subcategorization frame which says “use this suffix with bases whose rightmost consonant is something other than [r]”. The problem here is that the set of segments “consonants other than

[r]” is almost certainly not a natural class. (It would be if we posited a feature [-rhotic] or [-flap]; however, see Walsh Dickey 1997 for arguments that such features are neither necessary nor desirable.) Given the guiding assumption that linguistic rules/constraints should not refer to unnatural classes, such an analysis must be considered *prima facie* undesirable.

A similar example occurs involving geminates in English. English doesn't permit geminates morph-internally, but geminates can arise in compounding and level 2 junctures (Benus, Smorodinsky & Gafos 2004, Kaye 2005, Martin 2007): e.g. *sand dune*, *solely*, *cleanness*.⁴² Martin (2007) shows that—despite the allowability of geminates at such junctures—words containing such geminates are statistically underrepresented in corpora of English, at least for compounding and for the suffixes *-less* and *-ly*. (He also identifies similar patterns in Navajo and Turkish, wherein structures that are banned morph internally are found, but nonetheless tend to be avoided, at morph junctures.)

This result means that English speakers have a tendency to avoid *-less* and *-ly* with [l]-final bases. In a model where allomorph choice is governed by phonological markedness constraints, this can straightforwardly be understood as driven by a constraint against geminates. In the case of *-less*, for instance, the *GEMINATE constraint may cause a *-less*-using candidate to lose to a candidate that uses a different morph (e.g. *smell-free* instead of *smell-less*) or to a null output candidate (Martin 2005). Variable rankings could be called on to ensure that the *GEMINATE constraint does not block the use of *-less* with [l]-final bases all of the time (Martin 2005, 2007).

⁴² This is an example of marked structures being allowed only in morphologically-derived environment ('Derived Environment Blocking' or DEB). Chapter 4 presents additional examples and an analysis of such effects in OI.

By contrast, there is no straightforward way to model these facts using subcategorization frames. Even if subcategorization frames were implemented as violable constraints in the morphology, there is one immediate problem: an affix like *less* which avoids forming geminates would need a subcategorization frame like ‘use *less* with bases that end in segments other than [l]’. That is, geminate-avoidance in morphology would require subcategorization frames that refer to the complement classes of segments like [l]. Again, the subcategorization-only approach is placed in the unenviable position of having to allow the grammar to refer to unnatural classes.

Put somewhat differently, the Kɔ̀nni [r(V)r]-avoidance and English geminate-avoidance effects are better modeled by markedness constraints than by subcategorization frames because the relevant restrictions are better stated as negative than as positive conditions, and subcategorization frames are ill-suited for expressing negative conditions.

We can also note that a subcategorization analysis of the English-geminates example would display another instance of the duplication problem which we argued for in Kɔ̀nni. Specifically, it would be totally coincidental that English [l]-initial affixes should avoid attaching to [l]-final stems (as opposed to, say, [θ]-final ones). No principled connection would exist between the morphological geminate-avoidance pressure encoded in the subcategorization frames and the fact that geminates are generally banned in English (and marked cross-linguistically). The examples we’ve considered thus show that there are psychologically real generalizations about what root/affix combinations speakers will permit which can be sensibly understood in terms of phonological markedness but not in terms of subcategorization requirements.

2.3.6 Max-M(FS) violation: When no morph is inserted

Showing that a morpheme is spelled out by no morph at all due to the pressure of some phonological constraint is not entirely straightforward. This is because failure to insert any morph at all is phonologically impossible to distinguish from the insertion of a zero-morph (i.e., a morph with an empty underlying representation, though possibly with a non-empty FS). With that caveat borne in mind, though, there are a number of cases in which a morph alternates with zero under phonological conditions. Many of these involve apparent avoidance of consecutive morphs which are identical or phonologically similar.

A familiar and typologically common way in which consecutive identical or near-identical morphs are avoided is via haplology—i.e., omitting one of them (Stemberger 1981, Menn & MacWhinney 1984, de Lacy 2000). A simple example from English is discussed by Jäger (to appear) and Walter & Jäger (to appear). In English, use of the overt complementizer *that* is normally optional:

- (43) a. She said you came.
b. She said that you came.

In the studies just cited, a corpus search revealed that omission of complementizer *that* was significantly more likely when the complementizer would have appeared adjacent to demonstrative *that*, as in *She said (that) that inspector came yesterday*. Cases like this can be analyzed by assuming that a phonological OCP constraint (perhaps variably) dominates the MAX-M constraints that favor spelling out one of the two relevant morphemes (see Golston 1995, Yip 1998 for proposals in this direction):

(44)

COMP ₁ DEMONST ₂	OCP	MAX-M(DEMONSTRATIVE)
a. $\check{\delta}\text{æt}_1 \check{\delta}\text{æt}_2$	W ₁	L
b. $\text{r}\check{\delta}\text{æt}_1$		1

There is at least one plausible argument against treating haplology as outright omission of a morph. The problem comes from cases of partial haplology, which seem to involve partial fusion of two underlying strings, as in e.g. French / $\text{deksi}_1\text{s}_2 + \text{i}_3\text{s}_4\text{t}/ \rightarrow [\text{deksi}_{1,2}\text{s}_{3,4}\text{t}]$ *déixiste* ‘person who studies deixis’. In this example, the affix is clearly not omitted outright, because it still has a surface exponent in the form of the final segment [t].

However, there is reason to be skeptical of the coalescence analysis of partial haplology. This is that it requires us to assume that coalescence occurs between pairs of segments that are underlyingly non-adjacent—for example the [i]s and [s]es in the French example. As there is, to my knowledge, no evidence for non-local coalescence outside of haplology,⁴³ it would be desirable to pursue an analysis of these cases which don’t require any new theoretical devices. One simple strategy would be to assume that such cases simply involve selection of different morphs. In French, for instance, the default morph for ‘person who studies X’ would be /ist/, with another morph /t/ being used with stems ending in /...is/.

Phonologically-conditioned morph omission is not limited to cases of haplology. One non-haplological example occurs in Northeastern Central Catalan (Bonet, Lloret & Mascaró to appear). In this dialect, the plural suffix /-s/ is omitted between two

⁴³ Also relevant on this point is Kawahara (2004), who argues that the inverse of non-local coalescence, namely non-local diphthongization, does not exist. Wolf & McCarthy (to appear) propose a version of Correspondence theory which excludes the possibility of nonlocal coalescence or diphthongization.

consonants, even though other /s/es are retained interconsonantly (‘_’ indicates a location where the plural marker would be expected in standard Catalan):

- (45) *Plural suffix omitted interconsonantly*
- | | | |
|----|--|-------------------------------|
| a. | Un_ tap-s
a cork-pl | ‘some corks’ |
| b. | Quin_ mal_ camin-s
What bad paths-pl | ‘what bad paths’ |
| c. | El_ diferent_ grups
the different groups | ‘the different groups’ |
| d. | Molt_ poc_ bon_ professionals
Very few good professionals | ‘very few good professionals’ |
- (46) *Plural suffix present in non-interconsonantal contexts*
- | | | |
|--|-------------------------|-------------------|
| | El-s antic-s amic-s | ‘the old friends’ |
| | The-pl old-pl friend-pl | |
- (47) *Interconsonantal /s/-omission only applies to plural suffix*
- | | | |
|----|---|----------------------|
| a. | Un fals conseller
A false counsellor | ‘a false counsellor’ |
| b. | No vén-s pas?
Not come-2 nd sg. not | ‘don’t you come?’ |

One additional twist is that interconsonantal omission of the plural suffix occurs only in prenominal position. Postnominal adjectives have /-s/ in the plural, even when the /-s/ is interconsonantal:

- (48) a. Aquest_ cabell-s llarg-s tenyit-s ‘these dyed long hairs’
This hair-pl long-pl dyed-pl
- b. El_ vin-s blanc-s aquell-s tan car-s ‘those so expensive white wines’
The wine-pl white-pl that-pl so expensive-pl

These data can be analyzed in OI as follows. First, the omission of plural /-s/ interconsonantly requires that a constraint against interconsonantal [s]—which,

following Bonet, Lloret & Mascaró (to appear), I'll refer to as just *CsC—rank above both MAX-M(FS) and MAX-M(plural):

(49)

FS ₁ -FS ₂ √FS ₃ -FS ₄ A ₅ PL ₆ CORK ₇ PL ₈	*CsC	MAX-M(FS)	MAX-M(plural)
a. FS ₁ √FS ₃ -FS ₄ A ₅ CORK ₇ PL ₈ un tap s		1	1
b. FS ₁ -FS ₂ √FS ₃ -FS ₄ A ₅ PL ₆ CORK ₇ PL ₈ un s tap s	W ₁	L	L

In candidate (49)b, every input morpheme has a corresponding morph, so MAX-M(FS) is perfectly satisfied. Likewise, the input feature [plural] has a correspondent in the FS of the plural morph {/-s/, plural}, so MAX-M(plural) is satisfied. Satisfaction of these two constraints comes, however, at the expense of violating the phonological markedness constraint *CsC, because the /-s/ of the plural morph creates a sequence [nst]. By contrast, in (49)a, *CsC is satisfied, because the plural morph is omitted. Omitting that morph means that the input feature [plural] and the FS that contains it both lack correspondents, resulting in violations of MAX-M(FS) and MAX-M(plural). Because those two constraints are ranked below *CsC, (a) is the winner.

As examples like (47)b show, *CsC is not able to compel the omission of the 2nd person singular suffix, which is also /-s/. This implies that some MAX-M(feature) constraint relevant to the features of that morph is ranked above *CsC:

(50)

FS_1 $\sqrt{FS_2-FS_3}$ FS_4 NEG_5 $COME_6$ $2SG_7$ NEG_4	MAX-M(2 nd .sg)	*CsC	Max-M(FS)
a. FS_1 $\sqrt{FS_2-FS_3}$ FS_4 NEG_5 $COME_6$ $2SG_7$ NEG_4 no vén s pas		1	
b. FS_1 $\sqrt{FS_2}$ FS_4 NEG_5 $COME_6$ NEG_4 no vén pas	W_1	L	W_1

Candidate (50)b omits the 2nd-person singular suffix, resulting in the FS of the person/number morpheme and all of its features lacking correspondents at the morph level. Doing so is favored by *CsC, but opposed by both MAX-M(FS) and MAX-M(2nd.sg). Since MAX-M(FS) must be ranked below *CsC in order for the plural marker to be omitted, it must be the case that MAX-M(2nd.sg) dominates *CsC, in order to prevent (50)b from winning.

The last issue to be dealt with in Northeast Central Catalan is the fact that, as seen in (48), *CsC can only cause the plural morph to be omitted in prenominal position, and not in postnominal position. Bonet, Lloret & Mascaró (to appear) account for this asymmetry by assuming that postnominal agreement is established in the syntax, while prenominal concord within the DP occurs at PF. Consequently, under their proposal, phonological constraints like *CsC can interfere with prenominal concord but not with not with postnominal agreement.

This categorical split between prenominal and postnominal contexts is probably too strong, as there are a number of examples known in which the phonology interferes with the faithful expression of morphosyntactic features on the noun itself.

The Dyirbal Ergative is one; in the next section, we'll see another involving gender mismatches in Modern Hebrew plural suffixation. Moreover, OI denies the premise that the insertion of postnominal agreement morphs could be fixed in the syntax, assuming instead that all morph insertion happens in the phonology. A different solution is therefore required. A reasonable strategy would be to assume that certain morphosyntactic positions are 'strong' and have the protection of positional (Beckman 1998) morpheme/morph faithfulness constraints. In the case of Northeast Central Catalan, we could assume that postnominal positions within the DP are 'strong', and that *CsC is dominated by a positional constraint $\text{MAX-M}(\text{plural})_{\text{post-nominal}}$. The fact that spell-out of inflectional features should be more strongly favored in postnominal position is supported by a number of other languages identified by Bonet, Lloret & Mascaró (to appear) in which prenominal (but not postnominal) agreement is either entirely non-apparent or disappears under specific conditions.

Naturally, the suggestion that positional faithfulness constraints favor feature spellout in certain morphosyntactically 'strong' positions calls for a more extensive typological investigation to determine which contexts are 'strong' and, ideally, to identify a non-arbitrary basis for the property of being strong. Nevertheless, the possibility of such an analysis is welcome for my general proposal that spell-out is governed by faithfulness constraints. Ideally, we would expect morpheme-morph faithfulness constraints to exhibit the same general properties that phonological faithfulness constraints do, for example having positional variants. The prenominal/postnominal asymmetry in Northeast Central Catalan is exactly the sort of

thing we expect to find if morpheme/morph correspondence constraints come in positional versions.

Several cases have also been proposed of morph-omission driven by prosodic, as opposed to segmental, factors. In the case of English optional *that*, there is evidence (Lee & Gibbons 2007) that the inclusion or omission of the complementizer is influenced by a pressure to avoid stress clashes and lapses. In a similar vein, Fitzgerald (1994) proposes that the inclusion or omission of the *g*-determiner in Tohono O'odham is driven by the need for utterances to begin with a trochaic foot.

Another example occurs in Hausa (Inkelas 1988, Selkirk 2002). Hausa has a focus particle /*fa*/ which, when it does appear, surfaces to the right of a focused constituent. However, its appearance is subject to various restrictions relating to the size or presence of nearby material. For instance, when it's a verb that's focused, /*fa*/ will appear if the verb has no complement (making /*fa*/ VP-final) or if the verb's complement includes more than one PWD. However, /*fa*/ will not appear if the verb has a single-word complement:

- (51) a. Verb *fa*
b. Verb *fa* Adjective Noun
c. *Verb *fa* Noun

Inkelas (1988) and Selkirk (2002) propose to account for these facts in terms of the prosodic phrasing of the different VP types in (51):

- (52) a. (Verb *fa*)_{pph}
b. (Verb *fa*)_{pph} (Adjective Noun)_{pph}
c. *(Verb *fa* Noun)_{pph}

Normally the full VP will be parsed as a single phonological phrase, but when it contains three prosodic words, as in (52)b, the complement will be parsed as a separate PPh under the pressure of a BINARYMAXIMUM constraint (Selkirk 2000), which forbids a PPh node to dominate more than two Pwd nodes. The generalization on the appearance of /fa/ now becomes straightforward: it's omitted when it would not appear at the right edge of a phonological phrase.

This requirement could be enforced in one of two ways. Inkelas (1988) proposes that /fa/ has a subcategorization frame requiring it to appear at the right edge of the PPh. In Generalized Alignment terms, we could translate this proposal into a constraint ALIGN(/fa/, R, PPh, R). Selkirk (2002) proposes that /fa/ is banned from surfacing in phrase-medial position by a markedness constraint she calls MEDIAL EXHAUSTIVITY. Because /fa/ is a function word, it doesn't form a prosodic word of its own, and instead its syllable attaches directly to the PPh node. This skipping of levels in the prosodic hierarchy is marked, and violates constraints of a family that Selkirk (1995) calls EXHAUSTIVITY. The proposal in Selkirk (2002) is that there are separate exhaustivity-enforcing constraints for phrase-medial and phrase-peripheral positions, and that the MEDIAL EXHAUSTIVITY constraint dominates a morphological constraint requiring the surface realization of /fa/. This accounts for the ability of /fa/ to surface phrase-finally but not phrase medially:

(53) /fa/ omitted with single-word complement

//Verb fa Noun//	MEDIAL EXHAUSTIVITY	REALIZE(fa)	PERIPHERAL EXHAUSTIVITY
a. \llbracket Verb $\rrbracket_{\text{PwD}} \llbracket$ Noun $\rrbracket_{\text{PwD}}]_{\text{PPh}}$		1	
b. \llbracket Verb $\rrbracket_{\text{PwD}} \llbracket$ fa $\rrbracket_{\sigma} \llbracket$ Noun $\rrbracket_{\text{PwD}}]_{\text{PPh}}$	W_1	L	

(54) /fa/ appears with two-word complement

//Verb fa Adj Noun//	MEDEXH	REALIZE(fa)	PEREXH
a. $\left[\left[\text{Verb} \right]_{\text{PWd}} \left[\text{fa} \right]_{\sigma} \left[\left[\text{Adj} \right]_{\text{PWd}} \left[\text{Noun} \right]_{\text{PWd}} \right]_{\text{PPH}}$			1
b. $\left[\left[\text{Verb} \right]_{\text{PWd}} \right]_{\text{PPH}} \left[\left[\text{Adj} \right]_{\text{PWd}} \left[\text{Noun} \right]_{\text{PWd}} \right]_{\text{PPH}}$		W_1	L

Another situation which could be interpreted as involving morph omission is that of paradigm gaps (Carstairs 1988, Orgun & Sprouse 1999, Rice 2007, and the contributors to Rice to appear), particularly as these are analyzed by Walker & Feng (2004) and van Oostendorp (to appear). However, the question of how to treat gaps is somewhat unclear, as at least some cases of these seem to involve speakers avoiding forms for which they are uncertain of what the correct form of a word should be (Albright 2003, to appear). Given the complications involved, I will be sidestepping the matter of paradigm gaps in this thesis.

Additional examples of morph-omission from English and Italian will be discussed in the next chapter in connection with the issue of ‘lookahead’ in phonology/allomorphy interactions.

2.4 Phonologically-conditioned mismatches: DEP-M(F) violation

2.4.1 Gender discord in Spanish

Of the several examples that have been argued for of the phonology forcing the use of a morph whose features are inconsistent with the corresponding morph, the most thoroughly researched and most convincing comes from Spanish. In this language, the singular definite article is normally *el* before masculine nouns and *la* before feminine nouns. However, feminine nouns with an initial stressed vowel /á/ take *el* in the singular (Jaeggli 1980, Plank 1984, Posner 1985, Zwicky 1985b, Harris 1987,

1989, 1991, Hayes 1990, Halle, Harris & Vergnaud 1991, Janda & Varela-García 1991, Álvarez de Miranda 1993, Kikuchi 2001, Cutillas 2003, Paster 2006, Teeple 2006, Bonet, Lloret & Mascaró to appear, Eddington & Hualde to appear):⁴⁴

- (55) el arma ‘the weapon’⁴⁵
 el águila ‘the eagle’
 el agua ‘the water’

Less often remarked on (though see Bonet, Lloret & Mascaró to appear, Eddington & Hualde to appear) is the fact that, for many speakers, a gender mismatch also arises in the selection of the indefinite article ($un_{\text{masc}} \sim una_{\text{fem}}$) and the determiners meaning ‘some’ ($algún_{\text{masc}} \sim alguna_{\text{fem}}$) and ‘not any’ ($ningún_{\text{masc}} \sim ninguna_{\text{fem}}$). The common thread to all of these mismatches is that the masculine forms are C-final while the feminine forms are V-final.

We may follow Cutillas (2003: 175-184) in connecting this pattern of gender-mismatching allomorphy with the phonology of hiatus in Spanish. Sequences of identical vowels generally fuse into one, but this is not allowed if the second vowel is stressed. Using *el* rather than *la* with [á]-initial feminine nouns therefore permits the avoidance of a [a.á] sequence which the constraint ranking of Spanish does not permit to be resolved through an unfaithful mapping (see also Posner 1985: fn. 8, Bonet, Lloret & Mascaró to appear: §5.2).


⁴⁴ There are several exceptions to the use of *el* before [á]-initial feminine nouns. Names of letters of the alphabet, acronyms, nominalized adjectives, and proper names (other than *Asia* and *África*) do not take *el*. The other exception is that a noun will take *la* rather than *el* if its referent is biologically (rather than merely grammatically) feminine.

⁴⁵ These words are listed here in standard orthography; *arma* and *agua* have initial stress, even though it is not marked orthographically.

Assuming that the relevant morphs are as in (60) below, the ‘feminine *el*’ data require a ranking of UNIFORMITY/ó » *HIATUS » DEP-M(masc), MAX-M(fem), as shown in tableau (57):

- (56) a. {{{definite}, [masc]}, /el/}
 b. {{{defininte}, [fem]}, /la/}

(57)

{{[definite] ₁ , [fem] ₂ }, {water ₃ , [fem] ₄ }	UNIFORMITY/ó	*HIATUS	DEP-M (masc)	MAX-M (fem)
a.  {{{definite} ₁ , [masc]}, /el/} { {water ₃ , [fem] ₄ }, } [e.lá.gua]			1	1
b. {{{definite] ₁ , [fem] ₂ }, /la/} { {water ₃ , [fem] ₄ }, } [la ₁ .á ₂ .gua]		W ₁	L	L
c. {{{definite] ₁ , [fem] ₂ }, /la/} { {water ₃ , [fem] ₄ }, } [lá _{1,2} .gua]	W ₁		L	L

The attested winning candidate is (57)a, which uses the masculine morph *el* to spell out the determiner morpheme. This incurs a violation of DEP-M(masc), because the morph has a token of [masculine] without a correspondent at the morpheme level, and a violation of MAX-M(fem), because the determiner morpheme’s token of [feminine] has no correspondent at the morph level. Both of these constraints are satisfied by candidate (57)b, which uses the feminine morph *la* to spell out the determiner. However, doing so violates the higher-ranked markedness constraint *[a.á]. Another possibility would be to use the feminine morph but to eliminate the hiatus by fusing the vowels of *la* and *agua*, as in (57)c. This candidate loses because the positional faithfulness constraint UNIFORMITY/ó, which forbids coalescence involving segments of the stressed syllable, is also ranked above the morpheme/morph faithfulness constraints that would be violated by using *el*.

The argument that DEP-M(masculine) is violated by Spanish forms like *el agua* crucially depends on the assumption that the morph *el* has an FS containing

[masculine], as depicted in (56). An alternative analysis is possible, however, based on counter-proposals (Lamarche 1996, Mascaró 1996a, Lapointe & Sells 1997, Janda 1998) that have been made regarding cases of apparent phonologically-conditioned gender mismatch in French. This would be to assume that the morphs *el* and *la* actually looked like this:

- (58) a. $\{ \{ [definite] \}, /el/ \}$
 b. $\{ \{ [definite], [fem] \}, /la/ \}$

On this reanalysis, the FS of /la/ would still include a feature [feminine], but the FS of /el/ would include no gender features, since /el/ occurs (under the right phonological conditions) with both masculines and feminines. Given these FSes, only MAX-M(feminine)—but not DEP-M(masculine)—would be violated by *el agua*:

(59)

$\{ [definite]_1, [fem]_2 \}, \{ WATER_3, [fem]_4 \}$	*HIATUS	MAX-V	MAX-M (fem)
a. $\{ \{ [definite]_1 \}, /el/ \} \{ \{ water_3, [fem]_4 \} \}$ [e.lá.gua]			1
b. $\{ \{ [definite]_1, [fem]_2 \}, /la/ \} \{ \{ water_3, [fem]_4 \} \}$ [la.á.gua]	W ₁		L
c. $\{ \{ [definite]_1, [fem]_2 \}, /la/ \} \{ \{ water_3, [fem]_4 \} \}$ [lá.gua]		W ₁	L

Would it be possible to maintain that Spanish *el* is a genderless default item, rather than actually being masculine? There is at least one reason to think not. When an adjective intervenes between the article *el* and the noun, many Spanish speakers of both European and Latin American dialects will accept—and even prefer—for that prenominal adjective to be masculine, even though postnominal elements agreeing with the noun remain reliably feminine (Janda & Varela-García 1991, Bonet, Lloret & Mascaró to appear, Eddington & Hualde to appear):

(60) *el nuevo arma secreta* 'the new secret weapon'
 the.MASC new.MASC weapon.FEM secret.FEM

What this suggests is that the /el/ required by [á]-initial feminine nouns really is masculine, and via some mechanism propagates its [masculine] feature to prenominal adjectives.

Data like (60) do, however, seem to put a dent in the claim that the claim that the selection of 'feminine' *el* is phonologically conditioned (Bonet, Lloret & Mascaró to appear). Why should *el* remain obligatory with these nouns even when, owing to the presence of a prenominal adjective, it is no longer adjacent to the noun's [á]? A possible explanation of this can be found by assuming that DPs like *el nuevo arma* are grammatically derived from or analogically modeled on the corresponding adjective-less DP (*el arma*). One possible analysis would operate along the following lines: we could assume that roots, upon being spelled out, are initially unlinearized with respect to one another, such that there is a stage in the derivation of (60) that looks like {*nuevo, arma*}. Assume further that the definite article is spelled out before {*nuevo, arma*} is linearized. Being a clitic, the definite article morph must prosodically lean on one or the other of the two unlinearized PWds, and it plausibly may choose *arma*, since this is the head of the constituent which the definite article c-commands. (Section 3.9 includes some further discussion along these lines of how OI may work above the word level.)

In the case of Spanish 'feminine *el*' specifically, adopting an analysis like this would be supported by the fact that feminine nouns which do not begin with [á] always

take [la], and not [el], as the definite article, even if there is an intervening adjective which does begin with [á] (Bonet, Lloret, & Mascaró to appear):

- (61) la hábil maniobra ‘the skillful move’
 the.FEM skillful.FEM move.FEM

Here, as with *el nuevo arma*, the selection of *el* vs. *la* as the definite article morph proceeds as if the intervening adjective were not there, and responds solely to the gender features and phonological shape of the noun.

Spanish is not the only language in which PCSA seems to look across intervening morphosyntactic material. In English, as mentioned before, the indefinite article is (generally) *a* before a following consonant-initial word and *an* before a following vowel-initial word. Rotenberg (1978) and Zuraw (2006a,b) observe that *an* will sometimes be used, even if consonant-initial parenthetical material intervenes between the article and what would otherwise be the following word:

- (62) In the car on the way back to London, we had an-to me-even more peculiar exchange about my niece and her boyfriend.⁴⁶

By the same token, some speakers will prefer *a* when there is vowel-initial parenthetical material between the article and the otherwise-following word:

- (63) a—in my opinion, anyway—totally unexpected result (Rotenberg 1978, pp. 55)

The Spanish and English examples are also related to the Portuguese, Cibemba, and Pashto examples discussed in section 5.6 of phonological processes applying between two morphs that are linearly separated by other morphs on the surface.

⁴⁶ Julian Barnes, “The Past Conditional”, in the Dec. 25 2006/Jan. 1 2007 edition of *The New Yorker*, p. 57; cited by Zuraw (2006a).

If the gender-underspecification account is rejected for Spanish, a second alternative is possible for the skeptic wishing to conclude that phonologically-conditioned DEP-M(masc) violation is not taking place. This would be to assume that the *el* seen with feminine nouns is not the same morph as masculine *el*. Along these lines one could either assume that there are two homophonous *els*, one masculine and one feminine (Cutillas 2003) or that *la* and ‘feminine *el*’ are surface realizations of the same underlying form, and are therefore the same morph (Harris 1987, Halle, Harris & Vergnaud 1991, Kikuchi 2001). Accounts of this sort would face the same difficulty as the underspecification account: the fact that adjectives preceding [á]-initial nouns are preferentially masculine indicates that speakers really do analyze the *el* that occurs with these nouns as being the masculine *el*.

A final alternative solution would be to deny that gender discord at work is phonologically-conditioned. This is the position taken by Bonet, Lloret & Mascaró (to appear). They propose that the [á]-initial nouns which trigger the alternation are diacritically marked to take (unmarked) masculine agreement pronominally (see also Posner 1985). However, even if this approach is taken as a synchronic analysis, it requires one to assume (as Bonet *et al.* do) that the fact that all of the nouns bearing this diacritic begin with [á] is a carryover from a diachronically earlier stage in which the *el* ~ *la* alternation was phonologically-conditioned.

2.4.2 Gender discord in Modern Hebrew

Modern Hebrew presents a second case of phonologically-conditioned feature-mismatch which is also resistant to the underspecification account of the kind that we

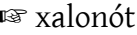
entertained and rejected for Spanish. Again, this is because the suffix which productively appears in wrong-gender environments is arguably not the unspecified default.

The phenomenon in question involves plural suffixation. Hebrew noun plurals are formed by one of two suffixes: /-im/, which is usually taken by masculine nouns, and /-ot/, which is the usual choice with feminines. The gender-based choice between these two suffixes is not exceptionless, however: there are feminine nouns which take /-im/ and masculine nouns which take /-ot/. The subpattern of *ot*-use with masculine nouns displays a phonological regularity. Most grammatically masculine nouns which take /-ot/ have [o] as the final stem syllable: Bolozky & Becker (2006) found 230 native masculine nouns that take /-ot/ in the plural, of which 146 had [o] as the rightmost stem vowel. Moreover, a preference for using /-ot/ in such nouns has been experimentally shown to be productive (Berent, Pinker & Shimron 1999, 2002, Becker 2008).

Becker (2008) presents an OT analysis of the use of /-ot/ with masculine bases. His analysis makes use to the fact that, for most native Hebrew nouns (as well as all deverbal nouns), stress shifts from the stem to the last suffix in affixed forms (Bat-El 1993, Becker 2003). He suggests that a dispreference for [...oC-ím] candidates is due to a constraint which demands that the stem-final mid vowel be licensed by a following stressed mid vowel. The licensing constraint⁴⁷ conflicts with a morphological constraint (dubbed φ -MATCH) which penalizes the use of feminine /-ot/ with a masculine stem:

⁴⁷ Here, following Zoll (1998), I formulate the proposed licensing requirement as a positional markedness constraint requiring a sequence of mid vowels to coincide with at least one stress.

(64) *Selection of gender-mismatched suffix in Hebrew ‘window-PL’*

/xalon- {im, ot}/	COINCIDE(midVs, stress)	φ-MATCH
a.  xalonót		1
b. xaloním	W ₁	L

Candidate (64)b, [xaloním], violates COINCIDE(midVs, stress) because the unstressed mid vowel [o] of the noun stem is not followed by a stressed mid vowel. Meanwhile the winning candidate (64)a, [xalonót], satisfies COINCIDE(midVs, stress), because the use of the gender-mismatched suffix /-ot/ supplies the required stressed mid vowel.

Because /-ot/ is not used with all masculine nouns whose rightmost vowel is [o], there have to be two lexically-indexed versions of COINCIDE(midVs, stress): one ranked above φ-MATCH, and indexed to the stems which take /-ot/, and one ranked below φ-MATCH, and indexed to the stems which take /-im/. The core point of Becker’s (2008) proposal is that novel items’ probability of selecting one of the two clones of *MID reflects on the percentage of existing lexical items that each of the clones is indexed to.

Since Becker’s (2008) concern is not with the exact nature of the morphological mismatch which COINCIDE(midVs, stress) compels, he does not provide an exact definition for φ-MATCH. The question we need to ask for present purposes is which of the morpheme-morph faithfulness constraints of OI theory φ-MATCH corresponds to. The answer to that question depends on what assumptions we make about the contents of the FSes of /-ot/ and /-im/. The first option is to assume that /ot/ carries a feature [feminine] and /im/ carries a feature [masculine]. Under this view, when a masculine noun takes /ot/, violations of DEP-M(fem) and MAX-M(masc) are incurred:

(65)

WINDOW ₁ -{PL ₂ , MASC ₃ }	COINCIDE(midVs, stress)	DEP-M(fem)	MAX-M(masc)
a. [☞] WINDOW ₁ -{PL ₂ , FEM} xalon ót		1	1
b. WINDOW ₁ -{PL ₂ , MASC ₃ } xalon ím	W ₁	L	L

An alternative account would be to use the underspecification strategy that we entertained for Spanish. As in that account, we would assume that /-ot/—the item which, depending on phonological and lexical conditions, appears sometimes with feminine and sometimes with masculine nouns—actually does not have any gender features in its FS. On this account, using /-ot/ with a masculine stem would violate only MAX-M(masc):

(66)

WINDOW ₁ -{PL ₂ , MASC ₃ }	COINCIDE(midVs, stress)	MAX-M(masc)
a. [☞] WINDOW ₁ -{PL ₂ } xalon ót		1
b. WINDOW ₁ -{PL ₂ , MASC ₃ } xalon ím	W ₁	L

Is the underspecification account viable for Hebrew? One possible objection would be that /-ot/, as the genderless morph, should be the default when speakers are asked to inflect stems whose genders they are unsure of, or which refer to mixed-gender groups. Meir (2006) calls on several pieces of evidence to argue that that it is actually /-im/, and not /-ot/, which is the default plural marker in these situations. First, /-im/ is preferred for pluralizing phrases which are used morphologically as a single word. For instance, several issues of the magazine [masa ʔaxer] (*A Different Journey*) would be [masa ʔaxerim] and not [masa ʔaxerot]. The masculine plural suffix /-im/ is also reportedly preferred for novel compounds formed from two noun stems of different genders, e.g. [xatan-kala] (lit. ‘groom-bride’, meaning a couple on their

wedding day). Finally, she cites research by Levy (1983) indicating that Hebrew-learning children acquire /-im/ before /-ot/, and pass through a stage of using /-im/ with all nouns, even obviously feminine ones like [ʔima] ‘mommy’. Together these facts suggest that /-ot/ is not a genderless default item, but instead really does carry a feature [feminine]. If so, then phonological constraints are capable of inducing violation of DEP-M(F) constraints, as depicted in the analysis of Hebrew that we’ve just given.

2.5 Phonological markedness and allomorphic economy

2.5.1 Blocking candidates with superfluous allomorphs

In most systems of suppletive allomorphy, whether phonologically-conditioned or not, the competing morphs are mutually exclusive. The English copula, for instance, is realized sometimes as *is* and sometimes as *be*, but there is no context in which it appears as **isbe*. Likewise, the Moroccan Arabic 3rd person masculine singular enclitic appears sometimes as /-u/ and sometimes as /-h/, but never as **-/hu/* or **-/uh/*.

Because of this, in analyses of allomorph selection, it is usually assumed (explicitly or implicitly) that the competing allomorphs are inherently mutually exclusive. In OT analyses, this takes the form of only considering candidates that use one allomorph or the other, and excluding from analytical consideration candidates where multiple allomorphs pile up. This assumption is made explicitly by, for instance, Mascaró (1996a), who states it as follows:

- (67) For a lexical item L such that $\Phi = a, b$:
 $\text{Eval}(\text{Gen}(a, b)) = \text{Eval}(\text{Gen}(a) \cup \text{Gen}(b))$

That is: when a morph L 's phonological representation Φ consists of two underlying forms a and b , the candidate set evaluated when L is in the input is defined as the union of two candidate sets: $\text{Gen}(a)$, the candidate set produced with just a in the input, and $\text{Gen}(b)$, the candidate set produced with just b in the input. The candidate set L therefore never includes any candidate which has both a and b in its input.

Principle (67) amounts to a stipulation that the two listed allomorphs compete with one another, since it guarantees that no candidate will use both allomorphs. This section will pose and answer two questions about assumptions like (67). First, are they necessary? That is, would analytic problems result if we included both a and b in the input? I will answer this question in the affirmative. Second, need (67) be stated as an autonomous principle of grammar, or can its effects be derived from independently-needed devices? I will argue that they can. Specifically, in OI, candidates with a redundant piling up of multiple morphs are ruled out by phonological markedness. When a second morph's presence isn't necessary for purposes of faithful feature spell-out, its insertion will be militated against by phonological markedness constraints (provided of course that the morph is phonologically-overt). OI is thus able to derive the fact that rival allomorphs compete with one another for insertion, rather than having to state a principle like (67) which forces them to be mutually exclusive.

For our first question, we need to show that something will go wrong for multiple-underlying-forms approaches if assumptions like (67) are omitted. If it is omitted, then candidates will have both underlying forms in their inputs, and will therefore be under pressure to be faithful to both allomorphs. In that case, candidates will have to delete all material in the URs of the allomorph(s) that they don't use. Such

deletion will only be possible if relevant markedness constraints rank above MAX. The nub of the problem—and the core of the argument for multiple-UR analyses needing (67)—is that the relevant M » MAX rankings at least sometimes demonstrably do not hold.

One language where we can show that they don't hold is Moroccan Arabic. As mentioned, the 3rd person masculine singular possessive enclitic in this language is /-h/ following a V-final stem, and /-u/ following a C-final stem. In (1)-(2), we saw that a multiple-UR theory equipped with assumption (67) can obtain the attested distribution of these allomorphs using a ranking of ONSET » NOCODA (Mascaró 1996b).

Let's now examine how this same analytic strategy would fare if Moroccan Arabic candidates had both /-h/ and /-u/ in the input, and therefore had to be faithful to both of them. In that case, the relevant constraints and candidates that need to be considered are as shown in the following ERC rows (see Prince 2002, 2003 on ERCs):

(68)

		ONSET	NoCODA	*h	*u	*COMPCODA	MAXC	MAXV
ktab-{h, u}	a. kta.bu				₁		₁	
	b. ktab		W ₁		L		₁	W ₁
	c. ktabh		W ₁	W ₁	L	W ₁	L	W ₁
	d. kta.bhu			W ₁	₁		L	
	e. kta.buh		W ₁	W ₁	₁		L	
xt ^ʰ a-{h, u}	f. xt ^ʰ ah		₁	₁				₁
	g. xt ^ʰ a		L	L			W ₁	₁
	h. xt ^ʰ a.hu		L	₁	W ₁			L
	i. xt ^ʰ a.u	W ₁	L	L	W ₁		W ₁	L
	j. xt ^ʰ a.uh	W ₁	₁	₁	W ₁			L

*h = One violation-mark for every instance of the segment [h].

*u = One violation-mark for every instance of the segment [u].

*COMPCODA = One violation-mark for every complex coda.

MAXC = One violation-mark for every deletion of an underlying consonant.

MAXV = One violation-mark for every deletion of an underlying vowel.

In the ERC rows in (68), the attested winners for each input are indicated by the arrows: [kta.bu] and [xt^ʰah]. In the rows for each of their losing competitors, Ws and Ls indicate for each constraint whether it prefers the attested winner, or that losing candidate. In order to show that there is no possible ranking of the constraints in (68) which will yield both [kta.bu] and [xt^ʰah] as optima, we can attempt to learn a ranking from the ERC rows via Recursive Constraint Demotion (Tesar 1995, Tesar & Smolensky 1998, 2000, Prince 2002, 2003). The RCD algorithm can be informally summarized as follows:

(69) *Recursive Constraint Demotion*

[1] Locate all constraint columns containing no Ls.

[2] Place these constraints in a stratum ranked immediately below all previously-created strata.

[3] Remove from consideration all of the constraints ranked in step [2], and all of the candidates to which they assign a W.

[4] If there are any remaining unranked constraints, return to step [1].

Let's now apply RCD to (68). ONSET and *COMP CODA are the only constraints which have only Ws in their columns, so we install them in a stratum above all of the other constraints. Those two constraints, along with candidates (c), (i), and (j), are then eliminated from consideration, yielding the following ERC set to work with:

(70)

		NoCODA	*h	*u	MAXC	MAXV
ktab-{h, u}	a. ktab			₁	₁	
	b. ktab	W_1		L	₁	W_1
	d. kta.bhu		W_1	₁	L	
	e. kta.buh	W_1	W_1	₁	L	
xt ^h a-{h, u}	f. $\text{xt}^{\text{h}}\text{ah}$	₁	₁			₁
	g. xt ^h a	L	L		W_1	₁
	h. xt ^h a.hu	L	₁	W_1		L

The RCD algorithm now returns to step [1], and looks for constraints which do not assign Ls to any of the remaining candidates. Inspection of (70) quickly reveals that there are no such constraints, so RCD crashes. There is therefore no ranking of the constraints in (68) which will select both (a) and (f) as optima for their respective inputs. A multiple-URs theory of allomorphy therefore requires principle (67), since without it, candidates will have to be faithful to both inputs, and the violation-profiles that result will yield inconsistent ERC sets for Moroccan Arabic.

In OI theory, on the other hand, a consistent ranking which chooses both [kta.bu] and [xt^hah] as optima does exist, as can be seen in the following tableaux (MAX-

M is shorthand for the various MAX-M(F) and MAX-M(FS) constraints relevant to the morpheme ‘3rd person masculine singular’:⁴⁸

(71)

BOOK-3.MASC.SG	ONSET	*COMPCODA	MAX-M	*u	*h	NoCODA
a. [kta.bu]				₁		
b. [ktab]			W_1	L		W_1
c. [ktabh]		W_1		L	W_1	W_1
d. [kta.bhu]				₁	W_1	
e. [kta.buh]				₁	W_1	W_1

(72)

ERROR-3.MASC.SG	ONSET	*COMPCODA	MAX-M	*u	*h	NoCODA
f. [xtsah]					₁	₁
g. [xtsa]			W_1		L	L
h. [xtsa.hu]				W_1	₁	L
i. [xtsa.u]	W_1			W_1	L	L
j. [xtsa.uh]	W_1			W_1	₁	₁

In the candidates in (71)-(72), the absence of [-u] or [-h] from a candidate is no longer the result of the deletion of an underlying segment, but rather the result of not inserting the relevant morph. Consequently, MAXV and MAXC no longer figure in the tableaux. Also, I am assuming that the FSes of [-u] and [-h] are identical, and that each contains all of the features found in the morpheme ‘3rd person masculine singular.’ Therefore, using [-u], [-h], or both will all equally well satisfy all MAX-M and DEP-M constraints.

In tableau (71), the undominated MAX-M constraints rule out [ktab], which inserts neither clitic morph, and undominated *COMPCODA rules out [ktabh], which inserts /-h/ but not /-u/. That leaves three contenders: the attested winner [kta.bu], which inserts [u] only, and [kta.bhu] and [kta.buh], which insert both /-u/ and /-h/. These latter two candidates are ruled out because they contain gratuitous violations of

⁴⁸ These rankings were originally found with the aid of OTSoft (Hayes, Tesar & Zuraw 2003).

*h. There is no morphological benefit to using /-h/ when /-u/ is also used, since /-u/ alone suffices to provide correspondents to all of the features in ‘3rd person masculine singular’. Therefore, as long as /-u/ is being used, any markedness constraints that disfavor the presence of the segment [h] will ensure that [kta.bu] beats [kta.bhu] and [kta.buh].

Now let’s consider tableau (72). Undominated MAX-M rules out [xt^ʰa], which uses neither clitic morph. Meanwhile, undominated ONSET rules out the two candidates with hiatus, [xt^ʰa.uh] and [xt^ʰa.u]. That leaves two contenders: attested [xt^ʰah], and [xt^ʰa.hu]. As before, there is no morphological gain to using /-u/ if /-h/ is being used too, and so *u will serve to rule out [xt^ʰa.hu], with its gratuitous use of /-u/.

The difference between OI theory and the multiple-UR analysis can best be understood if we ask what the penalty is in each theory for not using one of the allomorphs. In a multiple-UR theory shorn of principle (67), ‘not using a morph’ means deleting all of the segments in the morph’s UR. Deleting one of the morphs will always incur a penalty from phonological MAX constraints, regardless of whether or not the other morph is retained. It also means that markedness constraints ranked over MAX will be potentially relevant all of the time, causing one of the allomorphs to be deleted even in contexts where we want it to be used. In OI theory, the pressure for morph use is different. The motivation for using morphs comes from MAX-M constraints. If using just one morph suffices to satisfy the MAX-M constraints, then the only possible motivation for inserting the other morph would be if that produces a phonologically less-marked outcome.

If we take a step back from the specific details of Moroccan Arabic and RCD, we see that there is a basic conceptual problem with a multiple-UR theory which lacked principle (67). Specifically, there would be no sense in which /-u/ and /-h/ were in competition with one another. Using one of the two allomorphs in a given candidate does not free the language from the obligation to use the other allomorph, leading to problematic markedness-over-faithfulness rankings of the sort just mentioned. In other words, without (67), a multiple-UR analysis can no longer really be said to be a listed-allomorphy analysis, since a defining property of allomorphy systems is the competitive (even if not necessarily mutually exclusive) character of the listed allomorphs.

Multiple-UR theories thus need a stipulation like (67) to ensure that listed allomorphs compete with one another.⁴⁹ In OI theory, however, no such stipulation is required. Allomorphs compete because using one will result in greater satisfaction of MAX-M constraints, helping to take away the motivation for using the other. Phonological markedness is then free to rule out candidates which use superfluous morphs.

OI theory, then, derives economy of lexical insertion in the same way that OT derives other kinds of structural economy like limits on epenthesis: for the most part, more structure means more markedness violations (and more DEP violations, in the case of epenthesis), so structure will be added only to the minimum extent required

⁴⁹ Joe Pater points out that the stipulation to use only one allomorph wouldn't be required in versions of the multiple-underlying-forms approach which incorporated the PRIORITY constraint (see discussion in §2.3.4). This is because every allomorph beyond the first one which was used would bring with it additional violations of PRIORITY.

for the satisfaction of higher-ranked constraints.⁵⁰ This result is convergent with work on economy effects in phonology (Gouskova 2003) and syntax (Grimshaw 2003) which has argued that economy of structure does not need to be posited as a principle of the grammar in its own right. Instead, given the right assumptions about the constraint set, economy of structure emerges as a theorem of OT's system of minimal constraint violation.

The issue of economy of morphs and how to enforce it will arise in a somewhat different guise in Chapter 3, when I look at the question of why portmanteaux block multi-morph collocations (e.g. *went* blocking **go-ed* in English).

2.5.2 When extra morphs are inserted, part I: 'Epenthetic' morphs and DEP-M(FS) violation

In the previous subsection, I showed that candidates with 'extra' morphs—morphs which aren't needed for purposes of feature spell-out—can be excluded in OI theory by calling on phonological markedness constraints. If a morph doesn't improve the faithful expression of features, then there is no reason to keep it, if its presence produces a phonological configuration that is more marked than what could be obtained in the morph's absence.

However, it is entirely possible that phonological markedness constraints could favor the presence of a morph which wasn't needed for purposes of feature expression. That is, if "insert a morph" is one of the operations available to GEN, this could be done not only to satisfy constraints like MAX-M(F) but also as an alternative to epenthesis. In

⁵⁰ See Trommer (2001: §3.4.3) for a similar result about economy effects in another OT-based model of realizational morphology.

these cases, the ‘epenthetic’ morph could well correspond to no input morpheme, and hence DEP-M(FS) would be violated. There are situations in a few languages for which essentially this analysis has been suggested. Hale (1973) argues that the following word-final augmentation rule exists in certain Western Desert dialects such as Pitjantjatjara:

$$(73) \quad \emptyset \rightarrow pa / C_ \#$$

The process is clearly conditioned by the presence of what would otherwise be a word-final consonant—in Pitjantjatjara, when the stem is followed by a V-final suffix, the augmentative [pa] doesn’t show up:

<i>uninflected</i>	<i>ergative</i>	<i>dative</i>	
maṅkurpa	maṅkur-tu	maṅkur-ku	‘three’
punpunpa	punpun-tu	punpun-ku	‘fly’

Table 2.5. Distribution of [pa] in Pitjantjatjara

The /pa/ also appears after certain consonant-final verbal suffixes: /-n, -ṅin, -ṅin, -nin/ ~ /-npa, -ṅinpa, -ṅinpa, -ninpa/.

This augmentation process is theoretically challenging because the marked status of [labial] place means that epenthesis of [labial] consonants should be impossible. The tableau below illustrates both the analysis that I propose for Pitjantjatjara, and the markedness problem that would arise for the assumption that the augmentative [-pa] were epenthetic:

(74)

$[THREE]_1$	IO-DEP	$*C]_{PWd}$	$*[labial]$	DEP-M(FS)
a. $\{ [THREE]_1 \}$ mankur-pa			2	1
b. $[THREE]_1$ mankur		W_1	L_1	
c. $[THREE]_1$ mankurta	W_2		L_1	
d. $[THREE]_1$ mankurpa	W_2		2	

(n.b.: In this tableau, epenthetic segments are shown in outline so as to typographically distinguish affixal from epenthetic [pa].)

The markedness constraint responsible for /pa/-insertion is what we can call $*C]_{PWd}$, which bans Prosodic Words from ending in a consonant (see Flack 2007a for extensive typological justification of this constraint). For the input $//[THREE]//$, i.e. the root meaning ‘three’ alone, with no inflection, the winning candidate is [mankurpa]. This candidate has inserted the root morph /mankur/, as well as the affix /pa/, which has an empty FS (indicated by the empty curly brackets). The presence of /pa/ means that the winning candidate satisfies $*C]_{PWd}$, but it also means that the candidate incurs an extra violation of $*[labial]$, by virtue of containing the segment /p/.

One competitor of the observed winner is (74)b, which inserts only the root morph /mankur/. This candidate does better than (74)a on $*[labial]$, due to the absence of [-pa], but it loses by virtue of violating the higher-ranked constraint $*C]_{PWd}$. Of greater interest are the competitors (74)c-d, with epenthesis. Both of these candidates violate the anti-epenthesis constraint DEP, by virtue of epenthesizing the sequences [ta] or [pa]. By contrast, the winner (74)a does not violate DEP, because all of its surface segments—including the [pa]—stand in correspondence with the segments in the underlying form of some morph. Because of this, candidate (74)d is harmonically

bounded by (74)a—the two perform identically on all markedness constraints, but only (74)d violates DEP.

Crucially for my argument, (74)d is *also* harmonically bounded within this constraint set by (74)c, which epenthesizes [ta] rather than [pa]. The two perform identically on DEP and *C]_{PWD}, but (74)c is more harmonic than (74)d because the coronal [t] is less marked than the labial [p]. This means that if morph insertion were not available as a ‘repair’ in the phonological component of the grammar (that is, if (74)a were not a possible candidate) there would be no way for *C]_{PWD}-violation to be avoided by insertion of [pa], since [pa]-epenthesis should always be harmonically bounded by [ta]-epenthesis (except in specific contexts that might favor the presence of a labial, e.g. adjacent to another labial).

The prediction of markedness theory that marked segment types like labials can never be epenthetic is largely supported by typological surveys (e.g. de Lacy 2002). The analysis that I offer thus somewhat complicates the status of epenthetic quality as evidence about markedness, since any segment, no matter how marked, could in principle belong to the UR of a morpheme inserted for phonological reasons. This does not seem tremendously worrisome, though, as there are various diagnostics that will often be available to distinguish epenthetic segments from affix segments. For example, de Lacy (2002) notes that apparent epenthetic round vowels in Seri, Hungarian and Icelandic are restricted to particular morphological contexts, and suggests that these segments are therefore likely to be affixes rather than true epenthetic segments. Hale (1973) identifies similar conditions on the distribution of augmentative /-pa/ in Pitjantjatjara —it does not appear with vocatives or after the 2nd

person singular clitic /-n/—and argues therefrom that /-pa/ is an affix. Looking beyond surface evidence, there are also likely to be experimental means for disentangling the epenthetic vs. affixal status of segments.

Further possible examples of non-meaningful affixes inserted to satisfy phonological requirements are reported in Nunggubuyu (Heath 1984), Alabama (Montler & Hardy 1991), Axininca Campa (Black 1993), and Spanish and French (Allen 1976), as well as in a number of Athapaskan languages including Slavey (Howard 1990) and Navajo (Young & Morgan 1987)—which brings us to our next topic.

2.5.3 When extra morphs are inserted, part II: Phonologically-conditioned violation of morphosyntactic constraints disfavoring spell-out

The Athapaskan language Tsuut'ina (formerly called Sarcee: Cook 1971, 1984) presents a somewhat different example of 'extra' morphs appearing under conditions which are partly phonological and partly morphological in nature. Tsuut'ina, like most Athapaskan languages, has a rich system of inflectional prefixes. Among these, the following four are omitted in certain morphosyntactic contexts:

- (75) a. /mi/ 3rd person singular direct object
- b. /ni/ 2nd person singular subject
- c. /ni/ terminative
- d. /si/ perfective

Cook (1971) observes that these prefixes do appear, even in the morphosyntactic settings where they would normally be omitted, if omitting them

would yield a word which had no syllable nuclei in the prefix string.⁵¹ The terminative marker /ni/, for example, is normally omitted with 3rd person subjects:

- (76) a. nà-nī-s-nó home-terminative-1sg.subj.-√travel
 'I am going to camp (got there)'
 b. nà-∅-nó home-3sg.def.subj-√travel
 'He is going to camp (got there)'
- (77) a. tì-nī-s-ná theme-terminative-1sg.subj-√move.camp
 'I will move camp'
 b. tì-∅-ná theme-3sg.def.subj-√move.camp
 'He will move camp'

However, /ni/ is not omitted, even with 3rd person subjects, when there is no other morph in the prefix string to supply a vowel nucleus:

- (78) a. nī-s-nà terminative-1sg.subj-√travel
 'I have finished travelling'
 b. ní-∅-na terminative-3sg.def.subj-√travel
 'He has finished traveling'

This phonological restriction on whether or not to insert an affix is all the more striking if we look at Tsuut'ina words which have no phonologically-overt prefixes. In these words, the requirement that at least one vowel precede the stem is accomplished by [i]-epenthesis:

- (79) /∅-zí/ → ì.zí
 3sg.def.subj-√be.numb 'it will be numb'

As Cook (1971) notes, the epenthesis rule and the blocking of morph-omission in items like (78)b represent a clear case of a grammatical conspiracy (Kisseberth 1970):

⁵¹ Cook (1984: §11.40) states that this condition on the omission of (75)b-d actually make reference not to the full prefix string but to the 'conjunct' (as opposed to 'disjunct') prefix string. The presence of a syllabic disjunct prefix, he says, does not block /ni/-omission. In the Athapaskan literature, the term 'conjunct domain' refers to prefix positions 4 through 9; it includes subject and object markers, mode, tense, and aspect markers, classifiers, and certain adverbial prefixes (see, *inter alia*, Hoijer 1971, McDonough 1990, Halpern 1990, Hargus & Tuttle 1997 for details).

the language employs two different strategies in pursuit of satisfying the same surface wellformedness condition. In this case, the constraint served by the conspiracy demands that at least one vowel precede the stem. Sometimes, as in (79), the language epenthesizes an [i]. However, if the word in question contains an abstract morpheme [TERMINATIVE], the terminative morph /ni/ (which otherwise might be omitted) is inserted instead.

The Tsuut'ina facts can be analyzed as follows within the assumptions of OT theory. First, the usual omission of the terminative morph results from MAX-M(terminative) being dominated by a morphological markedness constraint something like the following:

- (80) *TERM-3
Assign a violation-mark if morphs whose FSes contain the features [terminative] and [3rd person] are present in the same morphosyntactic word.

As stated here, *TERM-3 is entirely *ad hoc*; presumably the avoidance of this particular feature co-occurrence at the morph level is due to some constraint(s) of a more general nature. It should be emphasized, though, that to posit markedness constraints against the presence of various kinds of features or feature combinations at the morph level is not unprecedented; such constraints can be found in OT implementations of Distributed Morphology by Noyer (1993) and Bonet (1994).

The following ranking yields omission of terminative /ni/ with 3rd person subjects:

(81)

theme ₁ -term ₂ -3p ₃ -√move.camp ₄	MAX-M(3p)	*TERM-3	MAX-M(term)
a. $\text{tì}_1 \emptyset_3 \text{ná}_4$			1
b. $\text{tì}_1 \text{ni}_2 \emptyset_3 \text{ná}_4$		W ₁	L
c. $\text{tì}_1 \text{ni}_2 \text{ná}_4$	W ₁		L
d. $\text{tì}_1 \text{ná}_4$	W ₁		1

The constraint MAX-M(3p), which demands insertion of the 3rd-person subject morph, is undominated, eliminating candidates which do not have the feature ‘3rd person’ at the morph level. This leaves as contenders (81)b, which inserts the terminative morph /ni/, and (81)a, which omits it. Ranking *TERM-3 above MAX-M(term) ensures that (81)a wins.

Next we need to account for the [i]-epenthesis process in (79). For this, we need to assume that some phonological markedness constraint which requires a vowel to precede the stem—call it NONINITIAL—dominates the anti-epenthesis constraint DEP:

(82)

/∅-zí/	NONINITIAL	DEP
a. ìzì		1
b. zí	W ₁	L

NONINITIAL should be understood as a cover constraint for constraints of a more general nature which produce a pressure to have at least one pre-stem syllable. One possible way of explaining this pressure would be to assume that the prefix domain in Tsuut’ina is a morphosyntactic constituent. We could then further assume that the right edge of the prefix domain must coincide with the right edge of a foot or some other prosodic constituent (McCarthy & Prince 1993b, Truckenbrodt 1995), which in turn would entail that the prefix domain must contain at least one syllable. This is essentially the same

analysis proposed by McDonough (1990) and Rice (1990) for similar effects in Navajo and Hare, respectively.⁵²

Next we have to consider words like (78)b, in which /ni/-omission is blocked for the sake of satisfying NONINITIAL. Here, NONINITIAL must dominate *3-TERM (because /ni/ is used in a third-person context) and DEP must dominate *3-TERM as well (because /ni/ is used rather than the epenthetic [i]):

(83)

terminative ₁ -3sg.def.subj ₂ -√travel ₃	NONINITIAL	DEP	*3-TERM
a. $\text{ni}_1-\emptyset_2\text{-na}_3$			1
b. $\emptyset_2\text{-na}_3$	W ₁		L
c. $i-\emptyset_2\text{-na}_3$		W ₁	L

(n.b.: the [i] in candidate (c) is epenthetic)

The Tsuut'ina facts are clearly linked to a class of related effects in the verbal systems of other Athapaskan languages which are traditionally referred to as 'augmentation'. These effects—including those from Navajo and Slave alluded to earlier—all involve an apparent phonological minimality requirement on the size of the prefix domain. It is a disputed question, however, whether this minimality effect is genuinely a phonological one, or if it is a morphological in nature. Is the constraint at work one which requires at least one *syllable* to precede the stem, or is it one which requires at least one *affix* to precede the stem? If the second view is correct for Tsuut'ina, then this example is not relevant for making the argument that morphological wellformedness conditions can be violated for the sake of satisfying phonological ones.

⁵² See also Halpern (1992), Hargus & Tuttle (1997), Tuttle (1998), and Cable (2006) for related proposals.

Hargus & Tuttle (1997) favor the morphological account, arguing convincingly that certain previously-proposed phonological accounts are unworkable for augmentation effects in a number of Athapaskan languages. They suggest that augmentative elements are morphs inserted under the pressure of a constraint requiring all verbs to have tense prefixes. This exact account will not work for Tsuut'ina, because the class of prefixes in (75) which can be included to satisfy the minimality requirement include aspect and person-agreement markers.

However, it is easy to imagine a looser restriction for Tsuut'ina: every verb stem must be preceded by a prefix, not necessarily just a tense prefix.⁵³ This is also unlikely to be viable for Tsuut'ina, given that the otherwise-expected omission of 3rd person singular direct object /mi/ is apparently blocked in words like the following, which contain the 1st person singular subject prefix /s/ (Cook 1971, p. 469):

- (84) a. mí-s-gúł 3.sg.obj-1sg.subj.-√hit
 'I am hitting him'
- b. mí-s-ʔás 3.sg.obj-1sg.subj.-√kick
 'I am kicking it'
- c. mí-s-mō 3.sg.obj-1sg.subj.-√pick
 'I will pick it'

If the requirement at issue were simply that at least one prefix morph precede the verb stem, then it is unclear why /s/ should not suffice to meet this requirement.

⁵³ Classical Nahuatl reportedly requires all nouns to carry at least one affix, with a meaningless suffix /li/ appearing if no meaningful affix is required (Andrews 1975, Trommer 2001: §3.3.1)

2.6 Conclusion

In Optimal Interleaving theory, the phonology and morphology are ‘interleaved’ in two senses. The first sense is that phonological markedness and faithfulness constraints occupy the same OT grammar as the morpheme-morph correspondence constraints. All these types of constraints are freely re-rankable with respect to one another, predicting that phonological constraints will be able to interfere in various ways with the faithful spell-out of morphosyntactic features. In this chapter, we’ve examined a number of empirical reasons to think that this prediction is correct. MAX-M and DEP-M constraints, both for FSeS and for individual morphosyntactic features, can be violated under the compulsion of phonological constraints. Markedness constraints on the FSeS of morphs, as in the Tsuut’ina example, also can be violated in order to better-satisfy a phonological requirement.

The second sense in which phonology and morphology are interleaved in OI theory is that of serial interleaving. The next chapters focus on this second sense. In chapter 3, I begin to look in detail at how the ‘insert a morph’ operation works in the context of OT-CC, the serial architecture which OI theory adopts. Within this discussion, I’ll also have more to say about the first sort of interleaving, by looking at various ways in which phonological constraints can force violations of the constraint MIRROR which was introduced in this chapter. I’ll also show how OI theory derives restrictive generalizations about the (in-)ability of morph choice to look ahead to the outcome of subsequent phonological and morphological events.

CHAPTER 3

THE SERIAL INSERTION OF MORPHS

3.1 Introduction

In OI, phonology and spell-out are interleaved in two senses. The first sense is that the two occur in a single OT grammar, meaning that constraints on morphosyntactic feature spell-out can be violated in order to better satisfy phonological constraints, and vice versa. This was the topic of chapter 2. The remainder of this thesis is about the second sense of interleaving: phonology and spell-out are interleaved in that these two kinds of operations can be serially interspersed in the course of a single derivation. In this chapter, I'll be examining three main empirical areas in which the particular model of serial phonology/morphology interspersal assumed in OI attains empirical advantages over other theories:

- *Allomorphy and 'lookahead'*: Cyclic models like Lexical Phonology make very different predictions from multiple-URs parallel OT about what information is available to influence allomorph choice. I'll show that OI is, in different respects, both more and less restrictive than each of these competing theories, and argue that OI's predictions better fit the attested data. These issues are discussed in sections 3.2 through 3.6.

- *'Local ordering' of phonological and morphological rules*: Lexical Phonology models involve a single order of rules (split into alternating blocks of morphological and phonological rules). It therefore predicts that if a phonological rule p precedes a morphological rule m in some derivations, p must precede m in *all* derivations. I'll show that, under certain conditions, OI permits the insertion of

a certain morph to sometimes follow and sometimes precede a given phonological process, and that just this kind of ‘local ordering’ is attested in Tigrinya. This is the subject of section 3.7.

•*Infixation*: Horwood (2002) provides convincing arguments that morph order is regulated by faithfulness, and argues that infixation is really a form of metathesis. This is in tension with a desirable prediction of the gradualness requirement of OT-CC, namely that unattested long-distance metathesis is predicted to be impossible (McCarthy 2007b). If infixation is metathesis, it would involve metathesis over long distances which is otherwise unobserved. I’ll show that OI is able to resolve the tension. Morph order can be regulated by the morpheme/morph faithfulness constraint MIRROR, but infixes don’t have to metathesize from prefix or suffix position into root-medial position, because they’re inserted in root-medial position in the first place. In conjunction with this discussion, I review the evidence (from infixation and other domains) that phonological factors are capable of influencing the surface linear order of morphs. This is the subject of section 3.8.

Lastly, in section 3.9, I give a preliminary sketch of how OI’s approach to allomorphy and linear order might be extended to effects above the word level. Section 3.10 summarizes the results of the chapter.

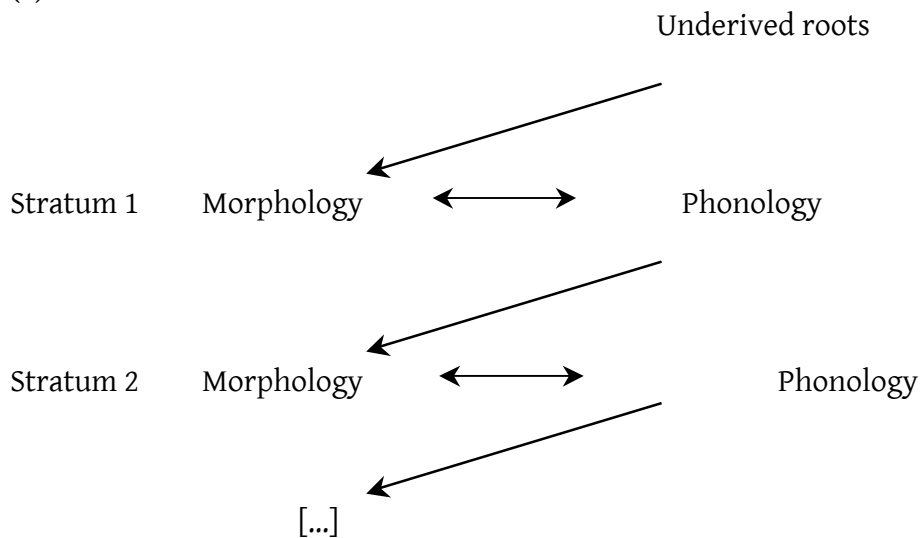
3.2 ‘Lookahead’ in phonology/allomorphy interactions

Different theories about the serial relationship between phonology and morph insertion make different predictions about what kinds of phonological information is

available to allomorph selection. In rule-based theories where there is no entertaining of different candidate derivations, a single choice is made at the point where each rule applies. When determining whether or not to apply, a given rule *R* has access to (at least some) information about what the previous rules have done, but *R* cannot have access to information about the effect of rules ordered after *R*, for the very simple reason that those rules haven't applied yet. That is to say, in theories with ordered rules, a given rule can't 'look ahead' to the results of applying subsequent rules.

In Lexical Phonology, there are two kinds of rules: phonological ones and morphological ones. Each (lexical) level of the grammar consists of a battery of morphological rules followed by a battery of phonological rules.⁵⁴

(1)



Because of the two kinds of rules that it has, Lexical Phonology makes two kinds of predictions regarding the inability of morphological rules—that is, of allomorph choice—to look ahead (Carstairs 1987, 1990, Kiparsky 1994, 2007a). First, a

⁵⁴ If a stratum is noncyclic, then the arrow between the 'Morphology' and 'Phonology' modules on that stratum will go in only one direction, from morphology to phonology.

morphological rule of stratum n is necessarily ordered before a morphological rule of stratum m , where $m > n$. On the usual assumption that affixes nearer to the root are added on earlier strata than affixes further from the root, this means that, in LP, the choice of allomorphs at level n cannot be affected by the phonological shapes of morphs added at level m .

To give a hypothetical example, imagine a language in which nouns have the structure [[[root] gender] number]. LP predicts that there could not be a language in which (say) feminine gender was marked by /-za-/ before a following consonant-initial number suffix but by /-xof-/ before a following vowel-initial suffix. LP shares this property with other cyclic theories, for instance a version of Distributed Morphology that incorporates cyclic vocabulary insertion (Bobaljik 2000), as well as with Stratal OT.⁵⁵

While Stratal OT doesn't have ordered rules, it does involve selecting a single winning candidate at the end of every pass of constraint evaluation. Work in Stratal OT universally assumes that the phonology of each level corresponds to a pass of constraint evaluation. Little explicit discussion exists in the Stratal OT literature regarding the internal character of the morphology components of each stratum, but these would presumably (assuming architectural parallelism with rule-based LP) be OT grammars too, with a pass of constraint evaluation occurring at the end of each. Since a single winning candidate is chosen by each of the phonologies and morphologies to pass along to the next one, none of the decisions in any of those modules can be affected by anything that's destined to happen in one of the later modules.

⁵⁵ See also Dolbey (1997) and Paster (2006, to appear) on the no-lookahead prohibition of cyclic models.

The second type of lookahead prohibition on allomorphy predicted by LP regards relationships between a morphological rule and a phonological one. Suppose that one of the allomorphs of a level n affix has a phonological shape which causes it to (sometimes) condition application of a phonological rule p . Since the insertion of an affix necessarily precedes any phonological rule-applications which that affixes serve to condition, it follows in an ordered rule theory like LP that allomorph choice is always opaque with respect to phonological rules which any of the allomorphs serve to condition. A straightforward example of such opacity is found in Polish (Łubowicz 2006, in press). The locative singular suffix in Polish has two listed allomorphs /e/ and /u/. Noun stems which end underlyingly in the alveolars /t d n s z/ take the /e/ allomorph. Using this allomorph conditions a general process of the language whereby alveolars become prepalatals before a front vowel:

(2)

<i>Nominative sg.</i>	<i>Locative sg.</i>	
lis[t]	o lis[ć]e	'letter'
obia[d]	o obie[dź]e	'dinner'
ok[n]	o ok[ń]e	'window'
bruda[s]	o bruda[ś]e	'dirty man'
łobu[z]	o łobu[ź]e	'troublemaker'

This system of allomorph choice is opaque because stems ending in underlying prepalatals take the /u/ allomorph:

(3)

lis[ć]	o lis[ć]u	'leaf'
narzę[dź]-e	o narzę[dź]u	'tool'
ko[ń]	o ko[ń]u	'horse'
łoso[ś]	o łoso[ś]u	'salmon'
pa[ź]	o pa[ź]u	(type of butterfly)

Thus, in Polish, alveolar-final stems take a different allomorph from prepalatal-final stems, even though the alveolar/prepalatal contrast is obliterated stem-finally in locative singular words due to a rule triggered by the /-e/ allomorph. Similar systems of opaque allomorphy exist in Japanese (Gibson 2008), Ukrainian (Darden 1979, Gibson 2008), Turkish (Aranovich et al. 2005, Lewis 1967, Paster 2006, to appear, Gibson 2008), German (Kiparsky 1966, 1994, Aronoff 1976) Spanish (Aranovich et al. 2005, Aronovich & Orgun 2006), and Sanskrit (Kiparsky 1997).

Importantly, Lexical Phonology not only predicts that this kind of opaque allomorphy system is possible, but also that allomorph selection is *always* opaque (though perhaps uninterestingly so) with respect to phonological processes which one of the allomorphs is able to condition. That is, a hypothetical language like the following would be inconsistent with LP. Suppose that the plural marker in the language has two suppletive allomorphs /-is/ and /-eʒ/, with the first being used if the rightmost sibilant in the stem is alveolar, and the second if the rightmost sibilant in the stem is prepalatal (thus following the kind of sibilant-harmony pattern that is phonologically productive in such languages as Chumash—Applegate 1972, Poser 1993, Kiparsky 1993a, McCarthy 2007c):

- (4) sum-is
zak-is
ʃug-eʒ
ʒab-eʒ

Suppose also that the language assibilates /t/ and /d/ to [s] and [z] before front vowels:

- (5) /pat-i/ → [pasi]
/kad-e/ → [kaze]

Using either /-is/ or /-eʒ/ on a stem ending on one of these segments would therefore result in a stem-final alveolar sibilant. Given this, consider what we might expect as the outcome of the plural allomorphy in this language for a stem like /ʒad/. In a rule-based LP model, allomorph selection would occur prior to palatalization, so /-eʒ/ would be chosen, since at this stage the rightmost stem sibilant is /ʒ/. The affixed form /ʒad-eʒ/ would then undergo palatalization, yielding the surface form [ʒazeʒ].

Very different predictions are made in the multiple-underlying-forms approach to PCSA like the one illustrated in the last chapter. This approach is cast within a monostratal version of OT, which means that allomorph choice and all phonological processes occur simultaneously, in a single pass of candidate comparison. This theory predicts just the opposite of LP, namely that allomorph choice will always be *transparent* with respect to phonological processes that the allomorphs serve to condition. Let's illustrate by again considering the hypothetical sibilant-place-agreeing-allomorphy language. On the assumption that [eʒ] is more marked, on all dimensions, than [is], our hypothetical PCSA system would require the assumption that the markedness constraint requiring consecutive sibilants to agree in their coronal subplace (call it 'SIBAGR') dominated the markedness constraints preferring [is] over [eʒ] (which I'll summarize with a cover constraint '*eʒ'):

(6)

/ʃug + {is, eʒ}/	SIBAGR	*eʒ
a. ʃugis	W ₁	L
b. ʃugeʒ		1

/sem + {is, eʒ}/	SIBAGR	*eʒ
a. semis		
b. semeʒ	W ₁	W ₁

The existence of the assibilation process in the hypothetical language requires that a markedness constraint against alveolar-stop/front-V sequences (call it *Te) dominate IDENT[contin]:

(7)

/te/	*Te	IDENT[contin]
a. ʈe		1
b. te	W_1	L

Now suppose that *Te and IDENT[anterior] dominate SIBAGR. This ranking predicts that alveolar-final stems will take the /-is/ allomorph of the plural suffix:

(8)

/zad + {is, eʒ}	*Te	IDENT[ant]	SIBAGR	*eʒ
a. ʈazis			1	
b. zadis	W_1		1	
c. zadeʒ	W_1			1
d. zazeʒ			W_2	1
e. zazis		W_1		
f. zaʒeʒ		W_1		1

The undominated status of *Te eliminates candidates like (8)b-c which use one or the other allomorph, but which don't assibilate the root-final [d]. Likewise, the undominated status of IDENT[anterior] rules out candidates like (8)e-f which bring about perfect satisfaction of SIBAGR by changing the underlying anteriority of one of the sibilants. This leaves as viable options only [zazis], which has one violation of SIBAGR,⁵⁶ and [zazeʒ], which has two. With SIBAGR as the next-highest-ranked constraint, [zazis] is then the winner.

In this hypothetical scenario, then, allomorph selection is transparent with respect to assibilation. In the winning candidate, the rightmost stem sibilant is [z], and

⁵⁶ I'm assuming here that SIBAGR is defined as 'For each sibilant, assign a mark if the next sibilant in either direction has a different place of articulation'.

the [is] allomorph is used. The generalization that ‘the allomorph which matches the anteriority of the rightmost stem segment should be used’ is respected on the surface. A multiple-underlying-forms OT model of allomorphy thus predicts the possibility of allomorphy and a phonological process interacting transparently. Moreover, since this mode of analysis employs only the architecture of classic OT, with just markedness and faithfulness constraints and no intermediate derivational levels, it cannot model opacity of any kind.⁵⁷ Consequently, it predicts that allomorphy and phonology will always interact transparently (just as classic OT predicts that two phonological processes can only ever interact transparently).⁵⁸ This is the exact inverse of the prediction made by Lexical Phonology that phonology and allomorphy always interact opaquely.

Owing to the existence of allomorphy systems like that of the Polish locative singular which are demonstrably opaque, this prediction of monostratal, multiple-URs OT is wrong. Allomorph selection is at least sometimes opaque.

Now let’s examine the multiple-underlying-forms theory’s predictions with regards to morphology-morphology lookahead. Consider again the hypothetical language where [feminine] is marked by /-za-/ before a following C-initial suffix and by /-xof-/ before a following V-initial suffix. The multiple-UR theory can easily model this language, as seen in the following tableaux:

(9)

a.

/peto-{za, xof}-bi	NoCODA	*Z
i. pe.to.za.bi		₁
ii. pe.to.xof.bi	W ₁	L

b.

/peto-{za, xof}-u/	ONSET	*X
i. pe.to.xo.fu		₁
ii. pe.to.za.u	W ₁	L

⁵⁷ Except for chain shifts, which can be modeled if we allow ourselves particular kinds of faithfulness constraints (Kirchner 1996, Cable 2000, Moreton 2000, Moreton & Smolensky 2002, Jesney 2005, 2007, McCarthy 2007a: §3.4).

⁵⁸ See Paster (2005, 2006, to appear) for discussion of classic OT’s predictions on this point.

If NoCODA and ONSET are undominated in the language, then /za/ will always be used with a following C-initial suffix (because using /xof/ would create a coda) and /xof/ will always be used with a following V-initial suffix (because using /za/ would create hiatus). The multiple-UR theory is able to model this language because all of the morphs are in the input simultaneously, so information about the surface form of the outermost suffix is available to the optimization that decides whether to use /za/ or /xof/.

The multiple-UR theory therefore predicts that allomorphy of an inner suffix *can* look ahead to the phonological properties of an outer suffix. However, it doesn't necessarily predict that inner-suffix allomorphy will *always* look ahead. Non-lookahead can be made to occur by calling on output-output faithfulness (Benua 1997). We can ensure that /peto-{za, xof}/-bi/ will always use the same allomorph as /peto-{za, xof}/ if OO-faithfulness is sufficiently high-ranked:

(10)

a. *Selection of surface form of inner constituent*

/peto-{za, xof}	NoCODA	*Z
i. pe.to.za		1
ii. pe.to.xof	W_1	L

b. *Selection of surface form of outer constituent*

/peto-{za, xof}-u/	OO-DEP(seg)	OO-MAX(seg)	ONSET
i. pe.to.za.u	1		1
ii. pe.to.xo.fu	W_4	W_2	L

In (10)a, /za/ is chosen over /xof/ because avoiding a word-final coda is more important than avoiding any of the markedness violations incurred by using /za/. Consequently, the output of /peto-{za, xof}-u/ in (10)b will be pressured to be OO-faithful to the surface form [pe.to.za] of the inner constituent. As seen in (10)b, using /za/ in the longer word can be compelled if either OO-DEP(seg) or OO-MAX(seg) dominates any constraints like ONSET that would favor using /xof/ instead. Candidate (10)b.ii gets one violation of OO-DEP(seg) for each of the segments of /xof/, since these segments have no correspondents in [pe.to.za]. (Both candidates in (10)b also get one violation of OO-DEP(seg) due to the presence of the additional suffix /u/, whose segment has no correspondent in the base either.) Additionally, (10)b.ii violates OO-MAX(seg) because the segments /za/ are present in the base output form [pe.to.za] but not in [pe.to.xo.fu].

The predictions of cyclic, LP-type theories and of the multiple-UR theories regarding the ability of allomorph selection to ‘look ahead’ can thus be summarized as follows:

<i>Will allomorph choice look ahead to...</i>	<i>Cyclic allomorphy</i>	<i>Classic OT with multiple URs</i>
<i>a. Phonological shape of more-peripheral affixes?</i>	Never	Sometimes, but not always
<i>b. Outcome of phonological processes conditioned by one or more of the allomorphs?</i>	Never	Always

Table 3.1. Predictions of different theories regarding allomorphic lookahead

The majority of this chapter will be devoted to examining where OI falls relative to these two theories in terms of the predictions in table 3.1. Two different sub-versions of OI will be considered in this regard. I’ll first look at a version which includes a

stipulation that morphs must be added from the root outwards, with less-peripheral morphs added before more-peripheral ones. I will show that this version of OI predicts that both conceivable types of allomorphic look-ahead will not occur. This prediction is owing to an independently-motivated assumption of OT-CC called Local Optimality (hereafter abbreviated 'LO': McCarthy 2007a, to appear b). LO says, informally, that GEN is free to pursue only the most harmonic way of doing some operation in the course of chain construction. This means that the candidate set will only feature those allomorphs which were the best option at the point at which they were inserted. OI with stipulated root-outwards spellout is thus similar to rule-based theories insofar as a single choice is made at the point where each morpheme is spelled out, meaning that the outcome of subsequent steps in the derivation cannot affect the choice.

There will, however, be one respect in which the root-outwards version of OI is less restrictive than cyclic allomorphy models. This is the following: while the choice of whether to use one morph vs. another cannot look ahead (in either sense), the choice of whether to use some morph vs. no morph at all can look ahead. The lack of restrictiveness in this case may be desirable, as this very specific form of lookahead is, I'll argue, attested. The some-morph/no-morph choice is able to look ahead because LO forces GEN to pick only the single best way of doing some particular operation, but it doesn't force GEN to choose between doing something vs. doing nothing.

The second version of OI that I'll entertain is one which omits the stipulation that morphs be inserted strictly from the root outwards. There may, in such a version, be constraints which favor proceeding in root-outwards fashion, but since these constraints are violable there is no guarantee that derivations will always proceed this

way. I'll show that the second version of OI still predicts that that allomorph choice is universally opaque with respect to phonological processes which any of the allomorphs being chosen among would condition. This prediction seems to be correct. The second version of OI is, however, less restrictive than the first one in that it allows the other type of lookahead. That's because a more-peripheral morph could be inserted before a less-peripheral one, allowing the phonology of the more-peripheral morph to influence the choice of which less-peripheral allomorph to use. This lack of restrictiveness may be desirable as well, given possible cases of outwards-sensitive allomorphy in Italian and Southern Zaria Fulfulde.

3.3 The order of spell-out

As discussed in the preceding section, a rule-based serial theory of morphology predicts that phonologically-conditioned suppletive allomorphy of some morpheme cannot be affected by the phonological shape of another morph which is added later in the derivation. This doesn't necessarily mean that allomorphy of less-peripheral morphs can't be influenced by the phonological properties of more-peripheral morphs. That version of the prediction only follows if the theory incorporates the additional assumption that morph insertion begins at the root (the most-embedded constituent of the word) and proceeds in a strictly outwards fashion.

The assumption of root-outwards spellout is almost universally held by item-based theories of realizational morphology. While the *SPE* cycle doesn't necessarily make a claim about the order in which morphs are added, it does entail an assumption that morphosyntactically interior morphs become accessible to the phonology before

outer ones do. Likewise, in work on Lexical Phonology and Stratal OT, it's more or less universally assumed that an affix's greater linear externality from the root goes along with its being added on a later stratum. In Distributed Morphology, root-outwards spellout has been invoked to account for restrictions, like some of the ones discussed in this chapter, about what information is available to suppletive allomorphy (Bobaljik 2000). More recently, the spellout of morphosyntactic structure beginning with deeper constituents has been argued to be connected with the structure of the syntactic derivation, in the form of phase theory.⁵⁹ A non-phase-based Minimalist model which assumes that spellout proceeds strictly from the inside out has also recently been proposed by Wojdak (2008).

While there are, to be sure, empirical and conceptual arguments for assuming that morph insertion proceeds from the root outwards, it is by no means the case that morph insertion *of necessity* proceeds in this fashion. It would be perfectly coherent, for instance, to entertain a version of Lexical Phonology identical to the usual version of that theory except that the first lexical stratum introduced the most-peripheral class of affixes, with the root being added only at the last level. Indeed, it has been suggested that spellout above the level of the word proceeds in a top-down fashion, starting with the least-embedded rather than the most-embedded constituent (Legate 1999, Schlenker 1999).⁶⁰ This means that, in LP and other cyclic models, nothing about the structure of the theory inherently predicts that the introduction of affixes proceeds

⁵⁹ See Chomsky (1999, 2001) for the original proposal for phases; Marantz (2001) and Arad (2005) for the extension of phases to word-formation, and Marvin (2002), Oltra-Massuet & Arregi (2005), Piggott & Newell (2006), Bachrach & Wagner (2007), and Skinner (to appear) for the use of phases in word-internal cyclic effects.

⁶⁰ Yet another view is proposed by Emonds (2000, 2002; see also Hannahs & Tallerman 2006), in which the order of insertion is determined by the type formal features that morphs express, rather than (necessarily) their structural depth of embedding.

from the root outwards. As such, the assumption that affix-insertion does proceed in that order is effectively a stipulation.⁶¹

In the following sections, I'll be exploring the predictions of a version of OI in which morph-insertion is stipulated to proceed strictly from the root outwards. The foregoing discussion is meant to emphasize that this version of OI does not suffer relative to Lexical Phonology or other theories in terms of its degree of stipulativeness—in this version of OI as well as in LP, root-outwards spellout is just as much an elementary postulate of the theory.

3.4 OI with root-outwards spellout assumed

3.4.1 On Local Optimality and the need to assume it

The Local Optimality requirement can be stated as follows:

(11) *Local Optimality*

Let $\langle \dots f_{n-1}, f_n \rangle$ be a valid chain in some language L . Let g_1, \dots, g_m be all of the forms which can be formed from f_n by applying some operation O in GEN. The chain $\langle \dots f_{n-1}, f_n, g_i \rangle$ is then a valid chain in L iff:

- a. g_i is more harmonic than f_n .
- b. g_i is the most harmonic member of the set $\{g_1, \dots, g_m\}$

Clause (a) of Local Optimality is simply the Harmonic Improvement requirement that we've already seen. What's new is clause (b). Under clause (b), when GEN is

⁶¹ Except in the case of the phase-based theory of cyclicity, where the successive (semantic and phonological) interpretation of certain successively larger syntactic constituents is grounded in a specific theory of how syntactic derivations proceed. While the phase-based theory does have a conceptual advantage in not having to stipulate root-outwards spellout as an otherwise unmotivated theoretical primitive, it does suffer from a number of empirical drawbacks as a theory of word-internal cyclicity, as discussed in chapter 5.

attempting to build valid chains off of some existing subchain, it is allowed only to pursue the single most harmonic way of doing each of the operations in its inventory.⁶²

To give a concrete example of Local Optimality at work and to demonstrate why we need to assume it in OT-CC, let's consider the case of serial interactions involving the assignment of metrical structure. McCarthy (to appear b) proposes that the assignment of foot structure and stress happens as a single LUM in OT-CC.⁶³ This proposal is motivated by the need to model systems of metrically-conditioned syncope, in which a language lays down stress and then deletes some or all of the unstressed vowels.

Imagine, for instance, a hypothetical language with a metrically-conditioned syncope system like that of Awajún, which was formerly known as Aguaruna (Payne 1990, Alderete 1999, McCarthy to appear b). In general, what happens here is that iambic stress is assigned, followed by deletion of all of the unstressed vowels.⁶⁴ For an input like /ka:sotyna/, the valid chains of interest will then be the following:⁶⁵

- (12) a. <ka:sotyna, (kà:)(so.tý)na, (kà:s)(týn)>
b. <ka:sotyna, (kà:)(só.ty)na, (kà:)(sótn)>

⁶² Local Optimality does not need to be stipulated in the original version of Harmonic Serialism proposed in Prince & Smolensky (2004 [1993]). In the original HS proposal, a single operation is chosen at every pass through the grammar until convergence is reached, so every way of doing some operation competes with every other way of doing that same operation. The trouble is that it also competes with every way of doing every *other* operation, and this seriously limits HS's usefulness as a theory of opacity (McCarthy 2000, 2007a). The addition of the LO stipulation in OT-CC is thus the price paid (relative to HS) for being able to have an adequate theory of opacity.

⁶³ However, see Pruitt (in prep.) for a different view, with feet built one at a time.

⁶⁴ An exception to this occurs with sequences of two word-final light syllables in even-parity words. McCarthy (to appear b) argues that these are parsed trochaically (in order to avoid final stress), owing to the fact that final vowels are systematically syncopated. Additionally, the first vowel is never syncopated, which McCarthy (to appear b) attributes to positional faithfulness to the initial syllable.

⁶⁵ For ease of illustration, in this example I follow McCarthy (to appear b) in assuming that assignment of all feet happens in a single LUM, and that syncope of multiple vowels can also occur in a single LUM.

In chain (12)a, the word is exhaustively parsed into iambic feet, and the unstressed vowels are then deleted. In actual Awajún, this is exactly the pattern that we find as the winner for inputs with the same syllabic makeup as our hypothetical example:

/ʃa:ɲumina/ → (ʃá:)(ɲu.mí)na → [(ʃá:ɲ)(mín)] ‘your corn.ACCUSATIVE’. A potential competitor of this chain is (13)b, in which the second foot is trochaic rather than iambic at the intermediate step where stress is assigned.

By hypothesis, our hypothetical language always behaves like Awajún in that (under most circumstances) candidates with all-iambic intermediate steps (like (12)a) always beat competitors with all- or partly-trochaic intermediate steps (like (12)b). If we don't assume Local Optimality, however, explaining (12)a's victory in terms of a preference for iambs is impossible. The reason is that the final feet of both candidates are monosyllabic, so they satisfy both IAMB and TROCHEE. Metrically-conditioned syncope crucially involves deletion of vowels which would be unstressed if they were kept, and, as our pseudo-Awajún example shows, the desired distribution of syncope in languages where syncope is metrically-conditioned cannot be obtained from markedness constraints evaluating the surface foot structure (a problem first noted by Kager 1997, and extensively discussed by Blumenfeld 2006 and McCarthy to appear b).

Local Optimality allows us to solve this problem by dictating that the initial subchain <ka:sotyna> can be immediately followed by only one way of laying down feet.⁶⁶ After discovering that <ka:sotyna, (kà:)(so.tý)na> and <ka:sotyna, (kà:)(só.ty)na> are both harmonically-improving ways of performing the same LUM on the original

⁶⁶ In McCarthy (to appear b), Harmonic Serialism rather than OT-CC is used. For the purposes of this example, the selection of a single winning candidate in the stress step of an HS derivation is equivalent to the selection of a single Locally Optimal way of laying down feet in OT-CC. Either way, the crucial effect is that the grammar commits to a single most harmonic way of assigning feet before it makes any decisions about deleting vowels.

input, GEN will consult EVAL to see which subchain is more harmonic. The all-iambic subchain <ka:sotyna, (kà:)(so.tý)na> will be judged the more harmonic choice, given the ranking IAMB » TROCHEE:

(13)

/katesyto/	IAMB	TROCHEE
a. ☞ <ka:sotyna, (kà:)(so.tý)na>		₂
b. <ka:sotyna, (kà:)(só.ty)na>	W ₁	L ₁

As a result, <ka:sotyna, (kà:)(so.tý)na> will be eligible to serve as subchain for further chain construction (via, most relevantly, the application of syncope) whereas <ka:sotyna, (kà:)(só.ty)na> will not.

The example I'm using is hypothetical pseudo-Awajún rather than actual Awajún in order to illustrate a second line of argumentation for Local Optimality which will lead us back to the question of 'lookahead'. Suppose that we didn't assume LO, and that we managed to contrive some *ad hoc* means of ensuring that chains with iambic medial steps usually beat chains with (all- or partly-) trochaic medial steps. We still have a problem, though: (12)b can be gotten to win via the markedness of the vowel [y]. All-iambic footing in (12)a means that the [y] gets stress, protecting it from syncope. By contrast, the partly-trochaic footing in (12)b leaves the [y] unstressed, allowing it to be deleted.

Therefore, if both of (12)a-b compete as candidates, then (12)b will win provided that a markedness constraint *[y] dominates all of the constraints which prefer (12)a (abbreviated C below):

(14) *Allowing different foot parses into final candidate set yields unattested system*

/katesyto/	*y	C
a. <ka:sotyna, (kà:)(so.tý)na, (kà:s)(týn)>	W ₁	L
b. ☞ <ka:sotyna, (kà:)(só.ty)na, (kà:)(sótn)>		₁

There is no attested system of metrically-conditioned syncope which works this way, with stress deviating from its normal pattern (in this case, all iambs) in order to ensure that certain marked vowels are unstressed and hence eligible for deletion. Because this never happens, some means of ruling out the hypothetical language just described has to be found. Local Optimality ensures exactly this. Candidates (12)a-b differ at their first LUM in that they choose different ways of assigning foot structure. If we assume Local Optimality, however, then GEN will select only the one most harmonic way of performing the assign-foot-structure LUM at this stage as a basis for further chain construction. Since vowels can't be deleted in a single step with foot construction, all possible footings, prior to deletion, tie on *y. Therefore, the all-iambic parse is judged Locally Optimal, even if *y dominates IAMB:

(15) *Markedness of potentially-syncopeable vowels can't affect choice of Locally Optimal footing*

/katesyto/	*y	IAMB	TROCHEE
a. \llcorner <ka:soty ⁿ a, (kà:)(so.tý)na>	1		2
b. <ka:soty ⁿ a, (kà:)(só.ty)na>	1	W ₁	L ₁

In the analysis of metrically-conditioned syncope, assuming that foot-construction is subject to Local Optimality ensures that the choice of where to put stress cannot look ahead to the outcome of processes which crucially follow stress-placement (in the example just presented, to which vowels will be deleted as a result of being unstressed). In languages with metrically-conditioned syncope, the choice of which vowel to syncopeate is optimized based on the location of stress, but the location of stress is not optimized with reference to which vowels could be syncopeated. Provided that syncope is only harmonically-improving once stress is placed (a nontrivial matter to ensure: McCarthy to appear b), Local Optimality ensures this

generalization by choosing one single way to place stress, and then moving on to syncope. If only one way of placing stress can be pursued, then there is no way for constraints which prefer for certain vowels to be syncopated (or not to be syncopated) to distinguish among different ways of placing stress. This, again, is simply because the choice of how to place stress is narrowed down to just one option before syncope even comes up. If morph-insertion is subject to Local Optimality, the same goes in OI for PCSA: only the single best way of inserting a morph can be entertained, ensuring that nothing that happens later can affect how to perform morph insertion. That is, morph insertion can't look ahead to anything that occurs later in the chain. The next subsection explores this prediction.

3.4.2 How Local Optimality prevents allomorphic lookahead

Suppose that all of the different ways of inserting a morph onto some morpheme *M* count as instances of the same operation for purposes of Local Optimality. That means that, given some preceding subchain, just one way of spelling out *M* can be pursued. That means that the choice of how to spell out *M* can't be influenced by any process that necessarily happens later on in the chain. This includes (1) the spell-out of morphemes that are further from the root than *M*, and (2) any phonological process whose application would be made possible by the presence of a morph used to spell out *M*. I will now show in turn how derives both types of non-lookahead.

First, we'll look at how OI plus Local Optimality rules out the possibility of PCSA conditioned by the phonological properties of more-peripheral morphs. Consider again the hypothetical language discussed earlier in which feminine gender is marked by

/-za-/ before a following C-initial (number) suffix and /-xof-/ before a following V-initial suffix. Suppose now that the grammar of this language is calculating the surface form of a feminine plural noun, with the plural suffix being /-u/. If the choice between whether to use /-za-/ or /-xof-/ isn't subject to Local Optimality, then both of the following will be potential valid chains:

- (16)
- a. <[ROOT]-[FEM]-[PL], peto-[FEM]-[PL], peto-za-[PL], peto-za-u>
- b. <[ROOT]-[FEM]-[PL], peto-[FEM]-[PL], peto-xof-[PL], peto-xof-u>

If both of the chains in (16) are part of the final candidate set, then (16)b can win under the rankings that we saw earlier in (9):

(17)

/peto-{za, xof}-u/	ONSET	*X	*VOICEDOBSTRUENT
a. pe.to.xo.fu		1	
b. pe.to.za.u	W_1	L	W_1

If *x dominates every other constraint in the language but ONSET,⁶⁷ we expect for this language to always pick chains that use the /-za-/ allomorph of the feminine, except when there is a following V-initial suffix, which gives /-xof-/ the advantage of avoiding hiatus. Thus, the choice of allomorphs of the feminine looks ahead to the phonological shape of the more peripheral plural suffix.

The reason that we were able to set up a language with lookahead is that /za/-use and /xof/-use both figure in our set of candidates, allowing us to compare the choice of feminine morphs in a way which takes into account phonological information about the subsequent number suffix. Local Optimality will therefore be able to rule out

⁶⁷ In tableau (17), *VOICEDOBSTRUENT is chosen as a representative example of a markedness constraint which prefers /-xof-/ over /-za-/, but which in all cases is overruled by *x.

this lookahead scenario by demanding that the grammar pick only the most harmonic way of spelling out the feminine morpheme. That is, the grammar looks at two subchains below and determines which is more harmonic:

- (18) a. <[ROOT]-[FEM]-[PL], peto-[FEM]-[PL], peto-za-[PL]>
b. <[ROOT]-[FEM]-[PL], peto-[FEM]-[PL], peto-xof-[PL]>

One or the other of these subchains will be more harmonic, depending on the ranking. Therefore one and only one of them will figure in the ultimate candidate set, either as a chain in its own right or as the initial subchain of a longer chain which performs subsequent operations, like spelling out the plural morpheme. Given the assumption of root-outwards spellout, there will be no valid chain in which the number morpheme is spelled out before the gender morpheme. As such, at the point where Local Optimality decides among the various available ways for spelling out the gender morpheme, the number morph is guaranteed not to be present yet. Consequently, the phonological shape of the number marker can play no role in Local Optimality's determination of which gender morph would be most harmonic.

Now let's look at how LO rules out the other kind of lookahead: the prediction that allomorphy is always opaque with respect to phonological processes which the allomorphs themselves condition. In looking at this, we'll see that assuming spellout to be subject to Local Optimality is necessary for opaque allomorphy to be analyzable in OI at all. I'll illustrate using the example of the Polish locative singular. Recall that this suffix has two allomorphs /e/ and /u/. Noun stems which end underlyingly in /t d n s z/ take the /e/ allomorph and subsequently undergo prepalatalization:

(19)

<i>Nominative sg.</i>	<i>Locative sg.</i>	
lis[t]	o lis[ć]e	'letter'
obia[d]	o obie[dź]e	'dinner'
ok[n]	o ok[ń]e	'window'
bruda[s]	o bruda[ś]e	'dirty man'
łobu[z]	o łobu[ź]e	'troublemaker'

Meanwhile, stems ending in underlying prepalatals take the /u/ allomorph:

(20)

lis[ć]	o lis[ć]u	'leaf'
narzę[dź]-e	o narzę[dź]u	'tool'
ko[ń]	o ko[ń]u	'horse'
łoso[ś]	o łoso[ś]u	'salmon'
pa[ź]	o pa[ź]u	(type of butterfly)

In rule-ordering terms, these data would call for an analysis in which allomorph choice must occur before the application of the palatalization rule. At first glance, it might seem that, even without Local Optimality, we could implement this ordering requirement in OI by invoking a constraint $\text{PREC}(\text{insert-locative}, \text{IDENT}[\text{back}])$:

(21) $\text{PREC}(\text{insert-locative}, \text{IDENT}[\text{back}])$

Assign a violation-mark if:

- a. An $\text{IDENT}[\text{back}]$ -violating LUM occurs and is not preceded by an insertion of a locative morph.
- b. An $\text{IDENT}[\text{back}]$ -violating LUM occurs and is followed by an insertion of a locative morph.

(Not much should be read into my expositional assumption that [back] is the feature that distinguishes alveolars from prepalatals; the choice of feature is arbitrary for the purposes of this section.)

In reality, however, this won't allow us to properly analyze the opacity of the Polish locative singular. To see why, let's now try to construct an analysis without invoking Local Optimality. First off, the existence of the palatalization process tells us

that a markedness constraint against alveolar/front-vowel sequences dominates IDENT[back]:

(22)

/se/	*Te	IDENT[back]
a. [s]e [s]e		₁
b. se	W ₁	L

Now, consider a root ending in /t/. For such a root in the locative singular, the chains of interest are as follows:

- (23) a. <ROOT-LOC, list-LOC, liste, lisće>
 b. <ROOT-LOC, list-LOC, liste>
 c. <ROOT-LOC, list-LOC, listu>

Chain (23)a is the attested winner: it inserts the /e/ allomorph, and then performs the palatalization. Chain (23)b inserts the /e/ allomorph, but does not perform palatalization. Chain (23)c uses the wrong allomorph, /u/. No palatalization occurs with this allomorph, since the constraint ranking of Polish makes palatalization harmonically improving only before front vowels.

Suppose we submit these candidates to the following constraint-ranking:

(24)

//ROOT-LOC//	PREC(insert-loc, ID[pal])	*Te	IDENT[back]
a. [s]e <ROOT-LOC, list-LOC, liste, lisće>			W ₁
b. <ROOT-LOC, list-LOC, liste>		W ₁	
c. [u] <ROOT-LOC, list-LOC, listu>			

Even if PREC(insert-loc, ID[back]) is top-ranked, the chain that uses the /u/ allomorph incorrectly wins. All three of our candidates turn out to satisfy the PREC constraint. Candidate (24)a satisfies it because it features palatalization, and the palatalization is preceded by locative suffixation. Candidates (24)b and (24)c,

meanwhile, vacuously satisfy the *PREC* constraint because they do not have palatalization LUMs. Since the *PREC* constraint is indifferent, the choice is made by **Te*, which penalizes the chain that uses /e/ but fails to palatalize, and by *IDENT[*palatal*]*, which penalizes the chain which uses /e/ and *does* palatalize. Candidate (24)c has no palatalization and no alveolar/front-vowel sequences. As a result, it violates neither of these constraints, and incorrectly wins.

To circumvent this problem, we could try adding a markedness constraint **u* and rank it above **Te*. But **u* can't be top-ranked, because /-u/ is used with roots that ends in an underlying prepalatal. For /-u/ to win with those roots, **u* would have to be dominated by a constraint against alveolar/front vowel sequences (call it **T'e*). But such a constraint can't dominate **u*, since it would then by transitivity dominate **Te*. Having **T'e* ranked above **Te* would make coronal palatalization non-harmonically-improving. Since coronal palatalization does happen, we seem to be at an impasse.

What went wrong in our attempt to analyze Polish without Local Optimality? The problem is that the constraint *PREC(insert-loc, ID[*pal*])*, which was supposed to be responsible for making the grammar pick an allomorph before palatalizing, actually does nothing of the sort. This is because using /e/ and using /u/ can both be pursued as alternatives which satisfy the *PREC* constraint. *PREC(insert-loc, ID[*pal*])* demands that that one of these morphs be inserted before performing palatalization, but it doesn't force us to commit ourselves to one or the other before moving on to palatalization. If that constraint can't do the work, our only alternative would be to rely on a markedness constraint to make the /u/-employing chain lose, but as we just saw, that idea is a nonstarter for Polish.

In order to analyze the Polish facts, then, we need some way to *literally choose* one allomorph or the other in a way that PREC constraints can't. Local Optimality does exactly this. Building off of a subchain like <ROOT-LOC, list-LOC> where only the root has been inserted, there are two things which would be harmonically-improving for GEN to try out: inserting /e/ or inserting /u/. Since these count as LUMs of the "same kind", Local Optimality means that only one or the other can be pursued. EVAL is then consulted to see which is more harmonic.

Our analysis of Polish will rely on making a representational distinction between two sequences that are both phonetically [će]. I will assume that the prepalatalization process /te/ → [će] is an autosegmental spreading process, perhaps of a feature [-back] (though for our purposes here it doesn't much matter exactly what feature is involved). As such, [će] sequences derived through palatalization share a single token of the feature [-back] which is linked to both segments. I will henceforth designate sequences with a shared [-back] token using a combining breve: [cê]. The notation [će] will be used for sequences in which each segment is linked to a separate token of [-back]. This structure will arise when the /-e/ allomorph is tried out with a root which underlyingly ends in /ć/. Since morph-insertion and feature-spreading are separate operations, inserting /-e/ onto such a root will result in the unlinked structure [će]. Hence it is [će], and not [cê], which competes with [cu] for Local Optimality with underlyingly /ć/-final roots. The reason for invoking this representational distinction will become apparent shortly.

For an underlyingly alveolar-final root like /list/, the forms which compete for Local Optimality are [liste] and [listu]. The first candidate violates the constraint *Te

which drives coronal palatalization. Therefore, in order for [listu] not to be Locally Optimal, it must violate some other constraint which is ranked above *Te. I'll label this constraint as simply *u:

(25)

<ROOT-LOC, list-LOC, ...	*u	*Te	IDENT [-back]
... liste> <i>Is more harmonic than:</i>		1	
... listu>	1		

For an underlyingly prepalatal-final root like /lisć/, the forms which compete for Local Optimality are [lisće] and [lisću]. The latter form must be Locally Optimal, so [lisće] must violate some constraint ranked higher than *u. As [lisće] involves separate tokens of [-back], we may assume that OCP[-back] is at work here:

(26)

<ROOT-LOC, lisć-LOC, ...	OCP [-back]	*u	*Te	IDENT [-back]
... lisću> <i>Is more harmonic than:</i>		1		
... lisće>	1			

Now I can explain the motivation for assuming a distinction between [će] and [cê]. Because the latter structure involves a single token of [-back], it doesn't violate OCP[-back]. The representational assumption therefore allows us to assume that the constraint which blocks /e/-use with underlying prepalatals isn't violated in derived [cê]. This is crucial, because, as we saw earlier, *u can't be dominated by a constraint which is violated by all prepalatal/front-vowel sequences, because coronal palatalization then wouldn't be harmonically improving:

(27)

/te/	*T'e	*u	*Te	IDENT [-back]
[te] <i>Is incorrectly more harmonic than:</i>			1	
[çe]	1			1

Additional support for the idea that avoidance of the /-e/ allomorph after underlying prepalatals is due to an OCP constraint on palatality or frontness comes from the fact that /-u/ is also that allomorph that's used with stems ending in the postalveolars [š, ž, ě] and palatal [j] (Łubowicz 2006, in press).

Opaque allomorphy systems like that seen in Polish involve the grammar winnowing its choice of allomorphs down to one option based on conditions which obtain prior to the subsequent application of some phonological process. Local Optimality performs exactly this choice by making GEN pursue only that allomorph which is most harmonic at the point of insertion.

Additionally, because PREC constraints can play no role in bringing about opaque phonology/allomorphy interactions, there is no way for phonology and allomorphy *not* to interact opaquely. Local Optimality will always narrow down the choice of allomorphs to one option prior to the application of any phonological process that one of the allomorphs might condition. OI needs to assume that spell-out is subject to Local Optimality in order to make opaque allomorphy analyzable, and this brings with it a prediction that allomorphy is always opaque. OI, if equipped with this assumption about spell-out and Local Optimality, therefore derives the non-existence of both types of lookahead. Importantly, it does so while keeping PCSA within the purview of the

phonological component of the grammar. This is a desirable thing to achieve for two reasons that were discussed in chapter 2. First, from the standpoint of parsimony, it's preferable if all linguistic phenomena that involve phonological generalizations can be assigned to the phonology. Second, a theory which removes PCSA from the phonology and instead relies solely on subcategorization misses a number of generalizations, for instance in Kɔnni, where the choice of noun-class affixes duplicates the efforts of the language's phonotactic restriction against $[r(V)r]$ sequences.

3.4.3 Local Optimality allows (some) do-something vs. do-nothing choices to look ahead

The two assumptions of Local Optimality and root-outwards spellout together assure that the choice of morph *A* vs. morph *B* cannot look ahead to subsequent events. However, the choice of whether to use some morph vs. no morph at all *can* look ahead. This is because 'doing nothing' is not among the set of choices from among which Local Optimality selects the most harmonic option. For instance, in our hypothetical example in (17), the subchain $\langle [ROOT]-[FEM]-[PL], \text{peto}-[FEM]-[PL] \rangle$ does not compete with $\langle [ROOT]-[FEM]-[PL], \text{peto}-[FEM]-[PL], \text{peto-za}-[PL] \rangle$ or $\langle [ROOT]-[FEM]-[PL], \text{peto}-[FEM]-[PL], \text{peto-xof}-[PL] \rangle$ for Local Optimality. What this means is that both the chain $\langle [ROOT]-[FEM]-[PL], \text{patka}-[FEM]-[PL] \rangle$, where no plural morph is inserted, and the most harmonic of the two chains which do insert a plural allomorph both make it into the candidate set and both could potentially be extended by spelling out plural marker. Hence, our final candidate set will include both of the following chains:

(28)

a. <[ROOT]-[FEM]-[PL], peto-[FEM]-[PL], peto-[FEM]-u>

b. <[ROOT]-[FEM]-[PL], peto-[FEM]-[PL], peto-za-[PL], peto-za-u>

Because both of these are members of the final candidate set, it's entirely possible that the grammar could elect not to spell out the feminine morpheme at all (i.e. select (28)a as the winner) because of some marked property of the juncture between the feminine marker and the more-peripheral plural marker (i.e., because some constraint were violated in (28)b but not in (28)a). Thus, while Local Optimality makes it impossible for the choice of which allomorph of the feminine is used to make reference to the phonological shape of the plural suffix, the choice of whether or not to spell out the feminine morpheme at all *could* make reference to the phonological shape of the plural marker.

Such lookahead effects in the choice of some morph vs. no morph are indeed arguably attested. We'll now consider several examples. The first involves English *-ful* suffixation (Brown 1958, Chapin 1970, Siegel 1974). The adjective-forming suffix *-ful* normally attaches to bases which are nouns, but not to verbs:

- (29) *agreeful
*disturbful
*seizeful
*preventful
*admitful

Siegel (1974) identifies a number of exceptions where *-ful* is found with a verb or adjective, and where the suffixation of *-ful* to a nominalization of the same verb or adjective would be ill-formed:

- (30) resentful (*resentmentful)
 forgetful (*forgettingful)
 mournful (*mourningful)
 inventful (*inventionful)
 heedful (*heedingful)
 bodeful (*bodeingful)
 wakeful (*wakingful)
 wearyful (*wearynessful)

Siegel (1974) proposes to explain these exceptions in terms of the prosodic subcategorization behavior of *-ful*: the suffix generally appears only following a stressed syllable.⁶⁸ In all of the cases in (30), the observed verbal base has final stress, but the corresponding nominalization of the verb does not.

In OI terms, we can treat this phenomenon as involving the omission of the morphosyntactically expected nominalizing affix for the sake of satisfying the subcategorization requirements of the subsequent suffix *-ful*. That is, the choice of whether or not to spell out the nominalizer morpheme looks ahead to the fact that *-ful* will subsequently be inserted.

I'll illustrate this line of analysis using the example of *wakeful*. Since, for morphosyntactic reasons, *-ful* only attaches to noun bases, I'll assume that *wakeful* has the following abstract structure:

- (31) [[[√WAKE] N] A]

⁶⁸ There are (as Siegel 1974: 172 notes) a small number of *-ful* adjectives whose bases don't have final stress. Most of these end in orthographic *-y*, which is generally pronounced [ɪ] when preceding a suffix: Siegel lists *fanciful*, *merciful*, *wearyful*, *pitiful*, *plentiful*, *bountiful*, *beautiful*, and *dutiful*. It's unsurprising that these final vowels don't count towards determining whether a base has final stress, as they are omitted from consideration for purposes of the subcategorizational requirements of other English affixes. For instance, comparative *-er* can only attach to bases that are monosyllabic (**intelligenter*, **obtuser*, **violeter*) or which have one syllable plus a second headed by *-y* (*happier*, *wearier*, *fancier*, *greasier*, *messier*, etc.).

Following Marantz (2001), Arad (2005), and related work, I'm assuming here that root morphemes⁶⁹ have no inherent part-of-speech category, and only become nouns, verbs, adjectives, or whatever by combining with a category-endowing head. The affix *-ful* is an adjectivizer, so it must spell out an *A* head. However, the morphosyntactic requirements of this particular suffix are such that it has to attach to a noun. If the sister of the *A* head is a noun, then this sister constituent must contain a nominalizer head *N*, as depicted in (31).

With (31) as our input, the following two chains can be considered:

- (32) a. < $\sqrt{\text{WAKE-N-A}}$, *weik-N-A*, *wéik-N-A*, *wéik-N-ful*>
 b. < $\sqrt{\text{WAKE-N-A}}$, *weik-N-A*, *wéik-N-A*, *wéikɪŋ-A*, *wéikɪŋful*>

Both of these chains will be valid, Locally Optimal continuations of the subchain < $\sqrt{\text{WAKE-N-A}}$, *weik-N-A*, *wéik-N-A*> provided we assume that all of the ways of spelling out a given morpheme compete for Local Optimality. (This is essential, since it allows for *-ful*-insertion and *-ing*-insertion to both be kept alive as options.) In chain (32)a, the root morph *wake* is inserted first; then final stress is assigned to it, and finally the adjectivizer morph *-ful* is inserted. Chain (32)b is identical except that the nominalizer morph *-ing* is inserted prior to the insertion of *-ful*. I will assume that candidates with other combinations of spelled-out vs. non spelled-out morphemes (e.g. inserting neither *-ing* nor *-ful*) are ruled out by undominated constraints demanding the spellout of the root and of the adjectivizer.

⁶⁹ However, I'll still assume that root *morphs* can have an inherent part-of-speech category. This will occur when a morph's FSes include features both of the root morpheme and of a nominalizing (or verbalizing, or adjectivizing...) head.

Assuming, then, that all options besides (32)a-b are ruled out by other constraints, (32)a will win under the following ranking:

(33)

//√WAKE-N-A//	*LAPSE	MAX-M(nominalizer)
a. we wéik.fəl (=(32)a)		1
b. wéi.kiŋ.fəl (=(32)b)	W ₁	L

Candidate (b), *wakingful*, spells out all three of the morphemes making up the word, but does so at the expense of having *-ful* appear immediately to the right of an unstressed syllable. This violates the constraint *LAPSE (Selkirk 1984, Ishii 1996, Elenbaas 1999, Elenbaas & Kager 1999), which penalizes sequences of consecutive unstressed syllables like [kiŋ.fəl]. Candidate (a) satisfies *LAPSE by virtue of omitting the nominalizer morph *-tion*, thereby allowing unstressed *-ful* to be adjacent to a stressed syllable. This violates MAX-M(nominalizer), which demands that the nominalizer morpheme be spelled out. If MAX-M(nominalizer) ranks below *LAPSE, then (a) will win, as shown.

Under this analysis of the generalization in Siegel (1974), the decision about whether or not to insert the nominalizer morph *-ing* is made with reference to prosodic configurations (i.e., stress lapse) which would arise only under the insertion of the more peripheral morph *-ful*. The decision of whether to use *any* morph to spell out a given morpheme thus can look ahead to the phonological attributes of further-out morphs, even though the decision of *which* morph to use on an inner morpheme cannot look ahead in this way.

A second possible example of outwards-looking omission of an affix is found in Italian. Certain verbs, such as *fin-* ‘finish’ feature a stressed variant ending in *-ísc* before unstressed suffixes (Paster 2006):⁷⁰

<i>finísco</i>	‘I finish’	<i>finiámo</i>	‘we finish’
<i>finísci</i>	‘you.SG finish’	<i>finíte</i>	‘you.PL finish’
<i>finísce</i>	‘he/she/it finishes’	<i>finíscono</i>	‘they finish’

Table 3.2. Present tense paradigm of Italian ‘to finish’

If the *-ísc* is viewed as part of the root, then these verbs would have to have two root allomorphs which alternated suppletively based on the phonological shape of a following suffix. All affixes are peripheral to the root, so this allomorphy system would involve lookahead. However, there is a way to avoid having to treat paradigms like the one in Table 3.2 as a counter-example to the no-lookahead prediction. Specifically, we can assume that *-ísc* is not part of the root but is instead a morph unto itself (in this regard following Di Fabio 1990, Schwarze 1999).⁷¹ As just saw with English *-ful*, the decision to omit an affix *can* look ahead, and so if *-ísc* is an affix, it could be omitted under conditions which looked ahead to the stressed vs. unstressed status of following affixes.

If we look above the word level, the examples discussed in Chapter 2 of plural /s/ omission in Northeast Central Catalan and of focus-particle /fa/ omission in Hausa will be seen to also fall into the same category as *-ful* and *-isc-*. If—as Lexical Phonology assumes—the morphological construction of words is performed prior to the junctural assemblage of separate words, it shouldn’t be possible for the choice of whether or not

⁷⁰ Other verbs that pattern this way include *mentire* ‘to lie’, *diluire* ‘to dilute’, *diminuire* ‘to diminish’, and *ammonire* ‘to admonish’.

⁷¹ As *-ísc* does not correspond to any identifiable meaning, and there is no clear set of semantic or syntactic properties that pick out the roots that take *-ísc*, it presumably serves to spell out a diacritic declension-class feature borne by these roots.

to include a morph to know anything about the phonological properties of neighboring words. This prediction is falsified by the Catalan and Hausa data. OI, on the other hand, can easily accommodate them, in a manner exactly analogous to that invoked above for *-ful*.

In all of the examples we've just considered, a morph whose presence was expected on morphosyntactic grounds is omitted in a way that looks ahead to subsequent phonological conditions. It is natural to ask whether it would be possible in OI to obtain the inverse situation, in which a morph whose presence is otherwise unexpected is inserted for ahead-looking phonological reasons. I will now show that this scenario cannot arise. To illustrate what's predicted to be impossible and why, we can consider an example from Western Armenian (Vaux 2003; see also Burzio 2007) which appears to be of the disallowed type. The phenomenon in question involves formation of nouns with plural possessors. In nouns with *singular* possessors, the noun consists of the root, followed by a plural suffix (if the possessed item is plural), followed by an enclitic which marks the person of the possessor. This can be seen in the following table from Vaux (2003: 113):

	'cow'	'cows'	'cat'	'cats'
<i>unpossessed form</i>	gov	gov	gadu	gadu-nər
'my X'	gov-əs	gov-ər-əs	gadu-s	gadu-nər-əs
'your (sg.) X'	gov-ət ^h	gov-ər-ət ^h	gadu-t ^h	gadu-nər-ət ^h
'his/her/its X'	gov-ə	gov-ər-ə	gadu-n	gadu-nər-ə

Table 3.3. Paradigms of Western Armenian nouns with singular possessors

Vaux (2003) suggests that the 1st, 2nd, and 3rd person possessive clitics are, respectively, /s/, /t^h/, and /n/. In the case of [gov-ə] and [gov-ər-ə], he argues that the /n/ of the clitic triggers schwa epenthesis to avoid forming a cluster with the preceding consonant, and then deletes.

There are two ways to form nouns with plural possessors. The one relevant to our concerns involves adding a plural-possessor morph /ni/ to the forms in (36). This appears immediately to the left of the person marker. Curiously, when the noun root is monosyllabic, the plural marker /ər/ is apparently added between the root and /ni/, even when the possessed noun is singular. As a result, the singular vs. plural forms of the same monosyllabic noun are identical when the noun has a plural possessor:

	'cow'	'cows'	'cat'	'cats'
<i>unpossessed form</i>	gov	gov	gadu	gadu-nər
'our X'	gov-ər-nis	gov-ər-nis	gadu-ni-s	gadu-nər-ni-s
'your (pl.) X'	gov-ər-ni-t ^h	gov-ər-ni-t ^h	gadu-ni-t ^h	gadu-nər-ni-t ^h
'their X'	gov-ər-ni-n	gov-ər-ni-n	gadu-ni-n	gadu-nər-ni-n

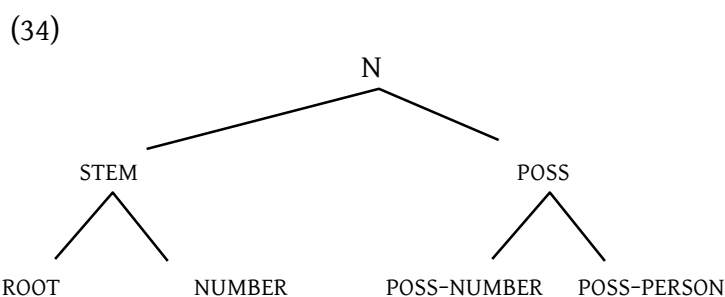
Table 3.4. Paradigms of Western Armenian nouns with plural possessors

Vaux (2003) proposes to explain this fact by assuming that /ni/ has a prosodic subcategorization requirement to the effect that it must attach to a greater-than-monosyllabic base. This requirement would be violated were /ni/ to be attached directly to a monosyllabic noun base like /gov/ 'cow'. That potential violation is avoided by adding the plural suffix /ər/ to monosyllabic roots, even when the noun is morphosyntactically singular.

If we were to assume that Western Armenian had no singular morph at all (as opposed to a singular morph which is phonologically null), then these facts would seem to present exactly the inverse of the English *-ful* data. Normally, it appears, singular

morphemes in Western Armenian are not spelled out with any morph, but in possessives with /ni/, the plural /əɾ/ is recruited to spell out the singular morph and thereby satisfy /ni/’s prosodic subcategorization requirement.

Assuming that this is what is going on, one might imagine that it would be straightforward to give an analysis of the Armenian data along the same lines of the one we gave for English. It turns out, however, that we can’t. Let’s examine why. We can assume, with Vaux (2003) that possessed nouns in Armenian have the following morphosyntactic structure:



To simplify the range of possible chains we need to examine, I’ll assume that POSS-NUMBER (the number of the possessor) must be spelled out before POSS-PERSON (the person of the possessor) is.

Consider now the word [gov-əɾ-ni-n] ‘their cow’. Here, the chains of interest would be the following:


- (35)
- a. <ROOT-SG-POSS.PL-POSS.3P, gov-SG-POSS.PL-POSS.3P, gov-əɾ-POSS.PL-POSS.3P, gov-əɾ-ni-POSS.3P, gov-əɾ-ni-n>
 - b. <ROOT-SG-POSS.PL-POSS.3P, gov-SG-POSS.PL-POSS.3P, gov-SG-ni -POSS.3P, gov-SG-ni-n>

In chain (35)a, the root is inserted first, and then the plural suffix /əɾ/ is inserted in correspondence with the underlying SINGULAR morpheme. After that, the possessive-

plural morph /ni/ and lastly the 3rd-person possessive morph /n/ are inserted. Chain (35)b is identical, except that the LUM of inserting /əɾ/ onto the SINGULAR morpheme does not occur.

Obviously, we need (35)a to be a valid chain, since it's the one that terminates in the attested surface form. The LUM of inserting /əɾ/, which has plural features, onto the morpheme SINGULAR, which lacks such features, bears remarking on. This LUM creates a violation of the constraint DEP-M(-singular). In order for it to be harmonically improving, then, DEP-M(-singular) must be dominated by MAX-M(FS), which wants the morpheme SINGULAR to have some morph to correspond to, irrespective of any mismatches in their featural content:

(36) *Ranking to ensure harmonic improvement of /əɾ/-insertion with singulars*

FS ₁ +SINGULAR ₂	MAX-M(FS)	DEP-M(-singular)
a.  FS ₁ -SINGULAR əɾ		1
b. ∅ (i.e., no morph)	W ₁	L

It is at this point that our attempt to analyze Western Armenian as a “reverse-ful” lookahead system falls apart. The problem is that the ranking just adduced means that /əɾ/ would *always* be used to spell out singular morphemes, since giving the morpheme a correspondent morph would take priority over avoiding number mismatches. Clearly this is wrong, since /əɾ/ appears with singulars only in plural-possessor words formed with /ni/.

How are we to analyze the Western Armenian data in OI, then? Perhaps the easiest solution would be to simply assume that there are two plural-of-possessor

morphs: /əɾni/, which is used with monosyllabic bases, and /ni/, which is used with longer bases. This reinterpretation of the morphological affiliation of the /əɾ/ sequence seen in singulars results in the allomorphy system being entirely inward-looking, and thus unproblematic.

The reason that we couldn't analyze the Armenian data in the same way we handled the English *-ful* facts is simply that the operation that we needed to look ahead can't be harmonically improving. If a language normally chooses to use no morph at all instead of some alternative morph, then that can only be because adding the morph doesn't improve harmony. If it doesn't, then the morph can't 'reappear' in a context which is defined in a forward-looking way. That's because this would require there to be chains where the morph is inserted, and such chains can't exist if inserting the morph isn't harmonically improving at the point of insertion.

To sum up, then: our assumption that the choice of which morph to associate with a given morpheme is subject to Local Optimality therefore derives the general lack of look-ahead in PCSA, while also permitting one very specific kind of lookahead. Allowing this exception gives the OI approach to no-lookahead an empirical advantage over Lexical Phonology approaches like that advocated by Paster (2005, 2006, to appear) and the cyclic Distributed Morphology model of Bobaljik (2000). The OI approach enjoys a conceptual advantage as well: PCSA remains something that happens in the phonology and is governed (at least in part) by phonological constraints. This stands in sharp contrast with subcategorization approaches, where the phonological generalizations governing allomorph choice are excised from the phonology, even though this means that the morphology and the phonology, as separate components of

the grammar, will in many languages be redundantly enforcing overlapping sets of phonotactic constraints (as in the Kɔnni example that we considered in chapter 2).

3.4.4 ‘Epenthetic’ morphs can look ahead

If morph insertion is an operation available to the phonology, then—as I argued in Chapter 2 in relation to Pitjantjatjara /pa/-augmentation—morphs can be inserted for strictly phonological reasons as an alternative to epenthesis. Dummy morphs inserted in this fashion need not actually correspond to any morpheme: inserting a morph which corresponds to no morpheme violates DEP-M(FS), but that constraint could well be violated if it ranks below the phonological constraints which favor the presence of the ‘epenthetic’ morph.

If an ‘epenthetic’ morph corresponds to no morph, then it can in principle be inserted at any point in a chain. If root-outwards spellout is assumed, then less-peripheral morphemes must be spelled out before more-peripheral ones. However, this imposes no condition on the point in the derivation that ‘epenthetic’ morphs can be inserted, since these morphs bear no relation to the morphosyntactic tree. Therefore, it’s entirely possible for two affixal morphemes to be spelled out, and then for an ‘epenthetic’ morph to be inserted in between the two affix morphs. Consequently, if we countenance the possibility of dummy morphs that violate DEP-M(FS), it’s entirely possible for such a morph to ‘look ahead’ in the sense that its presence or absence is sensitive to phonological conditions on both sides. While clear cases of ‘epenthesis’ of morphs are not abundant, this prediction does seem to be correct. For instance, the apparent epenthetic [ɣ] of Icelandic serves to break up clusters of a stem-final

consonant and a following affixal [r] (de Lacy 2002: §4.4.1.4). In general, any ‘epenthetic’ morph whose phonological function is to break up clusters of segments that (at least in some cases) belong to different morphs would also support the prediction that ‘epenthetic’ morphs are not constrained to look exclusively inward in deciding whether or not to appear.

3.5 OI without stipulated root-outwards spellout

3.5.1 Introduction

As was emphasized above in section 3.3, the usual assumption that morphology is added to words in a monotonically root-outwards fashion is a stipulation for most models that include that assumption, for instance Lexical Phonology. If coupled with a similar stipulation, OI theory is able to derive the same no-lookahead predictions as Lexical Phonology, with the one (attested) exception that ‘something vs. nothing’ choices can look ahead. Thus, OI with a root-outwards-spellout stipulation demonstrably fares better than Lexical Phonology as regards the possibility of lookahead in allomorphy.

In the interest of eliminating stipulations from linguistic theory, it is worth also considering the predictions of a version of OI in which the order of morph insertion was in principle free. In such a version, it would be typologically possible for a more-peripheral morpheme to be spelled out before a less-peripheral one. Clearly, in this case, it’s predicted that PCSA of the inner morpheme could be sensitive to the phonological properties of the outer morpheme. Abandoning root-outwards spellout therefore requires us to countenance the possibility of this type of lookahead.

However, OI without root-outwards spellout would still predict the impossibility of the other type of lookahead. Owing to Local Optimality, the single most harmonic way of spelling out a given morpheme will be chosen before the chosen morph (or any of its competitors) has a chance to trigger any phonological processes. Therefore, phonology which would be conditioned by any of the competing morphs will remain incapable of altering morph choice. As such, even if root-outwards spellout is abandoned, OI still predicts that PCSA will be universally opaque with respect to phonological processes that one or more of the competing allomorphs serve to condition. OI therefore remains both restrictive as well as empirically superior to classic OT, which, as we saw earlier, predicts incorrectly that PCSA should be universally transparent with respect to phonology conditioned by the competing morphs.

3.5.1.1 Excursus: Additional motivations for abandoning root-outwards spellout

While the discussion that follows will focus on considerations of allomorphy and lookahead, there are some other motivations for entertaining the abandonment of root-outward spellout as an inviolable requirement. The main one is bracketing paradoxes. In a bracketing paradox, there is phonological evidence (from cyclic rule application, phonological subcategorization requirements, etc.) that affixes are added in one order, while morphosyntactic evidence (scope, lexical-category selection requirements, etc.) indicates that their relative degrees of structural nestedness are different. For example, in Indonesian (Cohn 1989), [root + suffix] units form domains for

cyclic application of the stress rules. Prefixes are treated as being outside the stress domain, seemingly indicating that they are added after all of the suffixes, even though morphosyntactically, prefixes are bracketed more deeply than suffixes:

(37) [[[prefix [root]] suffix] suffix].

Similar examples of paradoxical bracketings between prefixes and suffixes are reported by Pesetseky (1985) in English and Russian, Booij & Rubach (1984) in Polish, and Chelliah (1992) in Manipuri.

Bracketing paradoxes involving a prefix and a suffix can be given a representational solution (Booij & Rubach 1984, Cohn 1989, Chelliah 1992). For Indonesian, we could assume that the root and suffixes were parsed into one Prosodic Word domain, that the prefixes were parsed into a separate PWD, and that the stress rules apply within the domain of the PWD. However, it's not clear that a strategy of this sort would let us explain away all bracketing paradoxes. While it has been claimed that bracketing paradoxes *only* ever occur between prefixes and suffixes (Strauss 1982b), there is also evidence for paradoxical orderings between two suffixes. An example is found in Portuguese (Ranier 1995, Benua 1997) where phonological processes conditioned at the juncture of the root and the plural suffix are carried over to words of the form [[[root] diminutive] plural]:

cão	'dog'	cães	'dog-PL'
cãozinho	'dog-DIMINUTIVE'	cãezinhos	'dog-DIM-PL'
flor	'flower'	flores	'flower-PL'
florzinha	'flower-DIMINUTIVE'	florezinhas	'flower-DIM-PL'

Table 3.5. Portuguese plural/diminutive paradigms

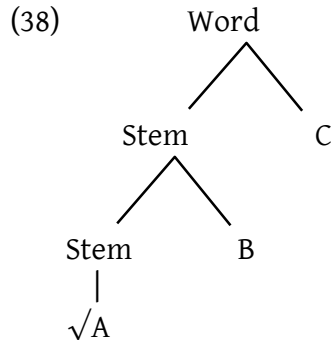
In the paradigm of ‘dog’, the plural suffix *-(e)s* causes the root-final [o] to either delete or assimilate to [e]. In the diminutive plural, the [ã] of the root is followed by [e] rather than [o], even though the plural marker is not adjacent to the root on the surface. Likewise, in the paradigm of ‘flower’, the [e] of the plural marker surfaces in [flores], and this same vowel is carried over in the diminutive plural, despite the fact that, as seen in the singular diminutive [florzinha], [rz] is a permissible intervocalic cluster. These facts suggest that the plural suffix is inserted before the diminutive suffix, even though the surface order of the morphs is the opposite. Given the strong cross-linguistic tendency for ‘derivational’ morphology like diminutives to occur inside ‘inflectional’ morphology like number, it seems reasonable to assume that the morphosyntactic bracketing of Portuguese words is [[[root] diminutive] plural] and not [[[root] plural] diminutive], and that the suffixes are added in an anti-cyclic fashion.⁷²

3.5.2 Deriving a violable reference for root-outwards spellout

In section 3.4, where root-outwards spellout was taken as a stipulated primitive of the grammar, I assumed that all the different ways of spelling out a given morpheme compete against one another for Local Optimality. In the present subsection, I’ll show that we can derive a violable preference for root-outwards spellout given the assumption that all of the ways of spelling out *any* of the morphemes in the tree compete for Local Optimality.

⁷² An apparently similar example is found in the Bantu language Cibemba (Hyman 1994, 2002, Benua 1997, Hyman & Orgun 2005). The causative marker [i] triggers spirantization of root-final consonants, even in applicative words, where the applicative marker always intervenes between the root and the causative. However, if we assume that the applicative marker is an infix, a derivation where the applicative is inserted after the causative is only anti-cyclic if the causative has scope over the applicative. According to Hyman & Orgun (2005), the causativized applicative structure is unproductive, which may serve to dampen the probative value of the Cibemba example *vis à vis* bracketing paradoxes.

Consider the following tree:



If all the ways of spelling out any of the terminal morphemes A, B, and C compete against one another for Local Optimality, then we can get the root A to be spelled out first if spelling it out confers a greater degree of harmonic improvement than spelling B or C out. One way to do this would be to redefine the constraint MAX-M(FS) so that it assigns more violation-marks to an morpheme lacking a corresponding morph, the deeper that morpheme is in the tree:

(39) MAX-M(FS)

For every FS x at the morpheme level that lacks a correspondent at the morph level:

Assign a violation-mark for every nonterminal node that dominates x .

Prior to the insertion of any morphs, the tree in (38) gets six violations from the reformulated version of MAX-M(FS) in (39): three violations for the two ‘Stem’ nodes and the one ‘Word’ node that dominate A; two violations for the ‘Stem’ and ‘Word’ nodes that dominate B; and one violation for the ‘Word’ node that dominates C. If MAX-M(FS) is top-ranked, then spelling out A will be locally optimal relative to spelling out B or C. That’s because giving A a correspondent morph removes three violations of MAX-M(FS), whereas giving B a correspondent removes only two violations and giving C a correspondent removes only one:

(40) *Determination of locally-optimal way of inserting a morph onto tree (38)*

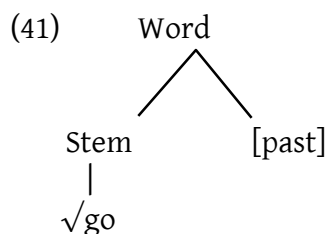
$\langle \sqrt{A-B-C}, \dots \rangle$	MAX-M(FS)
$\langle \dots, A-B-C \rangle$	₃
$\langle \dots, \sqrt{A-B-C} \rangle$	W_4
$\langle \dots, \sqrt{A-B-C} \rangle$	W_5

Likewise, after A is spelled out, spelling out B next will be locally optimal with respect to spelling out C. In general, if MAX-M(FS) is top-ranked, the locally optimal spellout operation to perform at any given point in chain construction will be to spell out the least-peripheral morpheme that hasn't been spelled out so far—because spelling out that morpheme removes the most violations of MAX-M(FS). Of course, MAX-M(FS) will not always be the top-ranked constraint, so sometimes the locally optimal morpheme to spell out will not be the least-peripheral one that lacks a correspondent. The proposal here thus furnishes a way to drive root-outwards spellout, without stipulating it as an inviolable universal.

Two last remarks about this proposal. First, in (38), in order for leaving the root A without a correspondent to get more marks than leaving the least-peripheral affix B without a correspondent, it was necessary to assume that the root to be dominated by a nonbranching node, which I've labelled 'Stem' in (38). Assuming this to be a universal property of roots might not be entirely unreasonable, on the theory that roots lack any intrinsic syntactic properties (see e.g. Zhang 2007, Acquaviva 2008). If the things that roots do contain are not objects of the sort that syntax can manipulate, we can speculatively imagine that roots must come 'pre-packaged' inside a non-branching node to enable them to interact with the syntax.

Second, this proposal to derive the root-outwards spellout preference using Local Optimality has a second advantage in explaining why using a portmanteau morph

to spell out two heads should best the use of two separate morphs to spell out those heads. For example, consider the past tense of English *go*, which is a single morph *went* and not the two-morph form *go-ed*. The input for this word would be a tree like the following:



Prior to any morph-insertion being done, the bare tree gets three violation-marks: two because the root morpheme \sqrt{go} is dominated by two nonterminals, and one because the $[past]$ morpheme is dominated by one nonterminal.

There are three relevant ways of inserting morphs onto the bare tree that compete for Local Optimality:

(42) *Use of portmanteau is Locally Optimal per MAX-M(FS)*

$\langle \sqrt{go}_1 - [past]_2, \dots \rangle$	MAX-M(FS)
a. $\langle \dots, went_{1,2} \rangle$	
b. $\langle \dots, go_{1,2} - [past]_2 \rangle$	W_1
c. $\langle \dots, \sqrt{go}_1 - d_2 \rangle$	W_2

Option (42)a is to insert the morph $\{\{\sqrt{go}, [past]\}, went\}$ and to place it in correspondence with both of the morphemes. The resulting structure gets zero violations of MAX-M(FS) (under either the modified definition in (39) or the original definition in Chapter 2), because both of the morphemes now have a corresponding morph. The competing options (42)b-c are to insert either *go* or *-d*, but these both result in structures that have some violations of MAX-M(FS), because each leaves one of the morphemes without a correspondent. If MAX-M(FS) is top-ranked, then, it will be

Locally Optimal to use the portmanteau, because spelling out more than one morpheme in a single step confers a greater degree of improved performance on MAX-M(FS).

Thus, if we assume that all possible ways of inserting a single morph anywhere on the tree compete for Local Optimality, the preference for portmanteaux over multi-morph spellouts can be driven by the same MAX-M(FS) constraint which is needed anyway to make spellout occur at all. As such, OI can do without economy-enforcing markedness constraints which either give a mark for every morph used (Teeple 2006) or for every word that contains more than one morph (Grimshaw 1997a, Kiparsky 2005).⁷³ It likewise has no need of a principle which states that listed single-morph expressions block the assembly of multi-word constructions simply in virtue of existing (Giegerich 2001, Williams 2007, cf. Embick & Marantz 2008). This result complements the one from Chapter 2 about deriving economy of competing allomorphs from phonological markedness, and is in keeping with other work (Trommer 2001, Gouskova 2003, Grimshaw 2003) arguing that economy effects can and should in OT be derived from the effect of more general constraints, rather than posited as constraints in their own right.

3.5.3 Outwards-sensitive PCSA

If root-outwards spellout is driven by a violable constraint like (39), then we expect there to be languages in which the first morpheme to be spelled out is not the most embedded one. In such a language, some constraint favoring the spellout of the less-embedded morpheme must dominate (39). If it's possible for a more-peripheral

⁷³ See also Siddiqi (2006) for a proposed 'minimize exponence' principle in the context of rule-based DM.

morpheme to be spelled out before a less peripheral one, then it's possible for allomorphy of the less peripheral morpheme to be sensitive to the phonological properties of the morph that spells out the more peripheral morpheme. In this section, I'll review attested cases of allomorphy which have been argued to have this outward-looking character.

3.5.3.1 Roots

Except in compounds (where there's more than one root), the root will be the most-embedded morpheme in any word. Therefore, if a root exhibits PCSA, this allomorphy is by definition outward-looking, since any morph which could contribute to the phonological conditioning environment for the suppletion would be more peripheral than the root itself. Several possible cases of root PCSA have been argued for.

Several verbs in Italian exhibit a suppletive alternation conditioned by the (un)stressedness of the following inflectional ending—thus paralleling the pattern seen with the *-isc-* verbs discussed earlier. In three of the verbs in question, the relevant alternation occurs in the preterit (Carstairs 1990). For instance *rompere* 'to break' appears as *rupp-* when stressed, and as *romp-* when unstressed:

1sg. rупpi	1pl. rompemmo
2sg. rompesti	2pl. rompeste
3sg. ruppe	3pl. ruppero

Table 3.6. Present-tense paradigm of Italian *rompere*

The same pattern is followed in the preterit by *muovere* ‘to move’ (*moss-* when stressed, *m(u)ov-* when unstressed) and *prendere* ‘to take’ (*pres-* when stressed, *prend-* when unstressed).

Italian also shows stress-based root allomorphy in the paradigms of *andare* ‘to go’ (Hurch 1994, Kiparsky 1994, Burzio 2003) and *uscire* ‘to go out, to exit’ (Hurch 1994):

vád-o	‘I go’	and-iámo	‘we go’
vá-i	‘you.SG go’	and-áte	‘you.PL go’
vá	‘he/she/it goes’	ván-no	‘they go’
ésc-o	‘I go out’	usc-iámo	‘we go out’
ésc-i	‘you.SG go out’	usc-íte	‘you.PL go out’
ésc-e	‘he/she/it goes out’	ésc-ondo	‘they go out’

Table 3.7. Present-tense paradigms of Italian *andare* and *uscire*

In the paradigm of ‘to go’, the root is spelled out as [va-] when it carries stress, but as [and-] when the inflectional ending carries stress. Likewise, the root meaning ‘to go out’ is spelled out as [esc-] when it gets stress, but as [usc-] when the suffix gets stress.

At least two possible examples of phonologically-conditioned root allomorphy have been argued to occur in English. The first involves the suffix *-en*, which is used to verbalize adjectives. Siegel (1974) notes that there are two phonological conditions on *-en* suffixation: the suffix can only attach to bases which are monosyllabic ((43)a) and which end in an obstruent ((43)b):

- (43) a. whiten *but* *violeten
 smarten *but* *intelligenten
 darken *but* *opaquen
- b. red *but* *greenen
 sharpen *but* *dullen
 shorten *but* *tallen

While *-en* normally attaches only to adjectives, Siegel (1974) notes that it is possible for a nominal root to serve as the base for *-en*, if the related adjectival root would be ineligible for *-en*-suffixation by virtue of being polysyllabic or sonorant-final:

- (44) a. frighten *afraiden
 b. lengthen *longen
 heighten *highen
 strengthen *strongen

That is, the choice of which morph to spell out the root morpheme with depends on the phonological subcategorization requirements of the affix *-en*. This example is doubly interesting because the root morph chosen fails to match the lexical-category features of the morpheme that it spells out.

The other possible example of outward-looking allomorphy in English is cited by Kiparsky (1994). The root meaning ‘think’ appears usually as [θɪŋk], both in isolation and in affixed forms (*thinks, thinking, thinker, etc.*). The exception is before the past tense, perfect participle, and nominalizer suffixes with the shape [-t], where the root appears as [θɔ-], yielding *thought*.

Beyond these examples, another potential source of root-PCSA examples involves roots which seem to exceptionally undergo an alternation that’s not productive in the language generally (Hudson 1974, Mascaró 2007, Kager to appear). For example, a closed class of roots in Dutch appear to undergo exceptional lengthening of a root vowel when that vowel’s syllable is opened by a V-initial suffix like plural *-es*:

- (45)
- | | | | |
|---------|---------|------------|-----------|
| gl[a]s | ‘glass’ | gl[a:]zen | ‘glasses’ |
| sl[ɔ]t | ‘lock’ | sl[o:]ten | ‘locks’ |
| w[ɛ]g | ‘road’ | w[e:]gen | ‘roads’ |
| sch[ɪ]p | ‘ship’ | sch[e:]pen | ‘ships’ |

Because there is no general process of open-syllable lengthening or closed-syllable shortening in the language, Kager (to appear) proposes that the alternating roots have two listed allomorphs, one with a short vowel and one with a long vowel. The former is chosen when the root vowel would fall in a closed syllable, and the latter when it would fall in an open syllable. Since the open vs. closed status of that syllable depends on the phonological shape of the following suffix (if there is one), this would represent a case of root PCSA conditioned by affixes. Obviously, this particular source of outwards-looking-PCSA examples will not go through if we accept a different theory of exceptionality, e.g. one based on indexed markedness constraints (Pater to appear), input underspecification (Inkelas, Orgun & Zoll 1995) or cophonologies (Anttila 2002).⁷⁴ Nevertheless, the lack of a sharp dividing line between listed allomorphy and ‘minor rules’ means that unproductive alternations generally represent a potential source of additional cases of outwards-looking PCSA.

3.5.3.2 Affixes

At least one possible case of outwards-looking affix PCSA has been reported. In the Southern Zaria dialect of Fulfulde (Carstairs 1987: 186-188), the Habitual Imperative Singular marker has two allomorphs: /-ataj-/, which is found word-finally and before a following C-initial object marker, and /-at-/, which is found before the V-initial 1st person singular object marker:

⁷⁴ See, among others, Becker (2008), Kager (to appear) and Pater (to appear) for critiques of the underspecification approach, and Pater (to appear) for a critique of cophonologies.

(46)	dogg-ataj	'keep on running!'
	wall-ataj-6e	'keep on helping them!'
	wall-ataj-min	'keep on helping us!'
	wall-ataj-mo	'keep on helping him!'
	wall-at-am	'keep on helping me!'

However, as the 1st person singular /am/ is the only V-initial object maker which can occur with the Habitual Imperative Singular, it's not necessarily clear that the /-at/~ /-ataj/ allomorphy is conditioned by the phonological shape of this object morph, or by the morphosyntactic context of 1st person singular features.

One possible piece of evidence that the allomorphy is phonological is mentioned by Carstairs (1987: 205-206). In the Gombe dialect of Fulfulde, the 1st person singular marker is /-jam/ rather than /-am/, and in this dialect the Habitual Imperative Singular is consistently /-ataj-/. For this pair of dialects at least, there is then a correlation between the V-initial vs. C-initial status of the 1st person singular affix, and the existence vs. nonexistence of a special allomorph of the Habitual Imperative Singular before this suffix. If these two properties track each other across all or a consistent subset of Fulfulde dialects, then it may be reasonable to assume that the context for the /-at-/ allomorph is (or perhaps at an earlier diachronic stage, was) defined phonologically rather than morphosyntactically.

3.6 Lookahead to phonological effects: possible examples

As mentioned earlier, even if OI allows morphs to be inserted in any order, it will still be impossible for morph choice to make reference to the outcome of phonological processes that would be conditioned by one of the competing morphs.

This is because, due to Local Optimality, a single choice of morph will be made before any of the phonological processes conditioned by the morphs could be performed.

The correctness of this prediction is particularly important for OI, because it follows directly from the assumption that morph insertion is subject to Local Optimality. As we saw earlier in the discussion of Polish, OI *has* to assume this in order to be able to analyze cases of opaque allomorph selection. Any evidence that morph choice can look ahead to the morphs' phonological effects would directly challenge that assumption, and in turn undermine OI's descriptive adequacy as a theory of allomorphy and of phonology/morphology opacity.

Only a few possible cases are known to me in which allomorph choice appears to be transparent with respect to a segmental process conditioned by one of the allomorphs. The first and most potentially worrisome one involves the negative enclitic in Urban East Norwegian (Christensen 1985, Fretheim 1988, Kristoffersen 2000, Bradley 2007). This clitic varies optionally between two forms [-ke] and [-ike]. Use of the [-ke] form is only possible if the base underlyingly ends in a non-schwa vowel or /r/. The theoretically interesting twist is that, for [ke]-use to be well-formed, a preceding stem-final flap must delete:

- (47)
'dare' [tœr]
'dare not' [tœr.ri.ke] ~ [tœk.ke], *[tœr.ke]

Norwegian has a variable process of flap-deletion before noncoronal consonants across morph boundaries, so the [ke]~[ike] allomorphy can be thought of as instantiating lookahead (Kristoffersen 2000, Bradley 2007): whether /-ke/ use is permissible depends

on whether or not the grammar subsequently elects to apply the optional flap deletion rule whose application /ke/-use creates the environment for.

A non-lookahead-based account, however, presents itself if we consider another restriction on [ke]. If [ke] is attached to a base with a long vowel, the preceding vowel will shorten: [se:] ‘look!’, [sek.ke], *[se:.ke] ‘don’t look!’. The two processes associated with [ke]—flap deletion and vowel shortening—together ‘conspire to secure that at the surface level, the clitic is always immediately preceded by a short vowel’ (Kristoffersen 2000: 336).

For purposes of illustration, we can assume that this restriction on what [ke] can be found following results from the [ke] morph being indexed to the following alignment constraint:⁷⁵

- (48)
ALIGN(ke, L, short, R)
The left edge of [ke] must coincide with the right edge of a short vowel.

I will assume that, in light of the stylistic variation between [ke] and [ike], speakers may elect to use either one when spelling out a NEG morpheme. We may imagine that stylistic optionality in morph choice takes the form of prespecifying the morphosyntactic input with a diacritic indicating which morph should be used.⁷⁶ When

⁷⁵ My invocation of this constraint should be taken more as a point of descriptive convenience rather than a specific proposal about what the source of the ‘[ke] must follow a light syllable’ requirement is. If this requirement is simply due to an M/Cat/P/Cat alignment constraint, it presents a seeming counterexample to the suggestion in chapter 2 that M/Cat/P/Cat alignment constraints can only refer to positions of prosodic prominence, suggesting a possible functional grounding for these constraints. The constraint ALIGN(ke, L, short, R) can, however, be understood as referring to a prominent position if we assume that the first mora of a long vowel is the head mora. If so, then aligning /ke/ with a preceding light syllable means aligning it with the head mora of the preceding syllable.

⁷⁶ This is essentially Baković & Keer’s (2001) account of syntactic optionality, in which the different forms from which speakers can freely choose are the optima for different inputs. The suggestion here is that forms with /ke/ and ones with /ikke/ also result from morphosyntactically different inputs. Specifically, we can suppose that every morph is associated with a diacritic feature that functions as a sort of ID

[ke] is used, satisfaction of ALIGN(ke, L, light, R) can be brought about in one of several ways. If the base ends in a flap, the flap will obligatorily delete. This follows if ALIGN(ke, L, short, R) dominates MAX(r):

(49)

/tœr-ke/	ALIGN(ke, L, short, R)	MAX(r)
a. [tœk.ke]		1
b. [tœr.ke]	W_1	L

Likewise, if the base ends in a long vowel, that vowel has to shorten. This follows if ALIGN(ke, L, short, R) dominates IDENT(length):

(50)

/se:-ke/	ALIGN(ke, L, short, R)	IDENT(length)
a. [sek.ke]		1
b. [se:.ke]	W_1	L

Now we have to consider what happens when the speaker elects to use /ke/ with a base that ends in a consonant other than /r/. In this case, deletion of the stem-final consonant is not observed, implying that the MAX constraints for consonants other than /r/ rank above ALIGN(ke, L, short, R). In these cases, I will suggest that satisfaction of ALIGN(ke, L, short, R) is achieved via [i]-epenthesis, causing the surface form of /ke/ to neutralize with that of its stylistic alternative /ike/:


(51) *Epenthesis in 'don't sing!'*

/syŋ-ke/	MAX(ŋ)	ALIGN(ke, L, short, R)	DEP(i)
a. [syŋ.ŋi.ke]			1
b. [syŋ.ke]		W_1	L
c. [syk.ke]	W_1		L

number for the morph, and that this feature can be morphosyntactically specified in the input (see Hayes 1990 for a very similar proposal). If root morphs are inserted after the construction of the morphosyntactic tree, something like this is presumably needed anyway to explain how, for instance, the spell-out system chooses between pairs of (near-)homonyms like *lawyer* and *attorney*. In cases like this, the variation between two morphs really does seem to be simply a matter of speaker intentions, not grammatical variation, and so we have to assume that those intentions are specified in the input to spell-out.

Lastly, in order for flap-deletion to be possible with stems like [tœr], we need to assume that DEP(i) dominates MAX(r), which results in flap-deletion being the least-costly way to satisfy ALIGN(ke, L, short, R):

(52)

/tœr-ke/	ALIGN(ke, L, short, R)	DEP(i)	MAX(r)
a.  [tœk.ke]			₁
b. [tœr.ke]	W ₁		L
c. [tœr.ri.ke]		W ₁	

One final remark about the Norwegian data: this analysis needs to assume that there are two separate morphs /ke/ and /ike/ between which speakers can exercise stylistic free choice. This is necessary because /ke/ and /ike/ are both possible after bases which end in a short vowel. There would be no way to derive the /ike/ form from underlying /ke/ for these, since [i]-epenthesis is not necessary in this context to bring about satisfaction of ALIGN(ke, L, short, R). The assumption that /ke/ and /ike/ are distinct morphs may be necessary anyway, because they exhibit divergent morphosyntactic properties. These negative markers can attach to pronominal clitics as well as to verbs; /ike/, but not /ke/, can be used following certain pronominal clitics which are immediately preceded by a complementizer (Christensen 1985):

- (53) a. Vi vet at a ikke kan bo her.
 we know that she not can live here
- b. *Vi vet at a'kke kan bo her.

The fact that /ke/ is choosier than /ike/ about the syntactic category of the complex it attaches to suggests that /ke/ and /ike/ exist as distinct morphs. Nevertheless, the extreme phonological similarity of the two negative markers allows us to assume that

/ke/ neutralizes with [ike] (via epenthesis) following bases where either would be morphosyntactically permissible, but faithful realization of underlying /ke/ would not be phonologically permissible. As such, there is no need to regard Norwegian negative allomorphy as instantiating forward-looking PCSA.

A second possible source of lookahead to phonological effects involves allomorph choice being governed by what the prosodification of the competing allomorphs would look like. I know of no case where allomorphy refers to (say) the result of a stress-shift process conditioned by one of the allomorphs. However, it does appear that morph choice can refer to the result of building feet and syllables in order to parse the competing allomorphs into prosodic structure. Evidence for this comes from the many languages that have systems of even/odd syllable-counting allomorphy. One such language is Sami (Dolbey 1997), which we encountered in connection with the critique of subcategorization-only theories in chapter 2. In this language, a number of inflectional suffixes have even- and odd-syllabled allomorphs, which are used with bases of even and odd parity, respectively:

		<i>Even-σ root:</i>	<i>Odd-σ root:</i>
	<i>even ~ odd</i>	/jearra-/ ‘ask’	/veahkehea-/ ‘help’
1du:	∅ ~ -tne	[je:r.re]	[veah.ke.he:t.ne]
2du:	-beahtti ~ -hppi	[jear.ra.-beah.ti]	[veah.ke.heah.hp.pi]
2pl:	-behtet ~ -hpet	[jear.ra.-beh.tet]	[veah.ke.he:-h.pet]
3pl. preterit:	∅ ~ -dje	[je:r.re]	[veah.ke.he:-d.je]

Table 3.8. Syllable-counting allomorphy of person/number suffixes in Sami

Using even-parity suffix allomorphs with even-parity bases and odd-parity suffix allomorphs with odd-parity bases results in the overall inflected word having even parity. A preference for even parity can be straightforwardly understood as being

driven by the constraint $\text{PARSE-}\sigma$, which prefers for all syllables to be parsed into feet: exhaustive parsing into disyllabic feet is only possible if the total syllable count is even.

These data may or may not pose a problem for OI, depending on the assumptions we make about how the building of prosodic structure is accomplished in candidate chains. If morph-insertion and footing occur in separate steps, then all of the suffixal segments will be unfooted at the point that they're inserted. Even if we assume that the allomorphs contain syllable structure underlyingly, this means that the shorter allomorph will always be chosen, regardless of the parity of the base, since this adds fewer unfooted syllables:

(54)

<ROOT-AF, jear.ra-AF, (jear.ra)-AF, ...	PARSE- σ
a. (jear.ra)-hppi <i>Is incorrectly more harmonic than:</i>	1
b. (jear.ra)-beaht.ti	2

A generalization therefore emerges that allomorph choice can look ahead to the result of footing the competing allomorphs, but not to the outcome of any unfaithful mappings that the allomorphs condition. This suggests that, during chain construction, insertion of one morph may occur in a single step together with the building of enough prosodic structure to prosodically incorporate the morph into its base. Indeed, it may be that spelling an affix out and phonologically realizing it as part of a word necessarily presupposes the affix's incorporation into the prosodic structure of the word. Under this suggestion, <..., [(jear.ra)_{Ft}-AF]_{PWd}, [(jear.ra)_{Ft}-(beaht.ti)_{Ft}]_{PWd}> would be a valid chain in Sami. If a certain amount of prosodic parsing can occur in a single step with morph insertion, we can accommodate syllable-counting allomorphy like that of Sami in OI,

without giving up on Local Optimality and thereby losing the ability to analyze opaque allomorphy.

There are independent reasons in OT-CC to think that the construction of at least some types of prosodic structure happens ‘for free’ every time a LUM occurs. Syllabification presents the clearest example. Consider a language which epenthesizes a consonant in order to furnish an onset to otherwise vowel-initial syllables. This is an utterly unremarkable process, as it is found in many languages, for instance Axininca Campa where the epenthetic consonant is [t]: /no-ŋ-koma-i/ → [noŋ.ko.ma.ti] ‘he will paddle’ (Payne 1981, McCarthy & Prince 1993a). In order for /t/-epenthesis to be harmonically improving, it must be the case that the syllable headed by /i/ lacks an onset in the pre-epenthesis step /no-ŋ-koma-i/ but has one in the next step [noŋ.ko.ma.ti], which results from the /t/-epenthesis LUM. This means that the /t/ must be inserted and incorporated into syllable structure in one move. If we assumed instead that syllabifying the /t/ had to occur after epenthesis in a subsequent LUM, then the immediate result of epenthesis would be [noŋ.ko.ma.<t>i], with the /t/ present but not syllabified. The problem for this view would be that the mapping from /noŋ.ko.ma.i/ to [noŋ.ko.ma.<t>i] isn’t harmonically improving: we’ve added a violation of DEP-C without removing the violation of ONSET which supposedly motivates epenthesis. Thus, we must allow epenthesis to occur simultaneously with syllabification, so that a direct mapping from /no-ŋ-koma-i/ to [noŋ.ko.ma.ti] is licit.

A similar argument can be made for unfaithful mappings motivated by foot structure. A number of languages epenthesize a vowel in order to bring words which otherwise would be monosyllabic up to a required minimum disyllabic size, e.g.

Mohawk /w-e-ʔs/ → [í:weʔs] ‘she is walking around’ (Michelson 1988, 1989). If the incorporation of epenthetic [i] into syllable and foot structure had to occur in a separate LUM from epenthesis, then we would be hard-pressed to explain how the epenthesis step $\langle (weʔs)_{\text{Ft}}, i(weʔs)_{\text{Ft}} \rangle$ could be harmonically improving. Epenthesis results in violation of DEP-V, but brings with it no immediate improvement in performance on any foot-binarity constraint, since the previous foot remains monosyllabic after epenthesis.

Therefore, it is reasonable to assume that faithfulness-free building of prosodic structure, i.e. incorporation of segments of syllables and feet, can occur simultaneously with a LUM in a single step of chain-building. A more complicated question involves how stresses are placed. Stress can be contrastive, so there must be faithfulness to underlying stress. From this it follows that changing stress (including adding a new stress) comes with faithfulness cost, and is therefore a LUM in its own right. Since we’ve just argued that building feet must come for free alongside other LUMs, the fact that stress assignment can’t be for free suggests that there is a certain degree of derivational separation between building feet and placing stress-marks. It may be, for instance, that building a foot can take place for free, simultaneously with another LUM (such as the insertion of a suffix in Sami), but that assigning a head to a foot (i.e., laying down a stress-mark) only happens in a subsequent LUM.

One last possible counterexample to the ‘no lookahead to phonology’ generalization is reported from French by Swiggers (1985). Traditional grammars report that the French word for ‘egg’ has two allomorphs: singular *oeuf* [œf] and plural *ouefs* [ø]. In at least some colloquial varieties, however, both of these allomorphs can be

found in the plural, with their distribution subject to a phonological generalization: [ø] is found after [z], and [œf] is used elsewhere:⁷⁷

(55)	<i>les oeufs</i>	[lɛ.zø]	‘the eggs’
	<i>des oeufs</i>	[dɛ.zø]	‘some eggs’/‘of the eggs’
	<i>deux oeufs</i>	[dø.zø]	‘two eggs’
	<i>trois oeufs</i>	[tʁwa.zø]	‘three eggs’
	<i>six oeufs</i>	[si.zø]	‘six eggs’
	<i>dix oeufs</i>	[di.zø]	‘ten eggs’
(56)	<i>quatre oeufs</i>	[kat.ʁœf]	‘four eggs’
	<i>cinq oeufs</i>	[sɛ̃.kœf]	‘five eggs’
	<i>sept oeufs</i>	[sɛ.tœf]	‘seven eggs’
	<i>huit oeufs</i>	[ɥi.tœf]	‘eight eggs’

These data present a possible case of both outwards-looking PCSA and of PCSA being sensitive to the outcome of a phonological process. The allomorphy is outwards-looking because the choice of whether to use [ø] or [œf] must make reference to the preceding determiner or number word, which is structurally external to the root meaning ‘eggs’. The allomorphy seems to look ahead to the outcome of a phonological process because the [z]s that condition the allomorphy are *liaison* consonants. *Liaison* is the phenomenon whereby a word-final consonant will surface only if there is a following V-initial word (of sufficient syntactic/prosodic proximity) to allow the consonant to syllabify as an onset. None of the words in (55) will end in [z] on the surface if they precede a C-initial word.

Because the *liaison* consonant appears only if the following word is V-initial, *liaison* will not be conditioned in the words in (55)-(56) until after one or the other of

⁷⁷ The reader may have noticed that *neuf oeufs* ‘nine eggs’, for which we’d expect [nœ.fœf] in the variety described, is missing from the list. Swiggers (1985) reports that this form ‘is very difficult to elicit from native speakers... if forced to order nine eggs, they even prefer to use a compound expression “five and four eggs”, or “six and three eggs”’. We may assume, along with Swiggers, that this is owing to an OCP-type pressure to avoid consecutive [œf] sequences.

the vowel-initial allomorphs of ‘eggs’ has been inserted. The choice of which allomorph to use therefore depends on the outcome of a process (*liaison*) whose application the use of either allomorph would make possible. The data therefore represent a seeming counterexample to the prediction that allomorph selection is insensitive to the result of phonological processes that the allomorphs’ presence would cause to occur.

Upon closer examination, however, it is not so clear that we have a counterexample at hand. Clearly, since the choice of the allomorph of ‘eggs’ depends on the quality, if any, of the preceding word’s *liaison* consonant, the determiner or numeral will have to be spelled out before ‘eggs’ is. Now suppose that *liaison* consonants are present in the underlying representations of words that have them as ‘floating’ consonants (Tranel 1996a,b, Zoll 1996). That is, when a morph like *les* ‘the.PL’ is inserted, its final [z] is present in the phonological representation, but is somehow not fully integrated into prosodic structure (it lacks a root node/timing slot/etc.). Because it is representationally present, the information that the floating consonant is [z] will be able in principle to exert an effect on the subsequent selection of the allomorph of ‘eggs’.

3.7 Local ordering of phonological and morphological processes⁷⁸

As we saw earlier, the fact that allomorph selection generally respects a no-lookahead requirement can be derived in both Lexical Phonology and in a version of OI theory which assumes that allomorph selection is subject to Local Optimality. OI does enjoy an empirical advantage, however, in being able to admit narrowly defined

⁷⁸ The term ‘local ordering’ is borrowed from Anderson (1972, 1974).

exceptions to the no-lookahead requirement, whereas in Lexical Phonology no-lookahead is expected to be an absolute requirement.

This is not OI's only empirical advantage over Lexical Phonology when it comes to the serial interaction of allomorph selection with phonological processes. Buckley (1994) reports an ordering paradox involving affixation and stem-final epenthesis in the Ethiopian Semitic language Tigrinya which is highly problematic for Lexical Phonology but which can be handled easily in OI.

Tigrinya does not allow final clusters, and it avoids them via vowel-epenthesis. The epenthetic vowel appears as [i:] in final position, and as [i] if affixes are subsequently added to its right (Pam 1973). Suffixes in Tigrinya differ with respect to whether they are added before or after epenthesis. There is a plural suffix which appears as /-at/ following a consonant-final stem, and as /-tat/ following a vowel-final stem. Buckley (1994) reports that this suffix appears in its /-tat/ variant following a stem-final epenthetic vowel:

(57) 'pictures' /siʔl-{-at, -tat}/ → [siʔ.li.tat], *[siʔ.lat]

This implies that plural suffixation occurs after epenthesis:

(58)

	/siʔl/		/siʔl/
Epenthesis:	siʔ.li	Plural suffixation:	siʔlat
Plural suffixation:	siʔ.li.tat	Epenthesis:	n/a
	[siʔ.li.tat]		*[si.ʔi.lat]

3rd-person and 1st-person singular possessive suffixes in Tigrinya also have multiple variants following V-final vs. C-final stems. These are shown in the table below (Leslau 1941):

	Singular		Plural	
	After C	After V	After C	After V
1 st	-ey (after laryngeals) -äy (elsewhere)	-yäy (after non-epenthetic [i]) -y (elsewhere)	-na	
3 rd masculine	-u	-ʔu	-om -atom	-ʔom -ʔatom
3 rd feminine	-a	-ʔa	-än -atän	-ʔen -ʔatän

Table 3.9. Tigrinya 1st and 3rd person possessive suffixes

According to Buckley (1994), stems which end in -CC and which are immediately followed by possessive suffix take the vowel-initial allomorph of the suffix, rather than undergoing epenthesis:

(59) 'his picture' /siʔl-{-u, -ʔu}/ → [siʔ.lu], *[siʔ.li.ʔu]

This behavior prompts the assumption that possessive suffixation occurs prior to epenthesis. The data in (57) already implied that plural suffixation occurs after epenthesis, which means by transitivity that possessive suffixation occurs prior to plural suffixation. This is illustrated in the following diagram of a Lexical Phonology analysis of the facts in (57) and (59):

(60) *Lexical Phonology analysis implied by Trigrinya affixation/epenthesis orderings*

	‘his picture’	‘pictures’
UR of stem	/siʔl/	/siʔl/
[...]		
Stratum <i>n</i>		
Morphology		
Possessive:	siʔlu	<i>n/a</i>
Phonology		
Epenthesis:	<i>n/a</i>	siʔli
Stratum <i>n+1</i>		
Morphology		
Plural:	<i>n/a</i>	siʔlitat
[...]		
Surface form:	[siʔ.lu]	[siʔ.li.tat]

However, the implication that possessive suffixation in Tigrinya happens on an earlier stratum than plural suffixation cannot be correct, assuming that the surface linear order of the morphs reflects the order in which they’re added. In plural nouns which are possessed, the plural marker appears closer to the stem than the possessive marker. This would imply that plural affixation happens on an earlier stratum than possessive suffixation.⁷⁹

(61) ‘his pictures’ [siʔ.li.-ta.-tu] *stem-plural-poss*, *[siʔ.l-u.-tat] *stem-poss-plural*

The interaction of allomorph selection with epenthesis in Tigrinya is thus problematic for an LP approach. Importantly, this remains true regardless of whether the phonologies and morphologies of each stratum are rule-based grammars or OT grammars or something else entirely. The problem isn’t with the internal character of the strata, but rather with the fact that the strata can’t be placed in a single order that

⁷⁹ While it is usually assumed that greater linear externality of a morph implies greater morphosyntactic externality or association with a later stratum, this is not necessarily always true—see the discussion of Portuguese in §3.5.1.1, of Cibemba in fn. 13, of phonologically-conditioned affix order in §3.8, and of Pashto in §5.5.

would give the correct results. The Tigrinya data are thus equally probative as an argument against Stratal OT as against rule-based Lexical Phonology.

Let's now look at how the Tigrinya data can be handled in OI. First, how do we account for the interaction of epenthesis and plural suffixation? For an unpossessed plural word like 'pictures', the chains of interest are the following:

- (62)
- a. $\langle \sqrt{\text{PICTURE-PLURAL}}, \text{si}^? \text{li-PLURAL}, \text{si}^? \text{li-PLURAL}, \text{si}^? \text{.li.tat} \rangle^{80}$
 rLUMSeq: $\langle \text{insert-root}, \text{DEP}, \text{insert-plural} \rangle$
- b. $\langle \sqrt{\text{PICTURE-PLURAL}}, \text{si}^? \text{li-PLURAL}, \text{si}^? \text{.lat} \rangle$
 rLUMSeq: $\langle \text{insert-root}, \text{insert-plural} \rangle$

Chain (62)a does epenthesis, and then spells out the plural morpheme, choosing the allomorph /-tat/ which is appropriate for post-vocalic contexts. Since epenthesis has taken place, a violation of DEP is incurred. By contrast, in (62)b, there is no violation of DEP, because the potential complex coda is avoided by using the V-initial plural allomorph /-at/ rather than by doing epenthesis. Since DEP prefers (62)b, it must be dominated by a PREC constraint which requires plural affixation to be preceded by epenthesis:

(63)

$//\sqrt{\text{PICTURE-PLURAL}}//$	PREC(DEP, plural)	DEP
a. $\text{si}^? \text{.li.tat}$ rLUMSeq: $\langle \text{insert-root}, \text{DEP}, \text{insert-plural} \rangle$		1
b. $\text{si}^? \text{.lat}$ $\langle \text{insert-root}, \text{insert-plural} \rangle$	W_1	L

⁸⁰ To simplify the presentation of this example, I'm depicting the stem-internal [i] as underlying rather than epenthetic. Since Tigrinya has root-and-pattern morphology, vowels like this one which are intercalated with the consonantal root are presumably exponents of some sort of affix, which would be added to the root prior to the addition of root-external affixes like the plural (McCarthy 1979, 1981). In any case, the origin of this [i] is irrelevant to the ordering relation between stem-final epenthesis and plural or possessive suffixation, and consequently I'll depict it as part of the underlying form of the root morph, to avoid needless complication of the chains.

Now let's consider possessed singular nouns like 'his picture'. Here, the chains of interest are the following:

- (64)
- a. <√_{PICTURE-HIS}, siʔl-HIS, siʔli-HIS, siʔ.li.ʔu>
 rLUMSeq: <insert-root, DEP, insert-poss>
- b. <√_{PICTURE-HIS}, siʔl-HIS, siʔ.lu>
 rLUMSeq: <insert-root, insert-poss>

Since no plural-morph insertion occurs in either of these chains, PREC(DEP, plural) is vacuously satisfied by both. That leaves DEP free to prefer the chain which uses the V-initial plural morph rather than epenthesizing a vowel:

(65)

//√ _{PICTURE-HIS} //	PREC(DEP, plural)	DEP
a. siʔ.li.ʔu rLUMSeq: <insert-root, DEP, insert-poss>		W ₁
b. ʔ siʔ.lu <insert-root, insert-poss>		

Lastly, we need to consider plural possessed nouns like 'his pictures'. Based on surface morph order, we can assume that the plural morpheme is morphosyntactically interior to the possessive morpheme. Given root-outwards spellout, this means that the plural morph must be added before the possessive morph in all valid chains (or at least those which spell out both morphemes). That means that the chains of interest for 'his pictures' are simply proper superchains of those for 'pictures':

- (66)
- a. <√_{PICTURE-PLURAL-HIS}, siʔl-PLURAL-HIS, siʔli-PLURAL-HIS, siʔlitat-HIS, siʔ.li.ta.tu>
 rLUMSeq: <insert-root, DEP, insert-plural, insert-poss>
- b. <√_{PICTURE-PLURAL-HIS}, siʔl-PLURAL-HIS, siʔlat-HIS, siʔ.la.tu>
 rLUMSeq: <insert-root, insert-plural, insert-poss>

In chain (66)a, the root is inserted first, followed by epenthesis, then plural suffixation, and finally possessive suffixation. In (66)b, the root is inserted, and then the

plural and lastly the possessive morphs are inserted, with no epenthesis occurring. As with unpossessed plurals like ‘pictures’, for this pair of chains the ranking $\text{PREC}(\text{DEP, plural}) \gg \text{DEP}$ ensures that (75)a, with epenthesis, will win:

(67)

//√PICTURE-PLURAL-POSS//	PREC(DEP, plural)	DEP
a. $\text{si}^{\text{?}}\text{.li.ta.tu}$ rLUMSeq: <insert-root, DEP, insert-plural, insert-poss>		1
b. $\text{si}^{\text{?}}\text{.la.tu}$ <insert-root, insert-plural, insert-poss>	W_1	L

Why exactly can OI theory deliver the correct results when LP can’t? For LP, the problem was that affix order told us that possessives are affixed on a later stratum than plurals are. Since plural suffixation would have to occur on a later stratum than epenthesis, this means by transitivity that possessives are added on a later stratum than epenthesis, which makes the wrong prediction for possessed singulars like ‘his pictures’:

(68) *Incorrect result for Tigrinya possessed singular nouns*
‘his picture’

Stratum 1

Morphology

Root: /siʔl/

Phonology

Epenthesis: siʔli

Stratum 2

Morphology

Plural: n/a

Stratum 3

Morphology:

Possessive: siʔliʔu

Surface form:

☛ [siʔ.li.ʔu]

In Lexical Phonology, the generalization ‘plural suffixation happens after epenthesis’ is implemented by assigning the epenthesis rule to a stratum before the one

where plurals are added. Since, by transitivity, the epenthesis stratum precedes the possessive stratum, words destined to receive possessive morphology must pass through the epenthesis stratum before reaching the stratum where the possessive affix is added. This results in an incorrect prediction about the serial order of epenthesis and possessive suffixation.

In OI, the generalization ‘plural suffixation happens after epenthesis’ is implemented very differently. This generalization is enforced by the constraint $\text{PREC}(\text{DEP}, \text{plural})$ which says, in essence, “if you’re going to insert a plural morph, you’d better epenthesize a vowel first”. As we saw in (65), this constraint will be vacuously satisfied when there is no plural morph. As a result, in the OI analysis of Tigrinya, possessive suffixation is under no pressure to be preceded by epenthesis in singular words. This stands in contrast with LP, where the serial ordering of strata forces even nonplural words to (incorrectly) pass through the epenthesis stratum before reaching the possessive stratum. The Tigrinya example thus furnishes a straightforward argument for OI’s premise that phonology-morphology orderings emerge from the constraint ranking, rather than being hard-wired into the serial linkage of grammatical modules, as in LP.

Allomorphy/epenthesis interactions in Tigrinya also furnish a second reason to prefer OI over LP. This is that, for some speakers at least, the orderings between epenthesis and plural and possessive suffixation are subject to variation. According to Pam (1973: 96), plural nouns with stems ending in ...CC vary optionally between (on the one hand) having epenthesis and the /-tat/ allomorph of the plural, and (on the other hand) having no epenthesis, and the /-at/ allomorph of the plural:

(69) [ʕaddí:] ‘country’ [ʕad.dát] ~ [ʕad.di.tá:t] ‘countries’

As we saw, epenthesis can be made to occur before plural suffixation under the ranking $\text{PREC}(\text{DEP, plural}) \gg \text{DEP}$. The constraint $\text{PREC}(\text{DEP, plural})$ prefers doing epenthesis prior to affixing the plural, whereas DEP prefers using the V-initial allomorph of the plural as an alternative to epenthesis. In varieties of Tigrinya like the one reported on by Pam (1973), the alternatives favored by each of these constraints are in free variation. The free variation is easily captured in OI by assuming that the ranking of DEP and $\text{PREC}(\text{DEP, plural})$ varies stochastically from one utterance to another (Kiparsky 1993b, Reynolds 1994, Anttila 1997a,b, Boersma 1997, 1998, Nagy & Reynolds 1997, Boersma & Hayes 2001):

(70)

//√COUNTRY-PLURAL//	$\text{PREC}(\text{DEP, plural})$	DEP
a. ʕad.di.tá:t rLUMSeq: <insert-root, DEP, insert-plural>		1
b. ʕad.dát <insert-root, insert-plural>	W_1	L

(71)

//√COUNTRY-PLURAL//	DEP	$\text{PREC}(\text{DEP, plural})$
a. ʕad.di.tá:t rLUMSeq: <insert-root, DEP, insert-plural>	W_1	1
b. ʕad.dát <insert-root, insert-plural>		L

According to Leslau (1941: 50-51), the corresponding pattern of variation also holds for the possessive suffixes.

In OI theory, as was emphasized earlier, the relative order of phonological and morphological operations can differ from one candidate to another. The order shown by winning candidates is up to the constraint ranking. Therefore, as in (70)-(71), the

relative order of processes can be varied by varying the constraint ranking. Since phonological processes can apply variably, an OT phonology independently needs to admit the possibility of variable constraint ranking (or of some equivalent device). If, as in OI, phonology/morphology order flows from constraint evaluation, then the same device of variable ranking can be recruited to cope with variable orderings. This result therefore strongly recommends OI's (and more generally, OT-CC's) hypothesis that the observed order of processes emerges from the constraint ranking, instead of being independently specified.

In Lexical Phonology models, including Stratal OT, the situation is very different. In order to account for the variability of phonological processes, the constraint ranking for each stratum must be potentially variable (see Anttila 2006 and Anttila *et al.* to appear for analyses featuring Stratal OT combined with variable ranking). However, in Stratal OT the relative order of (say) epenthesis and plural suffixation results not from constraint ranking but from the order of the strata to which each process is assigned. Therefore, if the order of epenthesis and plural suffixation is variable, that can only be modeled by assuming that the plural is sometimes affixed on a post-epenthesis stratum and sometimes on a pre-epenthesis stratum. Such a solution is uneconomical from the standpoint of requiring an additional locus of variation in the grammar, separate from variation in constraint rankings.

There is one possible strategy for analyzing the Tigrinya variability scenario in Stratal OT using variably-ranked constraints. We could assume that epenthesis happens on the stratum before plural suffixation, and that in the phonology of the plural

stratum, there is a variable process which deletes the epenthetic vowel. When the vowel deletes, the /-at/ allomorph of the plural is used, and when the vowel is retained, the /-tat/ allomorph is used:

(72)

Output of previous stratum: [ʃaddí:] Affix added on current stratum: {/-at/, /-tat/}	*[i]	MAX
a. ʃad.dat		1
b. ʃad.di.tat	W ₁	L

(73)

Output of previous stratum: [ʃaddí:] Affix added on current stratum: {/-at/, /-tat/}	MAX	*[i]
a. ʃad.dat	W ₁	L
b. ʃad.di.tat		1

This analytic strategy is unworkable, however, for two reasons. First, outside of the variation involving the plural and possessive markers, neither Leslau (1941) nor Pam (1973) reports a variable rule of either /i/-deletion nor of /i/-deletion. Second, non-epenthetic /i/s are retained in the same contexts. For example, ‘help’ is [ʔagälgali], and ‘his help’ is [ʔagälgalə-ʔu] (Leslau 1941: 51).⁸¹ Since the strata where the deletion would optionally occur have no access to the inputs to previous strata, they can’t distinguish between /i/s that were originally epenthetic and those which came from the underlying form of some morph. Therefore, the fact that only epenthetic /i/s would be subject to the optional deletion process would be impossible to explain in Stratal OT.

⁸¹ The stem-final reduced vowel in this form is [ə] rather than [i] because it’s followed by a laryngeal segment (Leslau 1941).

3.8 Infixation and morph placement in OI

So far in this chapter, I've examined evidence from morph choice (i.e., allomorph selection) for OI's assumptions about the serial insertion of morphs. We now turn to a second class of arguments for the OI model, which involve the *positioning* of morphs relative to one another.

In a traditional, *SPE*-type view, the input to the phonology consists of a linear string of phonological underlying forms (i.e., a string of morphs). Every morph forms a contiguous string, and the strings belonging to different morphs don't overlap:

(74) *Standard view of possible underlying arrangement of morphs*

Morph 1 = /pato/, morph 2 = /kel/

OK: $p_1 a_1 t_1 o_1 - k_2 e_2 l_2$

Not OK: $k_2 e_2 - p_1 a_1 t_1 o_1 - l_2$ (morph 1 intervenes between segments of morph 2)

Not OK: $p_1 a_1 - k_2 e_2 l_2 - t_1 o_1$ (morph 2 intervenes between segments of morph 1)

Under phonologically-defined conditions, the underlying linear order of these morphs may have to be disrupted. For example, when infixation occurs, the segments of an affix may have to be shifted so that they intervene between the string of root segments. The reverse happens in circumfixation, when the root is seemingly repositioned to occur in between the segments of a single affix.

On the standard view, then, infixation and circumfixation involve metathesis. The standard view faces a pair of problems, however, one empirical and one theoretical. The empirical problem is that the unfaithful mappings that need to be assumed in the cases of these morphological phenomena would involve degrees of unfaithfulness which are otherwise unattested. The patterns of infixation and circumfixation observed in some languages would involve segments metathesizing

over a very long distance, longer indeed than is ever observed to occur between segments belonging to the same morph. The theoretical problem is that the undesired systems of ultra-long-distance metathesis are ruled out in OT-CC given the assumption that chains consist of steps which are both gradual and harmonically improving. Insofar as adopting OT-CC is desirable for the sake of analyzing opacity, the standard theory of infixation and circumfixation is untenable.

In this section, I will show how OI is able to solve both of these problems. Long-distance metathesis between segments of the same morph will continue to be ruled out for the same reason that it is in standard OT-CC. However, the correct placement of infixes and circumfixes will remain possible given OI's assumption that morphs are inserted one at a time, instead of being simultaneously present in the input to the phonology.

One of the classic arguments for minimal constraint violation (and thus for OT) comes from Prince & Smolensky's (2004 [1993]) analysis of Tagalog infixation, where the actor-focus marker /um/ appears after the first onset of the root, e.g. /um-sulat/ → [sumulat] 'to write (actor focus)'. On Prince & Smolensky's proposal, this results from the constraint ONSET dominating a constraint favoring realization of /um/ at the left edge of the PWD. The candidate *[um-sulat] perfectly satisfies ALIGN-(um)-L, but it violates ONSET, and therefore loses to [s-um-ulat], which satisfies ONSET but violates ALIGN-(um)-L. The winning candidate [s-um-ulat] also beats candidates like *[sul-um-at] or *[sulat-um], which incur more violations of ALIGN-(um)-L by placing the actor-focus morpheme further from the left edge, but without thereby gaining any improved performance on ONSET:

(75)

{um, sulat}	ONSET	ALIGN-(um)-L
a. um-.su.lat	W_1	
b. u s-u.m-u.lat		₁
c. su.l-u.m-at		W_3
d. su.la.t-um		W_5

This mode of analysis views Tagalog /um/ as a failed prefix: its default position is at the left edge of the word, but perfect satisfaction of this placement preference is sacrificed for the sake of better satisfying ONSET. Still, /um/'s desire to appear at the left edge is satisfied as best as possible, since infixation is minimal.

In Prince & Smolensky's (2004 [1993]) analysis of infixation, the root and infix are assumed to be unordered in the input to the phonology. This assumption is a consequence of their Containment theory of faithfulness, in which GEN is able to add structure (like linear precedence relations) but cannot literally delete or alter prespecified structure (for instance by reversing the linear order of a pair of input segments). Since there is no linear order specified between the morphs in the input, the only place where /um/'s propensity to appear at the left edge is encoded is its being indexed to an ALIGN-L constraint.

A different account of the 'failed prefix' analysis of infixation is offered by Horwood (2002). Horwood assumes that morphs *are* linearized with respect to each other in the input to the phonology, with the input for Tagalog 'write.ACTOR-FOCUS' being /um-sulat/. On this view, /um/ remains as close to the left edge as possible not due to minimum violation of an ALIGN-L constraint but due to minimal violation of the anti-metathesis faithfulness constraint LINEARITY:

(76)

/um-sulat/	HOMLIN	ONSET	LINEARITY
a. um-.su.lat		W ₁	
b. u s-u.m-u.lat			₂
c. su.l-u.m-at			W ₆
d. mu-.su.lat	W ₁		L ₁

The faithful candidate, (76)a, again loses by virtue of violating ONSET. The winner, (76)b, satisfies ONSET but in so doing incurs two violations of the anti-metathesis constraint LINEARITY, since two precedence relations (u<s and m<s) that were present in the input are not preserved in the output. An immediate worry is that the desired winner would lose to candidate (76)d, which transposes the segments of the actor-focus morpheme, achieving perfect performance on ONSET with just a single LINEARITY violation. Horwood prevents this undesirable eventuality by positing the constraint that is top-ranked in (76): HOMOMORPHEMICLINEARITY, which penalizes changing the precedence relations within a morph, as candidate (76)d does, but not altering precedence relations between (say) a segment of the actor focus morph and of the root, as the desired winner (76)b does twice. Candidates that shift /um/ further to the right than [sumulat], such as candidate (76)c are harmonically bounded since they incur gratuitous additional violations of LINEARITY beyond those incurred by (76)b, without thereby improving performance on ONSET.

Horwood's (2002) faithfulness-based theory of morph order is motivated by the need to account for the existence of universals and near-universals of affix order based on affix meaning. If affix order is not fixed until the phonology gets underway, and if the default position of an affix is encoded only in the ALIGNMENT constraints to which it is arbitrarily indexed, then there is no expectation that the order of affixes will respect

any tendencies that are defined in terms of the affixes' meaning. Since it's well-known that such tendencies do exist (e.g. Hawkins & Gilligan 1988), affix order can't be simply a matter of ALIGNMENT. Horwood's alternative is to assume that morphs are linearized in the syntax/morphology, according to meaning-based principles, and that this ordering then appears in the input to the phonology.

The faithfulness-based theory of morph order thus has much to recommend it, but its assumption that infixation involves metathesis will not work in OT-CC (McCarthy 2007b). The problem has to do with the gradualness and harmonic improvement requirements on chains. For metathesis, the gradualness requirement would presumably take the form of a requirement that a single LUM can reverse the pairwise linear order of only two segments. This forecloses the possibility of analyzing Tagalog /um/-infixation as metathesis, since it's impossible to get from /um-sulat/ to [s-um-ulat] via a series of harmonically-improving pairwise reorderings:

(77)


/umsulat/	ONSET	LINEARITY
1. um.su.lat	1	
2. us.mu.lat	1	1
3. su.mu.lat		2

Harmonically disimproving!

While the gradualness restriction on metathesis imposed by OT-CC is fatal to an analysis of Tagalog /um/-infixation as metathesis, it does impose desirable typological restrictions on the possible distance of metathesis involving segments of the same morph. This result is illustrated by the following. To borrow an example from McCarthy (2007b), consider a hypothetical language in which FINAL-C ('prosodic words must end in a consonant': McCarthy & Prince 1994) and CODACOND ('obstruent codas are

forbidden': Itô 1989, Zec 1995) dominate LINEARITY. In standard OT (i.e., OT without OT-CC's gradualness restriction), this ranking predicts scenarios like the following:

(78)

/palasanataka/	FINAL-C	CODACOND	LINEARITY
a.  [pa.la.sa.a.ta.kan]			5
b. [palasanata.ak]		W ₁	L
c. [pa.la.sa.na.ta.ka]	W ₁		L

With FINAL-C and CODACOND undominated, words in our hypothetical language are forbidden to end in either vowels or obstruent consonants. Hence, a sonorant must be found to put in word-final position. If both of these markedness constraints dominate the anti-metathesis constraint LINEARITY (McCarthy & Prince 1995, 1999), then a word-medial sonorant can be metathesized into word-final position no matter how far from the right edge the sonorant is underlyingly located—since there is no limit on the number of times LINEARITY can be violated for the sake of satisfying the higher-ranked constraints. In our example, the medial /n/ of /palasanataka/ reverses its pairwise linear order with each of the segments /...ataka/ in order to reach word-final position.

In OT-CC, a mapping like the one depicted in (78) is impossible, since a chain cannot go directly from the input form /palasanataka/ to the output form [palasaataka]. Instead, it has to get there incrementally via medial chain links which change only one pairwise ordering at a time. Moreover, each of these incremental reorderings would have to be harmonically improving for the chain to be valid. The problem for the language in (78) is that there is no way to get incrementally from /palasanataka/ to [palasaataka] in a way that is harmonically improving at each step. The first step of this gradual mapping would have to be /palasanataka/ →

[palasaantaka]. This mapping, however, brings about no improvement in performance on the markedness constraint FINAL-C which is assumed to trigger the observed long-distance metathesis.

In addition to being unanalyzable in OT-CC, languages like the one depicted in (78) are also unattested, as synchronic metathesis nearly always involves only adjacent pairs of segments (Hume 2001, see also Poser 1982, Carpenter 2002). Therefore, OT-CC's exclusion of long-distance metathesis and other types of long-distance unfaithfulness which are not optimizing locally is a typologically desirable result. As we noted earlier, though, this aspect of OT-CC also forces us to reject Horwood's (2002) account of infixation as metathesis.

What we need, then, is a theory of infixation in which the edge-tropism of affixes is attributed to faithfulness (thus preserving the main objective of Horwood's 2002 proposal) while also not assuming that infixes get where they do by means of metathesis. I will now argue that OI offers just such a theory, by resuming the discussion of the constraint MIRROR which was introduced in Chapter 2.

Let's continue to use the [s-um-ulat] example to illustrate. For our purposes it will suffice to assume that this word consists, morphosyntactically, of a root morpheme which is sister to the actor-focus morpheme:

(79)



Because spell-out proceeds strictly from the root outwards, the chain leading to the eventual surface from [sumulat] will begin < $\checkmark\text{WRITE}$ -[ACTOR FOCUS], sulat-[ACTOR FOCUS]>.

After that, it will become possible to spell out the actor-focus morpheme. We can assume that the LUM of /um/-insertion can in principle place the /um/ in any position relative to the segments of the root morph /sulat/ which was inserted earlier. The chain which we want to win will therefore be $\langle \sqrt{\text{WRITE-}}[\text{ACTOR FOCUS}], \text{sulat-}[\text{ACTOR FOCUS}], \text{sumulat} \rangle$. Thus, in OI, there is no problem of how to shift the morph /um/ into medial position because there is no shifting to do: /um/ starts out in medial position because that's where it's put in the first place by the LUM that inserts it.

Now we can look at the question of why infixation is minimal. That is, how do we ensure that chains terminating in [s-um-ulat] are more harmonic than competitors terminating in [sul-um-at] or [sulat-um]? As was previewed in Chapter 2, this will be the task of the constraint MIRROR, which pressures the linear order of morphs to reflect the constituent structure of the trees that they spell out. The full definition of the constraint is repeated below:

- (80) MIRROR
- a. Let M_1 be a morpheme and μ be a morphosyntactic constituent sister to M_1 , where μ dominates the morphemes M_2, \dots, M_n .
 - b. Let M_1', \dots, M_n' be morphs (if any) whose feature-structures correspond, respectively, to those of M_1, \dots, M_n .
 - c. Let p_1, \dots, p_m be the phonological exponents (if any) of all of the morphs M_2', \dots, M_n' . A phonological exponent of a morph M means any piece of output phonological structure which has a correspondent in M 's underlying form.
 - d. If morph M_1' is a prefix, assign a violation-mark for every p_i which linearly precedes some exponent of M_1' .
 - e. If morph M_1' is a suffix, assign a violation-mark for every p_i which linearly follows some exponent of M_1' .

In the Tagalog example at hand, /um/ will be diacritically marked as a prefix, while /sulat/ will not be marked as either a prefix or a suffix, since it's a root. Therefore, /um/ will be our M_1' and /sulat/ will be M_2' . Since /um/ is a prefix, MIRROR will assign a violation-mark for every segment of /sulat/ which linearly precedes a segment of /um/. This will give us the desired effect of favoring minimal infixation:

(81)

//√WRITE-[ACTOR FOCUS]//	ONSET	MIRROR
a. um-.su.lat	W_1	
b. u s-u.m-u.lat		₁
c. su.l-u.m-at		W_3
d. su.la.t-um		W_5

To sum up, then, OI makes it possible to reconcile OT-CC's goal of ruling out unattested systems of long-distance metathesis with Horwood's (2002) goal of attributing the edge-tropic behavior of infixes to faithfulness. In OI, infixes do not need to undergo metathesis to reach their surface position because they are inserted in that position in the first place. At the same time, the pressure to minimize infixation can be attributed to the morpheme-morph faithfulness constraint MIRROR, which requires a certain kind of relation to exist between the hierarchical organization of a morphosyntactic tree and the linear order of the morphs that spell out the tree's terminal nodes.

In cases of infixation, the segments of one morph are driven by a phonological requirement to linearly intervene between segments of another morph. We can also envision effects involving a greater degree of MIRROR violation. In these cases, the neither morph linearly interrupts the other, but the relative linear order of the two morphs is determined by a phonological condition. For example, the relative order of two affixes might be determined by their phonological shapes rather than (solely) by

their morphosyntactic function. Paster (2005, 2006) has recently argued that this does not occur, which she takes as evidence that the phonology and morphology are separate. Similar stances are taken by Werle (2002), who argues that phonology can never override a syntactically determined ordering of two clitics, and by Marušič (2003), who argues that it is impossible for an affix to alternate between appearing to the right vs. to the left of its root under phonological conditions. The basic claim underlying all of these works is that, while the phonology may be able to trigger linear re-ordering of phonological elements (i.e., metathesis), outright re-ordering of a pair of morphs for phonological reasons is unattested. In this section, I will review the evidence that the surface order of morphs can be determined by the phonology, in many cases contrary to what would be expected on purely syntactic grounds.

There is at least one attested example of phonology determining the linear order of function morphs. Noyer (1994), citing personal communication from Ken Hale, reports that in the Australian language Warlmanpa, the reflexive marker /-nyanu/ normally follows person/number clitics:

- (82)
-na-nyanu
1P-REFL
- lu-nyanu
PLURAL-REFL
- pala-nyanu
DUAL-REFL

However, the reflexive marker precedes the second-person clitic:

- (83)
-nyanu-n
REFL-2

Noyer (1994) proposes to connect this divergence to the second-person marker's consonant-final phonological shape. The opposite order, [n-nyanu], would be disfavored by any number of markedness constraints, for instance constraints against geminates in general or against sonorant geminates in particular (Kawahara 2007). If such a constraint dominates MIRROR, then we can obtain the attested reversal of the morphosyntactically-expected ordering of the reflexive clitic and the person/number markers.

There is also evidence that phonological factors can control whether an affix surfaces to the left or to the right of a root. Probably the most convincing example occurs in Choctaw.⁸² This language has a number of aspectual grades, all of which have phonological exponents that are tropic to one side or the other of the penultimate syllable in the verbal stem (Broadwell 2006: ch. 10). One of these is the instantaneous marker /h/, which is placed immediately to the right of the penultimate stem vowel. Since the location of the penult within the verb root will depend on the length of the root and whether there are any stem suffixes present (see Broadwell 2006: §10.7 on affixes which count as part of the stem), the /h/ will appear sometimes to the right of the root, sometimes between segments of the root, and sometimes to the left of the root (data from Stemberger & Bernhardt 1999):

⁸² Phonologically-conditioned prefix/suffix alternations are also reported in Afar (Fulmer 1991) and Huave (Noyer 1994). However, both examples are rather dubious (Marušič 2003). In Afar, the alternation evidently is an exceptional property of a closed class of stems. In Huave, the side-switching behavior of certain inflectional affixes can be seen as not actually phonological *per se*, but simply a matter of these suffixes remaining adjacent to the theme vowel; the theme vowel appears as either a prefix or suffix depending on argument structure, so its alternation is non-phonological.

(84)

	<i>plain</i>	<i>h-grade</i>	
a.	√pisa-či	pisah-či	‘show’
b.	√pisa	pihsa	‘see’
	√ona	ohna	‘arrive’
c.	sa-√bi	sahbi	‘he kills me’
	či-√bi	čihbi	‘he kills you’

There is also evidence that phonology can influence the linear order of the two parts a compound or coordinate structure, or the order of items in a list. A large number of researchers⁸³ from Pāṇini onwards have observed that, in some languages at least, there are strong phonological tendencies regarding the ordering of elements within compounds (particularly ‘reduplicative’ compounds like *hanky-panky*) and coordinations (e.g. *thick and thin*, *hustle and bustle*). Work on this topic (most of which has been on English) has identified a number of such tendencies:

	property	1 st element prefers	2 nd element prefers	examples
1	Number of syllables	Fewer	More	<i>salt and pepper</i> <i>free and easy</i>
2	Vowel length	Shorter	Longer	<i>hem and haw</i> <i>stress and strain</i>
3	Number of initial Cs	Fewer	More	<i>artsy-fartsy</i> <i>sink or swim</i>
4	Sonority of initial C	More	Less	<i>wear and tear</i> <i>surf and turf</i>
5	F ₂ of V	Higher	Lower	<i>riffraff</i> <i>ooh and ah</i>
6	Number of final Cs	More	Fewer	<i>wax and wane</i> <i>betwixt and between</i>
7	Sonority of final C	Less	More	<i>kith and kin</i> <i>thick and thin</i>

Table 3.10. Phonological tendencies on ordering of fixed expressions in English (adapted from Cooper & Ross 1975, Pinker & Birdsong 1979, Parker 2002; cf. Ross 1982)

⁸³ Parker (2002: ch. 6) provides a thorough overview of the literature on this topic. In addition to the sources cited by Parker, see Wescott (1970), Hetzron (1972), Cutler & Cooper (1978), Oden & Lopes (1981), Ross (1982), Oakshott-Taylor (1984), McDonald, Bock, & Kelly (1993), and Wright, Hay & Bent (2005).

There a number of exceptions and subtleties to these patterns which are discussed in detail on the previous literature on this topic. However, a couple of key points are particularly worth mentioning here. First, the ordering of the seven principles in table 3.10 reflects what has been argued (Cooper & Ross 1975, Pinker & Birdsong 1979, Oden & Lopes 1981) to reflect the order of relative priority among them in case of conflict: in general, a principle higher in the table trumps on lower down. As Parker (2002) notes, this idea clearly anticipates OT's use of ranking to resolve constraint conflict. As the linearization of expressions like these not only respects phonological tendencies but also exhibits a priority-ranking of those tendencies, there is good reason to suspect that this linearization is the responsibility of an OT phonology.

Second, the seven tendencies listed in table 3.10 are arguably not simply a random or accidental collection, as they might appear at first glance. With the exception of #6, they add up to a general preference for the first item in the expression to be shorter or phonetically less prominent than the second (Abraham 1950, Malkiel 1959, 1968, Cooper & Ross 1975). Law 6 goes against this in favoring more final consonants in the first member. However, Ross (1982) has suggested that the preference is actually the reverse—namely, for the second item have more final consonants. He suggests that the examples cited to support #6 above can be explained using other phonological or semantic ordering preferences. For instance, *wax and wane* and *betwixt and between* both could be re-attributed to the high-ranked preference #2 for longer vowels in the second item.

That the tendencies in table 3.10 involve a general preference for a shorter first member is interesting insofar as this means that they can be connected with English prosodic structure (Cambpell & Anderson 1976, McDonald, Bock & Kelly 1993, Parker 2002, Wright, Hay & Bent 2005). English shows a preference for left-to-right trochaic stress (Selkirk 1984, Hayes 1995). In the case of a pair like *salt and pepper*, the attested ordering (together with phonological reduction of *and*) results in a trochaic structure [(sált.ŋ)_{FT}(pé.pə)_{FE}], whereas the opposite order *pepper and salt* would be less well-formed from the standpoint of preferring trochaically-alternating prominences. The tendency of English speakers to prefer word orders which maximize trochaic alternations has been shown to hold up in experimental tasks (McDonald, Bock & Kelly 1993). Similarly, the preference for lists and fixed expressions to order items with longer vowels second (principle #2 above) has been suggested to be connected with the existence of phrase-final lengthening in English (Oakeshott-Taylor 1984, Wright, Hay & Bent 2005). Together, these facts suggest that the ordering of lists and fixed expressions in English not only respects phonological generalizations, but also that these generalizations are grounded in the active phonology of the language.

As mentioned, the above laws have been argued to hold primarily of English; however, there is evidence that at least some other languages respect some of these same principles (see in particular Wescott 1970, Hetzron 1972, Cooper & Ross 1975, Ross 1982). The first and third laws in (94) were originally noted by Pāṇini to generally hold in Sanskrit dvandva compounds (Cooper & Ross 1975, Pinker & Birdsong 1979, Cardona 1988, Parker 2002). Hetzron (1972) notes that the first law (shorter item goes first) determines the order of postverbal pronouns in Modern Hebrew, indicating that

factors like these can govern the order of ‘grammatical’ morphs as well of items in compounds and coordinate structures. Mortensen (2004) notes that coordinate compounds in Jingpho prefer for the vowel of the first root to be higher (i.e., less sonorous) than the vowel of the second root. Looking further, there are phonological principles beyond those in (94) which can be used to predict the ordering of roots in compounds for certain languages; for instance the ordering of coordinate compounds in Mong Leng (Mortensen 2004) and Classical Chinese (Ting 1975, Mortensen 2004) can be predicted from the tones of the two roots (in fact, the relevant tonal scale is the same for both of these languages).

3.9 Extending OI above the word level

Thusfar in this dissertation we’ve focused mainly on phenomena that occur within a single morphosyntactic word (if we allow, in some cases, for a loosening of the notion ‘word’ to include clitics). To attempt within this dissertation a full-scale extension of the OI model to phrasal phonology would be unrealistic for reasons of time and space. However, there is some evidence for the existence of phrasal phenomena that show parallels to the word-internal phenomena discussed in this chapter and elsewhere, it is worth making a preliminary sketch of what phrasal phonology might look like in OI.

Distributed Morphology takes it as axiomatic that the morphosynatic structure of words is assembled as part of the same syntactic derivation that produces the tree structure for the sentence that those words are found in (Halle & Marantz 1993, 1994). If we adopt this idea in OI, this would mean that entire utterances were submitted to

the phonology at once as inputs. With regard to the operation of morph-insertion, the main theoretical question that would have to be asked is this: at what point do morphs belonging to different words acquire a linear order relationship to one another? For example, in a sentence *Dogs bark*, suppose that the root morph *bark* is inserted first, and the root morph *dog* second. Does *dog* acquire a linear order relationship with *bark* immediately upon being inserted, or are the two root morphs at first unlinearized with respect to one another, and then get linearized by a subsequent LUM?

In chapter 2, the idea that words are initially unlinearized with each other was entertained as an account of the ability of Spanish *el/la* allomorphy to look across intervening adjectives at the quality of the initial vowel of the noun. In the next chapter, when we look at derived-environment effects, we'll see that a number of examples are attested of phonological processes occurring just in case their conditioning environment is met by bringing two words together in phrasal juncture. In the context of the PREC-based theory of DEEs developed in that chapter, this may also be taken as evidence for the view that words are at first unlinearized, and that the linearization of them with each other is an identifiable step which PREC constraints can refer to. Assuming that the notion 'morphosyntactic word' can be coherently defined, this hypothesis can be stated as follows:

- (85) *Word-Internal Linearization Hypothesis*
When a morph is inserted, it immediately acquires a linear order relation with all of the other morphs in the same morphosyntactic word, but not with morphs in other morphosyntactic words.

Earlier, in regard to Sami syllable-counting allomorphy, we entertained the idea that morph-insertion includes a built-in notion of prosodic incorporation. A fully-

developed theory of phrasal phonology in OI might be able to derive the WILH from an account of how prosodic structure is built. Specifically, we might entertain the idea that linear order relations between segments are necessarily mediated by prosodic structure. In the *Dogs bark* example, we can suppose that *bark*, upon being inserted, is simultaneously parsed into a Prosodic Word. Likewise, when *dog* is inserted, it is parsed into a PWD. However, if no phonological phrases have yet been constructed that parse both of these PWD nodes, it may be that the segments of *bark* and of *dog* can have no linear order with each other. A subsequent LUM of phonological phrase construction might be hypothesized to bring about a linear order relation between the two words.

Extending OI above the word level also has implications for the typology of allomorphy. Assuming that morphological spell-out operates post-syntactically on whole sentences, and not in the lexicon on words in isolation, further possibilities for outwards-looking allomorphy emerge. Specifically, suppose that *dog* and *bark* are linearized with each other before the plural suffix on *dog* is inserted. Allomorphy of the plural suffix could then in principle be sensitive to phonological properties not only of *dog*, but also of *bark*. Does anything like this ever occur?

In chapter 2, we saw the example of Hausa *fa*-omission, in which the insertion or non-insertion of any morph at all seems to be conditioned by phonological phrasing.⁸⁴ In addition, there are a few examples in which the selection of one allomorph vs. of another has been argued to be sensitive to both the phonological properties of the word the relevant morpheme belongs to (or is cliticized to) as well as to the phonological properties of the preceding/following word (though see Labov 2008 for an

⁸⁴ I know of no clear cases in which a morph that normally is omitted does appear under conditions defined by the phrasal phonology. However, see Kim (to appear) for a suggestion to this effect.

argument that this never happens). Mascaró (1996a) reports that many modern Western Catalan dialects, as well as Old Catalan, show an alternation in the shape of the neuter clitic (orthographic *ho*) which makes reference to the clitic's segmental context on both sides. The clitic is [w] if there is a vowel on either side; but as [o] if there is no adjacent vowel, i.e. interconsonantly, utterance-initially before a consonant, and utterance-finally after a consonant:

(86)	C_C	com [o] fa	'how does it'
	V_V	qui [w] ha fet	'who has done it'
	C_V	com [w] ha fet	'how has done it'
	V_C	qui [w] fa	'who does it'
	#_V	[w] ha fet	'has done it'
	V_#	porta [w]	'bring it!'
	#_C	[o] fa	'does it'
	C_#	fez [o]	'do it!'

Mascaró (1996a) argues that this alternation must be listed allomorphy rather than merely phonological (de-)vocalization, because the dialects in question do not otherwise show any [o]~[w] alternations. Obviously, though, if we allowed ourselves a way to implement minor rules in OT using either indexed markedness constraints (Pater to appear) or cophonologies (Anttila to appear), rather than analyzing them using listed allomorphy (Hudson 1974, Mascaró 2007, Kager to appear), this example would not necessarily go through as a case of allomorph selection looking outside the word.

Much the same goes for the definite article in Welsh (Hannahs & Tallerman 2006). The article is [r] (orthographic *r*) following a V-final word. If there is no preceding V-final word, the article is [ər] (*yr*) if the following word is vowel-, glide-, or [h]-initial, and [ə] if the following word begins with any other consonant:

- (87)
- | | | |
|----|-----------|------------------|
| a. | o'r afon | 'from the river' |
| | o'r llyfr | 'from the book' |
| b. | yr afon | 'the river' |
| c. | y llyfr | 'the book' |

Use of the [r] allomorph is also sensitive to phonological phrasing: it isn't used if an Intonational Phrase break follows the preceding V-final word. If these allomorphs are suppletive rather than derived from some common UR via minor rules (Coates 1987, Hannahs & Tallerman 2006) then we have another case of outwards-looking allomorphy at the word level: the words preceding and following the article would have to both be inserted and then linearized with one another before the article was inserted. As with the Catalan neuter clitic, though, the very similar phonological shapes of the competing allomorphs does not make this example *prima facie* convincing as a case of suppletive allomorphy.

A final possible example of suppletive allomorphy at the phrase level (again involving apparent minor rules) concerns auxiliary reduction in English. Kaisse (1985) takes the position that the alternation between, e.g., *She will come tomorrow* and *She'll come tomorrow* results from the selection of different allomorphs of the auxiliary, because English has no regular process of /w/-deletion. Moreover, she notes, reduction is not possible for all auxiliaries, as there are no comparable reduced forms of *was* or *were*:

- (88)
- | | |
|----|--|
| a. | They were going to come tomorrow. |
| b. | *They're going to come tomorrow. (* if meant with same meaning as (a)) |

The exact conditioning environment for auxiliary reduction has been debated, with both syntactic and phonological conditions suggested (see Kaisse 1985: ch. 3 for an overview; she favors a syntactic account). However, to the extent that phonological conditions may be partly implicated, and if the reductions are accepted as suppletion rather than minor rules, we may have another possible example of suppletive allomorphy at the phrasal level.

Outwards-looking allomorphy at the phrase level is not the only phenomenon that we expect to find if linearization of separate words occurs within an OI phonology. The other main thing that's predicted is that the linear order of morphs at the phrase level (like the linear order of morphs within words) can be driven by phonological constraints. Here, the evidence is more unambiguous. One prominent case in which phonologically-determined word order has been argued for is that of the English dative alternation. Anttila (2007) discusses several phonological influences on the dative alternation and presents an OT analysis which captures the quantitative patterns found in a corpus of data from Blogspot. One example: it's been observed that verbs which permit the alternation tend to consist of a single foot, whereas nonalternating verbs tend to have multiple feet (Grimshaw & Prince 1986, Fraser 1998, Grimshaw 2005, Anttila 2007, cf. Pullum & Zwicky 1988):

- (89) a. They (gave)_{Ft} the church money.
b. They (gave)_{Ft} money to the church.
- (90) a. *They (do)_{Ft} (nated)_{Ft} the church money.
b. They (do)_{Ft} (nated)_{Ft} money to the church.

Anttila (2007) suggests that the dispreference for double object forms like (90)a arises from prosodic phrasing. If the verb forms a phrase with an immediately

following goal DP like *the church*, then a multi-foot verb will result in this phrase being greater than binary at the foot level. Another example: Heavy NP Shift in English is subject (as the name implies) to restriction regarding the minimum size of the postposed DP. Zec & Inkelas (1990) propose that the size requirement be stated in terms of prosodic rather than syntactic complexity, and specifically that the postposed DP be able to form a branching Intonational Phrase (examples from Zec & Inkelas 1990: 377).

- (91) a. Mark showed some letters to John.
 b. *Mark showed to John [[some letters]_{PPH}]_{IP}.
- (92) a. Mark showed some letters from Paris to John.
 b. Mark showed to John [[some letters]_{PPH} [from Paris]_{PPH}]_{IP}.

Zec & Inkelas (1990) also suggest that the preposing of topicalized constituents in Serbo-Croatian is subject to a similar requirement of prosodic branchingness, but at a different level of the prosodic hierarchy: the preposed item must contain at least two phonological words.

A few further examples: Fitzgerald (1994) argues that the placement of the auxiliary in Tohono O’odham (as well as the presence or omission of the *g*-determiner) is controlled in part by a pressure for utterances to begin with a trochaic foot. Richards (2006) proposes that the surface position of *wh*-phrases is universally driven by a pressure for those phrases to be separated from their associated complementizers by the minimum possible number of Minor Phrase boundaries; cross-linguistic variation in the presence or absence of overt *wh*-movement is therefore to be attributed to differences in prosodic phrasing. Schülter (2005) argues that a variety of morphological and syntactic developments in the history of English are driven by a preference for words to contain alternating stresses. Zubizarreta (1998) argues that Germanic and

Romance focus scrambling is driven by the need to let the focused constituent get nuclear stress. Phonological factors have also been argued to be implicated in Norwegian V2 (Rice & Svenonius 1998), Basque V2 (Legendre 2000a), Chicheŵa, English, and French focus phenomena (Samek-Lodovici 2005), rightward dislocation in several Romance languages (López to appear) and the placement of functional items in Croatian (Wilder & Ćavar 1994, Bošković 2001), Pashto (Kenstowicz & Kisseberth 1977), Irish and Scots Gaelic (Elfner 2008), Romanian (Legendre 2000b), Modern Hebrew (Hetzron 1972, Vogel & Kenesei 1990) and Bulgarian and Macedonian (Rudin, Kramer, Billings and Baerman 1999, Legendre 2000c).

Thus, there is a reasonably strong body of evidence that the linearization of morphs both within and between words can be influenced by the phonology. A skeptic wishing to keep morph linearization out of the phonology might propose to follow suggestions (e.g. Zubizarreta 1998) that certain aspects of prosodic phrasing are determined in the syntax, and hence that prosodically-determined word order is not part of the phonology *per se*. There are two main arguments against such a course of action. First, prosodic phrasing in French seems to be influenced by the segmental make-up of words (Côté 2006), meaning that it can't take place before spell-out. Second, such an assumption would not enable us to dispense with phonological influences on morph order which involve phonological structures at the foot level or below, since it's only prosodic constituents above the foot that have reliable morphosyntactic correlates (e.g., Selkirk 1984, 1995). The conclusion that the phonology is capable of influencing morph order therefore seems unavoidable.

One final prediction of the OI approach to phrasal phonology envisioned here is that it predicts that phrase-level phonology can apply cyclically. In, for instance, a sentence like *Mary reads books*, it might be the case that *reads* and *books* are linearized into a string, and that some phonological process applies within the string *reads books* prior to that string being linearized with *Mary*. In *SPE*, it was assumed that the phonological cycle operated directly on syntactic constituents above the word level (Chomsky & Halle 1968). However, this idea fell out of favor with the advent of prosodic hierarchy theory (Selkirk 1980, 1984, 1986, Nespor & Vogel 1986, Hayes 1989b) and its recognition that the domains of postlexical processes do not perfectly correspond to syntactic constituency. Likewise, in *Lexical Phonology* (Kiparsky 1982a,b, Mohanan 1982) it was standardly assumed that the postlexical stratum is noncyclic (though cf. Kaisse 1985, 1990); this position has also been argued for in Stratal OT (Bermúdez-Otero to appear).

However, a number of works cast within prosodic hierarchy theory have identified cyclic effects, albeit operating over prosodic rather than syntactic constituents (Selkirk 1980, Shih 1986, McHugh 1986, 1990, Truckenbrodt 2002; see also Shen 1992).⁸⁵ The idea here is that prosodic constituents are built from the bottom up, smaller units being formed before larger ones, and that other phonological processes can be interspersed through the process of phrase construction. This picture is very much consistent with the idea about the WILH sketched at the beginning of this section, in which individual words start out with no linear order with each other, and

⁸⁵ The possibility of phonological cyclicity at the phrase level has also been recently revived in the context of work applying phase theory (Chomsky 1999, 2001) to sentence-level phonology (Legate 2003, Kahnemuyipour 2004, Wagner 2005, Selkirk & Kratzer 2007, Ishihara 2007, among others).

successively larger collections of words acquire linear order relations to one another as they are parsed into successively higher-level prosodic constituents.

Obviously, the discussion in this section has only barely scratched the surface of the rich array of phonological (and morphological) phenomena that occur above the word level. Nevertheless, I hope to have shown that an extension of OI to phrasal phonology (in keeping with DM's assumption that morphological spellout is post-syntactic) is both possible, and may meet with empirical support.

3.10 Conclusion

In this chapter, I examined the typological predictions about morph choice (allomorphy) and morph placement made by OI's assumptions about the serial interaction of phonology and morph-insertion. I showed that:

- If OI is coupled with the assumption that morph-insertion proceeds strictly root-outward (which would be no more a stipulation than it is in Lexical Phonology or the *SPE* cycle), OI predicts the impossibility of both kinds of lookahead: allomorph choice cannot see the phonological properties of more peripheral morphs, or the outcome of phonology that would be conditioned by one of the allomorphs. This puts OI at a major restrictiveness advantage relative to classic OT with multiple URs, where both types of lookahead are allowed (and the second is universally expected).
- If the requirement of inside-out morph insertion is abandoned, OI allows for 'inner' allomorphy to be sensitive to the properties of more-peripheral morphs, but still doesn't allow the choice of allomorphs to be sensitive to the result of

phonology that the allomorphs condition. This too may be desirable, as there is a certain amount of evidence for the first type lookahead, but little if any for the second.

- OI allows for phonology and morphology to be ‘locally ordered’ in a manner that is elusive for Lexical Phonology, despite being attested in Tigrinya.

- OI’s assumption that morph insertion is a single phonological operation allows OT-CC (and its desirable results about forbidding long-distance metathesis) to be reconciled with a faithfulness-based account of affix order (Horwood 2002).

Collectively, these results place OI in an advantageous position relative to both Lexical Phonology and classic OT with regard to its empirical predictions.

In the next chapter, we turn away from allomorphy, and begin to look at phenomena in which phonological processes are required to hold particular ordering relations relative to the insertion of particular morphs.

CHAPTER 4

NONDERIVED ENVIRONMENT BLOCKING

4.1 The phenomenon

A number of languages have phonological processes which apply only if their conditioning environment is derived through the prior application of some other process, which may be phonological (an unfaithful mapping) or morphological (addition of an affix). A phonological example is found in Polish (Rubach 1984, Kiparsky 1985, Burzio 2002a, Łubowicz 2002, 2003a, 2005, van Oostendorp 2007). In Polish, underlying velars become postalveolars before front vocoids of certain suffixes:⁸⁶

(1) *Velar palatalization in Polish*

kro[k]-i-ć → kro[č]-i-ć ‘to step’
stra[x]-i-ć → stra[š]-i-ć ‘step-diminutive’

In parallel with this pattern, we would expect underlying /g/ to become [j] in the same context. However, /g/ in fact surfaces as a fricative [ž]:

(2) *Palatalization and spirantization of underlying /g/*

va[g]-i-ć → va[ž]-i-ć ‘to weigh’
dron[g]-ik-Ń → drōw[ž]-ek ‘pole-diminutive’

In an ordered-rule theory, we could understand the patterning of /g/ as resulting from the application of two rules in a feeding relationship. Underlying velars palatalize before front vocoids, which feeds a second rule that spirantizes /j/:

⁸⁶ This process (‘first velar palatalization’) is thus itself a derived environment effect because it applies only at morphological junctures. Other junctural sequences of velars plus front vocoids undergo secondary palatalization, which is also a DEE. See §4.2.3 for discussion.

(3)	UR	/vag-i-ć/
	<i>Palatalization:</i>	
	[dorsal] → [postalveolar] / _ [-cons, -back]	vaǰić
	<i>Spirantization:</i>	
	ǰ → [+contin] /	važić
	...	
	SR	[važić]

The theoretical twist to this analysis is that the /ǰ/-spirantization rule does not apply to underlying /ǰ/s, which surface faithfully:

(4)	briǰ]-ǰk-ǰ	→	briǰ]-ek	‘bridge-diminutive’
	[ǰ]em-ǰ	→	[ǰ]em	‘jam’

Thus, in Polish, a /ǰ/ before a front vocoid undergoes spirantization just in case the /ǰ/ is derived through the application of a prior phonological rule (specifically, palatalization of underlying /g/). That is, the spirantization rule is blocked from applying in underived environments.

Rules can also be blocked from applying in environments that are morphologically underived, a fact which has been known to modern phonological theory at least as early as Trubetzkoy (1939) and Wells (1949). The classic example (Kiparsky 1968, 1973a), which we saw in chapter 1, comes from Finnish. That language assibilates /t/ to [s] before [i], but only if the /ti/ sequence in question is derived through morph concatenation; underlying root-internal /ti/ sequences are unaffected:

(5)	/tilat-i/	→	[tilasi], *[silasi] ‘order-PAST’
-----	-----------	---	----------------------------------

This sort of phenomenon has gone by a variety of names in the literature, depending mainly on the theoretical framework being employed. I will use the term *Non-Derived Environment Blocking* (NDEB: Kiparsky 1993a) to refer to the phenomenon of a process being blocked in nonderived environments, and the term *Derived Environment Effect* (DEE) to refer to the processes which apply only in a derived environment. In other work these phenomena have also been referred to as ‘global rules’⁸⁷ or ‘strict cycle effects’.

Numerous other examples of DEEs, arising in both phonologically-derived and morphologically-derived environments, have been reported in the literature:

- In English (Kiparsky 1973a, 1982a, Burzio 1994, 2000, 2002a, Steriade 2000b), stressed nonhigh vowels are tensed before CiV in morphologically-derived contexts (*Can[ə]da* ~ *Can[eɪ]dian*) but not in root-internal contexts (*c[æ]meo*, **c[eɪ]meo*).
- In Korean (Kiparsky 1973a, 1993a, Iverson & Wheeler 1988, Hume 1990, Iverson 1993, 2004, Suh 1995, T. Cho 1998, 1999, 2001, Anttila & Y. Cho 1999, Kim 2002, Suh & Park 2003, Y. Cho to appear), /t/ palatalizes before an /i/ in a following morph (/mat-i/ → [maci]) ‘eldest’) but tautomorphemic /ti/ sequences are unaffected (/mati/ → [mæti] ‘joint’).
- In Turkish (Zimmer & Abbott 1978, Sezer 1981, Inkelas & Orgun 1995, Inkelas, Orgun & Zoll 1997, Inkelas 2000), velars delete if they are placed in intervocalic position through affixation (/bebek-i/ → [bebei] ‘baby-ACCUSATIVE’) but root-internal intervocalic velars do not delete ([sokak], **[soak]*, ‘street’).

⁸⁷ Note however that not *all* argued cases of ‘global rules’ in phonology are DEEs. The Chimwi:ni example discussed at the end of this section is one; other examples see Miller (1975) and Kenstowicz & Kisseberth (1977).

•In Makassarese (Aronoff et al. 1987, McCarthy 1998, 2003b, McCarthy & Prince 1994, Broselow 1999) glottal stop is inserted following a word-final epenthetic copy vowel (/rantas/ → rantasa → [rántasaʔ] ‘dirty’), but not after underlying final vowels ([lóm̥po], *[lóm̥poʔ] ‘big’).

Additional examples that have been argued for, some of which will be discussed further in this chapter, include:

Basque word-final vowel raising (Hualde 1989, cf. Łubowicz 2002)
 Various processes in Catalan (Mascaró 1976)
 Chamorro vowel lowering (Chung 1983, Kiparsky 1993a)
 Chimwiini phrasal vowel shortening (Kenstowicz & Kisseberth 1977, Selkirk 1986)
 Chumash pre-coronal laminalization (Kiparsky 1993a, Poser 1993, cf. McCarthy 2007c)
 Daga hiatus resolution (Murane 1974, Casali 1997)
 Dakota intervocalic fricative voicing (Shaw 1985)
 Emai hiatus resolution (Schaefer 1987, Casali 1997)
 English velar softening, stress assignment, and trisyllabic shortening (Kiparsky 1973a, 1982, Halle & Mohanan 1985, Burzio 2000, cf. Szpyra 1989, Hammond 1992)
 Estonian hiatus lowering (Kenstowicz & Kisseberth 1970, Kiparsky 1973a, Hammond 1992)
 Finnish consonant gradation (Kiparsky 1993a)
 Friulian vowel lengthening (Hualde 1990, Repetti 1992, 1994, Łubowicz 2003, cf. Baroni & Vanelli 2001)
 German coda /g/-spirantization (Itô & Mester 2003b)
 Ancient Greek mid-vowel raising (Miller 1972)
 Hausa palatalization (Inkelas & Cho 1993)
 Tiberian Hebrew vowel lowering (Prince 1975)
 Hungarian vowel harmony (Polgárdi 1998)
 Icelandic /u/-umlaut (Anderson 1969, Orešnik 1977, Kiparsky 1984, cf. Kiparsky 1993a)
 Indonesian nasal substitution (Pater 1999, cf. Pater 2001)
 Latin rhotacism (Blumenfeld 2003b) and /t+t/ → [ss] (Wells 1949, Goldsmith 2008)
 Lithuanian /n/-deletion (Darden 1977)
 Meskwaki palatalization (Wier 2004)
 Ndjébbana gemination and gliding (Kurusu 2007)
 Norwegian flap deletion (Bradley 2007)
 Polish Iotation (Rubach 1984, cf. Rubach & Booij 2001)
 Romanian velar palatalization (Steriade 2008)

Russian velar palatalization (Rubach 2000, Halle & Matushansky 2002, Blumenfeld 2003a,b)
 Sanskrit *ruki* (Kiparsky 1973a, Selkirk 1980, Hammond 1992) and /as+n/ → [on], /ās+n/ → [ān] (Wells 1949, Goldsmith 2008)
 Campidanian Sardinian postvocalic spirantization (Bolognesi 1998, Łubowicz 2002, 2003a,b, Tessier 2004)
 Sekani /e/-raising (Hargus 1988, 1989)
 Slovak diphthogization and pre-sonorant voicing (Rubach 1993, Blaho 2003)
 Swedish velar palatalization (Kiparsky 1973a)
 Telugu vowel harmony (Wilkinson 1974)
 Tohono O'odham stress (Yu 2000, cf. Fitzgerald 1996, 1997, 2001)
 Turkish vowel harmony (Polgárdi 1998, van Oostendorp 2007) and coda devoicing (Kaisse 1986, 1990)
 Uighur /a/-raising (Orgun 1994, 1996b, Inkelas 2000, cf. Łubowicz 2002)
 Wichita cluster reduction (Deguchi 2001)

There is also evidence that DEEs can arise in intermediate stages of child language (Drachman & Malikouti-Drachman 1973, Kiparsky & Menn 1977: Greek-learning children seem to begin applying postnasal voicing at morph boundaries before they do in root-internal contexts) and in the developing interlanguage grammars of L2 learners (Eckman & Iverson 1997, 2000, Eckman, Elreyes & Iverson 2001, 2003, Iverson 2004). Additionally, certain DEEs, including Turkish velar deletion (Zimmer & Abbott 1978) and English Velar Softening (Pierrehumbert 2006) have been shown in experimental tasks to productively extend to nonce items. This rich space of attested examples leaves no doubt that NDEB is a possible active synchronic pattern in the phonologies of natural languages.

As we saw in chapter 1, the machinery of OT-CC unexpectedly turns out to provide a useful tool for analyzing NDEB. In an NDEB effect, the DEE is required to be preceded by the application of some other process. The first clause of a PREC constraint calls for exactly this:

- (6) $\text{PREC}(A,B)$
 Assign a violation-mark if:
 a. An A-violating LUM occurs without being preceded by a B-violating LUM.
 b. A B-violating LUM occurs and is followed by an A-violating LUM.

This proposal can be made concrete by giving an analysis of the Polish /g/-spirantization DEE. For simplicity, I'll assume that changing /g/ into [j] involves a change to a single multivalued feature [place] (from dorsal to coronal) and that changing /j/ into [ž] involves a change to a single feature [continuant] (from minus to plus). Because velars palatalize before front vocoids, we can assume that there is a constraint *KE ('one violation-mark for every instance of a velar followed by a front vowel') which dominates IDENT(place):

(7) *Palatalization of velars before front vowels is harmonically improving*

/ki/	*KE	IDENT(place)
[či] <i>Is more harmonic than:</i>		1
[ki]	1	

Second, because [j] derived from /g/ spirantizes, we can assume that a constraint *j, which assigns a mark for every instance of that segment, dominates IDENT(continuant):

(8) *Spirantization of /j/ is harmonically improving*

/j/	*j	IDENT(contin)
[ž] <i>Is more harmonic than:</i>		1
[j]	1	

Third, to account for the DEE, I'll assume that there is a constraint $\text{PREC}(\text{IDENT}(\text{place}), \text{IDENT}(\text{contin}))$. This constraint will assign a violation-mark whenever a candidate's rLUMSeq features an $\text{IDENT}(\text{contin})$ -violating LUM that isn't preceded by an $\text{IDENT}(\text{place})$ -violating LUM.

We can now illustrate what happens to derived vs. to underived /j/s. For underlying sequences of /g/ followed by a front vocoid, there are three harmonically-improving options: (a) do nothing; (b) palatalize; or (c) palatalize and then spirantize:

- (9) a. <gi>
rLUMSeq: <>
- b. <gi, ĵi>
rLUMSeq: <IDENT(place)>
- c. <gi, ĵi, ži>
rLUMSeq: <IDENT(place), IDENT(contin)>

Because none of these three candidates violates $\text{PREC}(\text{IDENT}(\text{place}), \text{IDENT}(\text{contin}))$, the markedness constraints *KE and *ĵ will be able to rule in favor of option (c):

(10) *Spirantization of underlying /g/ wins*

/gi/	PREC (IDENT(place), IDENT(contin))	*KE	*ĵ	IDENT (place)	IDENT (contin)
<gi> rLUMSeq: <>		W ₁		L	L
<gi, ĵi> rLUMSeq: <IDENT(place) >			W ₁	L	1
☞ <gi, ĵi, ži> rLUMSeq: <IDENT(place), IDENT(contin) >				1	1

For an underlying /j/, there are two options: (a) do nothing, or (b) spirantize it to [ž]:

- (11) a. <j>
 rLUMSeq: <>
 b. <ǰ, ž>
 rLUMSeq: <IDENT(contin)>

Because the /j/ is underlying and not derived by any change in place features, the spirantization candidate has an IDENT(contin)-violating LUM that isn't preceded by an IDENT(place)-violating LUM. Consequently, the candidate that spirantizes underlying /j/ violates top-ranked PREC(IDENT(place), IDENT(contin)), and therefore loses:

(12) *Spirantization of underlying /j/ blocked*

/j/	PREC (IDENT(place), IDENT(contin))	*KE	*j	IDENT (place)	IDENT (contin)
☞ <j> rLUMSeq: <>			1		
<ǰ, ž> rLUMSeq: <IDENT(contin)>	W ₁		L		W ₁

The markedness constraint *j will prefer changing the /j/ into [ž]. However, because changing the segment's [continuant] specification is not here preceded by a change to its [place] specification, the PREC constraint is violated by the spirantization candidate, so the preferences of the markedness constraint are overridden.

In OT, a ‘process’ is simply an unfaithful mapping that happens in response to a Markedness » Faithfulness ranking. In the OT-CC approach to DEEs, a process is blocked in nonderived environments via a ranking of the following form:

- (13) *Ranking schema for NDEB in OT-CC*
 $\text{PREC}(F_1, F_2) \gg M \gg F_2$

Normally, a mapping that violates faithfulness constraint F_2 is allowed to apply, if it would improve performance on markedness constraint M . However, the F_2 -violating mapping will fail to occur if it isn’t crucially preceded by an F_1 -violating mapping, because that violates the PREC constraint. This means that the OT-CC analysis directly encodes a quite intuitive idea of derived vs. underived environments: a process (F_2 -violation) is allowed to apply only when its application is made possible by the application of some other process (F_1 -violation). In Polish, spirantization is allowed to occur just in case a change in consonant place has previously occurred, meaning that /j/s derived from /g/ will spirantize, but underlying /j/s will not be allowed to.

OI theory amends OT-CC by assuming that morph-insertion occurs in the candidate chains of the phonology. Consequently, PREC constraints can refer to particular types of morph-insertion, and bar processes from applying in environments not derived by affix insertion. Furthermore, as we saw with respect to Finnish Assibilation in chapter 1, OI can use the chain-merger machinery of OT-CC in order to give a fully explicit characterization of the notion ‘derived environment’. This last result is worth stressing, because formalizing this notion in the context of rule-based accounts of NEDB like the Strict Cycle Condition required highly elaborate definitions

which moreover weren't needed for any purpose beyond NDEB itself (see e.g. Mascaró 1976).

To illustrate how OI distinguishes between derived and underived environments, we can consider an example like Finnish /tilat-i/ → [tilasi] 'order-PAST', which contains an instance of both kinds of environment. Assibilation applies to the root-final /t/, which is derivedly before the /i/ of the suffix. However, assibilation fails to apply to the root-initial /t/, which is underivedly followed by a root /i/. The chains of interest for input //√_{ORDER-PAST}// will be as follows:

(14)

Chains ending in [tilasi]:

- a. <√_{ORDER-PAST}, tilat-PAST, tilati, tilasi>
LUMSeq: <insert-root, insert-past, IDENT(contin)@5>

Chains ending in [silasi]:

- b. <√_{ORDER-PAST}, tilat-PAST, tilati, tilasi, silasi>
LUMSeq: <insert-root, insert-past, IDENT(contin)@5, IDENT(contin)@1>
c. <√_{ORDER-PAST}, tilat-PAST, tilati, silati, silasi>
LUMSeq: <insert-root, insert-past, IDENT(contin)@1, IDENT(contin)@5>
d. <√_{ORDER-PAST}, tilat-PAST, silat-PAST, silati, silasi>
LUMSeq: <insert-root, IDENT(contin)@1, insert-past, IDENT(contin)@5>

Chains ending in [silati]:

- e. <√_{ORDER-PAST}, tilat-PAST, silat-PAST, silati>
LUMSeq: <insert-root, IDENT(contin)@1, insert-past>
f. <√_{ORDER-PAST}, tilat-PAST, tilati, silati>
LUMSeq: <insert-root, insert-past, IDENT(contin)@1>

Chains ending in [tilati]:

- g. <√_{ORDER-PAST}, tilat-PAST, tilati>
LUMSeq: <insert-root, insert-past>

Because there are two potential loci of assibilation in this word, I'm following McCarthy (2007a) in using the notation '@' to distinguish between them in the LUMSeqs. Assibilation of the root-initial /t/ is 'IDENT(contin)@1', since this /t/ is the first segment

in the root. Assibilation of the root-final /t/ is ‘IDENT(contin)@5’, because this /t/ is the fifth segment in the root.

The root-final assibilation IDENT(contin)@5 occurs in a derived environment in that it’s crucially preceded by insertion of the past-tense suffix /-i/. Inspection of the chains above reveals no case in which IDENT(contin)@5 occurs earlier than ‘insert-past’ in a LUMSeq. The reason for this is simple: the only relevant markedness constraint ranked above IDENT(contin) in Finnish is *ti. Therefore, it’s not harmonically improving to assibilate the final segment of the unaffixed root string /tilat/:

(15)

/tilat/	*ti	IDENT(contin)
[tilat] <i>Is more harmonic than:</i>	1	
[tilas]	1	1

Assibilation of the root-final segment does, however, become harmonically-improving after the suffix morph /-i/ is introduced:

(16)

/tilati/	*ti	IDENT(contin)
[tilasi] <i>Is more harmonic than:</i>	1	1
[tilati]	2	

Because it’s harmonically-improving to perform the LUM IDENT(contin)@5 only after insert-past has been performed, IDENT(contin)@5 will always be ordered after ‘insert-root’ in a LUMSeq where IDENT(contin)@5 appears. This is in fact what we see.

Things are different for IDENT(contin)@1. It's harmonically-improving to assibilate the root-initial segment even if the affix hasn't been inserted yet:

(17)

/tilat/	*ti	IDENT(contin)
[silat] <i>Is more harmonic than:</i>		1
[tilat]	1	

Because of this, there are valid chains (namely (d) and (e)) in which IDENT(contin)@1 occurs earlier than insert-past in the LUMSeq. These chains each converge with at least one other chain in which IDENT(contin)@1 is ordered *after* insert-past. Chain (d), which ends in [silasi], converges with chains (b) and (c). Likewise, chain (e), which ends in [silati], converges with chain (f). Chains in which IDENT(contin)@1 occurs after insert-past exist because inserting the suffix /-i/ does nothing to take away the harmonically-improving status of IDENT(contin)@1.

As mentioned in chapter 1, it's assumed in OT-CC (McCarthy 2007a) that chains converging on the same output form are merged into a single chain in the final candidate set. Merged chains retain in their rLUMSeqs only the pairwise ordering relations among LUMs which are held in common by all of the chains which are merged together. There are two potential surface forms *[silasi] and *[silati] in which IDENT(contin)@1 occurs. As we just saw, each of these outputs can be reached via a path which performs IDENT(contin)@1 before performing insert-past, as well as via a path which performs insert-past before performing IDENT(contin)@1. Therefore, in the rLUMSeqs of the merged chains, no ordering relation is asserted between IDENT(contin)@1 and insert-past:

(18)

- a. [tilasi]
rLUMSeq: <insert-root, insert-past, IDENT(contin)@5>
- b. [silasi]
rLUMSeq: {<insert-root, insert-past, IDENT(contin)@5>,
 <insert-root, IDENT(contin)@1>}
- c. [silati]
rLUMSeq: {<insert-root, insert-past>, <insert-root, IDENT(contin)@1>}
- d. [tilati]
rLUMSeq: <insert-root, insert-past>

The fate of IDENT(contin)@5 under chain merger is very different. As we observed earlier, in the unmerged chains IDENT(contin)@5, when it occurred, was always preceded by insert-past. Because there were no chains containing the opposite pairwise order <IDENT(contin)@5, insert-past>, the pairwise order <insert-past, IDENT(contin)@5> survives chain merger and is reflected in the rLUMSeqs.

Intuitively, what chain merger does is to filter out pairwise orderings of LUMs which aren't crucial. Processes are crucially ordered if one process affects whether or not the other one is harmonically-improving—that is, if the two processes interact. Interacting processes can only be ordered in one way when they both happen, so the pairwise order of interacting processes (insert-past and IDENT(contin)@5 in our example) survive chain merger. By contrast, if two processes don't interact—if neither affects whether or not the other is harmonically-improving—then there will be chains leading to the same output which perform the processes in different orders. This is for the simple reason that either order is possible for non-interacting processes, while only one order is possible for interacting processes. Because there will always be convergent chains which assert different pairwise orders of non-interacting processes, the

rLUMSeqs left after chain merger will not contain any pairwise ordering of the two processes. In our example, we can see above that none of the merged chains asserts an order between IDENT(contin)@1 and insert-past.

Assibilation in a derived environment (IDENT(contin)@5) is always preceded by ‘insert-past’ after chain merger, because those two processes interact: insertion of past-tense /-i/ must occur in order for IDENT(contin)@5 to be harmonically improving. But insertion of past-tense /-i/ doesn’t interact with IDENT(contin)@1, because IDENT(contin)@1 is harmonically improving both before and after the insertion of /-i/. Chain merger therefore serves as a formally explicit means of dividing derived from underived environments: in our example, an IDENT(contin)-violating LUM is preceded in the rLUMSeq by an affix-insertion LUM only just in case IDENT(contin)-violation was only harmonically-improving after the insertion of the affix. The notion ‘derived environment’ can therefore be formally defined as follows in OI (and in OT-CC generally):

- (19) A LUM α occurs in an environment derived by another LUM β iff, in the candidate in question, β precedes α in the rLUMSeq.

This means that the process α can be blocked in non- β -derived environments by ranking PREC(β , α) above the markedness constraint which favors performing α . In the case of Finnish /tilat-i/, assibilation in the underived environment (IDENT(contin)@1) is blocked by ranking PREC(insert-affix, IDENT(contin)) above *ti:

(20)

//ORDER-PAST//	PREC (insert-affix, IDENT(contin))	*ti
a. [tilasi] rLUMSeq: <insert-root, insert-past, IDENT(contin)@5>		1
b. [silasi] rLUMSeq: {<insert-root, insert-past, IDENT(contin)@5>, <insert-root, IDENT(contin)@1>}	W_1	L
c. [silati] rLUMSeq: {<insert-root, insert-past>, <insert-root, IDENT(contin)@1>}	W_1	1
d. [tilati] rLUMSeq: <insert-root, insert-past>		W_2

The candidate *[silasi], which assibilates in both derived and underived environments, fares better than attested [tilasi] on *ti, but *[silasi] loses because it violates PREC(insert-affix, IDENT(contin)).

The formalization possible in OT-CC of what it means for an environment to be ‘derived’ bears a certain intuitive similarity to the formulation of the principle of “Proper application of cyclic rules” (i.e., the Strict Cycle Condition) in Mascaró (1976):

(21) For a cyclic rule to apply properly in any given cycle j , it must make specific use of information proper to (i.e. introduced by virtue of) cycle j .

In a cyclic analysis of Finnish /tilat-i/, we could assume that the first cycle of rule-application begins with the addition of the suffix /-i/ to input /tilat/. The proper application restriction would mean that the rule of Assibilation could not apply to the root-initial /ti/ sequence, because that sequence was not created on the current cycle.

This is conceptually similar to the way in which OT-CC distinguishes derived environments from underived ones. Processes in derived environments ‘make specific use’ of a prior LUM in that the earlier process crucially contributed to the later process being harmonically improving.

There is, however, an important difference between the OT-CC approach to NDEB and Mascaró’s (1976) “proper application” condition. The rLUMSeqs, as we’ve seen, encode an implicit division of derived environments from underived ones. The harmonic improvement requirement and the mechanism of chain merger give us this automatically. These characteristics of OT-CC are independently motivated to allow for the analysis of counterfeeding and counterbleeding opacity. This is apparent from the fact that these devices form part of the original OT-CC proposal (McCarthy 2007a), in which NDEB was not an envisioned application of the theory. (Indeed using OT-CC to model NDEB requires us to discard the $B \gg \text{PREC}(A,B)$ ranking metaconstraint proposed in that work.) What this means is that OT-CC requires no special assumptions of any kind that are specific to NDEB. The separation of derived from underived environments in the rLUMSeq comes for free from the general premises of the theory.

The fact that OT-CC’s can model DEEs without adding any new theoretical machinery gives it a major advantage over rule-based phonology of the *SPE* tradition (Chomsky & Halle 1968). In rule-based phonology, counterfeeding and counterbleeding opacity are modeled via rule ordering. However, rule ordering by itself is incapable of modeling DEEs (Kenstowicz & Kisseberth 1970, 1977). In Polish, for instance, merely ordering spirantization after palatalization does nothing to prevent underlying /j/ from being spirantized:

(22)	UR	/j/
	<i>Palatalization:</i> [dorsal] → [coronal] / _ [-cons, -back]	<i>doesn't apply</i>
	<i>Spirantization:</i> j → [+contin]	ž
	SR	*[ž]

SPE assumes that rules apply in Markovian fashion: all that a rule knows about is what the output of the last rule was. This has the result that, as shown above, the spirantization rule required in Polish has no way to tell whether any given /j/ is derived from /g/ or not.⁸⁸ The inability of rule ordering to account for DEEs means that rule-based phonology needs to add some additional theoretical device in order to explain them, and indeed a variety of such devices have been proposed. These include the Alternation Condition (Kiparsky 1968), the Revised Alternation Condition (Kiparsky 1973a), the Strict Cycle Condition (Chomsky 1973, Kean 1974, Mascaró 1976), lexical identity rules that block other rules through the Elsewhere Condition (Kiparsky 1973b, 1983, Giegerich 1988), and underspecification of segments that alternate in derived environments (Inkelas & Cho 1993, Kiparsky 1993a, Inkelas 2000). Another possibility, of course, would be to keep rules but abandon the assumption of Markovian application, allowing for ‘global rules’ which refer back to earlier stages of the

⁸⁸ Importantly (*pace* Anderson 1981), a theory that assumes Markovian rule application can’t simply explain NDEB via the hypothesis that language learners will assume a rule to apply in underived environments only if there is positive evidence for such application. The learner’s tentative assumption “this rule doesn’t apply in underived contexts” must be formally expressed in the grammar in some way. If individual rules have no access to prior stages of the derivation (and hence no ability to distinguish derived from underived environments), then there is no grammatical vocabulary by which learners could state such an assumption. (See Kiparsky 1993a for similar remarks.)

derivation in their structural descriptions (e.g. Miller 1974, 1975, Kenstowicz & Kisseberth 1977).

In OT-CC, by contrast, the situation is very different. The same formal devices that OT-CC uses to analyze counterfeeding and counterbleeding, namely *PREC* constraints and the system of chain merger that filters out noncrucial process interactions, can be extended to NDEB effects without having to add anything new. Occam's Razor therefore recommends OT-CC over rule-based phonology.

In addition to this parsimony argument, the OI/OT-CC approach to NDEB is supported by several empirical predictions which I will present in the following subsections. The predictions are five. First, OT-CC allows for DEEs which occur in phonologically-derived environments as well as ones which occur in morphologically-derived environments. Second, NDEBed processes will not be permitted to apply in vacuously-derived environments. Third, OI allows for NDEBed processes to apply in environments that are derived through the removal of a blocking condition, not just in those that are derived through the addition of a triggering condition. Fourth, only a single process or natural class of processes will be permitted to create the 'derived' environment that allows a given DEE to occur. Fifth, an NDEBed process will always be blocked if its conditioning environment was underlyingly present, even if subsequent processes derive a new conditioning environment ('once NDEBed, always NDEBed'). In the remainder of this chapter, I will present each of these predictions in turn, and then review some difficulties facing other theories of NDEB.

4.2 Predictions of the OI/OT-CC approach to NDEB

4.2.1 There are DEEs that occur in phonologically-derived environments

In the earliest generative literature recognizing the NDEB phenomenon (Kiparsky 1973a, Mascaró 1976), there were two ways in which a ‘derived environment’ was thought to be able to arise: either through morph concatenation (as in Finnish assibilation) or through application of a prior phonological rule (as in the Polish /j/-spirantization example). Several subsequent works have questioned, however, the possibility that a phonologically-derived environment can license a DEE (Hammond 1992, Anttila & Cho 1999, Čavar 2004, 2005). Also, as we’ll see, the possibility of DEEs in phonologically-derived environments is ruled out by certain accounts of NDEB based on Stratal OT or OO-faithfulness constraints.

As our discussion of the Polish example shows, OT-CC can model DEEs which occur in phonologically-derived environments. While doubts about this particular example have been raised (Čavar 2004, 2005), it is far from unique. Makassarese *ʔ*-epenthesis, for instance, is also a DEE that arises in phonologically-derived environments: /ʔ/ is epenthesized after a word-final vowel, but only if that vowel is itself epenthetic. As the /rantas/ → rantasa → [ràntasaʔ] example shows, this occurs even in unaffixed words, where the epenthesis is not conditioned by affixation. Campidanian Sardinian intervocalic lenition (Bolognesi 1998, Łubowicz 2002), Tiberian Hebrew vowel lowering (Prince 1975), and Slovak diphthongization (Rubach 1993) present further examples. In the following subsections, we’ll look at the cases of German /g/-spirantization and child English /z/-deletion, as well as Steriade’s (2000b)

and Burzio's (2002a) arguments that English CiV lengthening can apply only in environments characterized by both a phonological and a morphological change.

4.2.2 Vacuously-derived environments don't license application of DEEs

In rule-based phonology, the most prominent strategy for modeling DEEs is the Strict Cycle Condition (Chomsky 1973, Kean 1974, Mascaró 1976), which states that cyclic rules cannot apply in underived environments. There are a number of complications in defining what should count as a 'derived environment', however. One is that an underlying environment may become 'derived' through the vacuous application of a phonological rule. In the case of the Polish DEE discussed above, an input like /briǰ-ĭk-i/ might vacuously undergo the rule that makes [-anterior] consonants [coronal] before front vocoids. This should make the /ǰ/ 'derived' and hence eligible for spirantization, but, as we saw, underlying /ǰ/s do not spirantize.

In the OT-CC/OI account of derived environment effects, there is no possibility of vacuous application of phonological processes. In OT generally, a 'process' is simply a disparity between input and output which is harmonically-improving because the altered output does better than the unaltered input on some markedness constraint. If the input already satisfies the markedness constraint, however, the particular input/output disparity in question does not occur. In Polish, for example, the palatalization of velars before front vowels is due to a markedness constraint which (however exactly it is formulated) assigns violation-marks to sequences of a velar followed by a front vocoid (what I've labelled above as *KE). The input /ǰ/ of /briǰ-ĭk-i/ does not violate this constraint, so the place features of the /ǰ/ remain unchanged in

the output. So rather than the /j/ vacuously being made coronal, in OT *literally nothing happens*. There is no IDENT[place]-violating LUM involving the /j/ of /briĵ-ĵk-i/ in any valid chain. Hence, if the /j/ were to be spirantized, PREC(IDENT[place], IDENT[contin]) would be violated. Consequently, the NDEBed spirantization process is not able to apply in ‘vacuously derived environments’ because these really are ‘underived environments’, with the relevant PREC constraint being violated.

One possible example of vacuously derived environments counting as derived for NDEB purposes was argued to occur in Catalan (Mascaró 1976). Certain pre-stressing suffixes in Catalan cause stress to be assigned to the preceding syllable of the base. If /o, e/ become stressed in this manner, they lower to [ɔ, ɛ]:

- | | | | | |
|------|---------|---------|-------------|-------------|
| (23) | [kánon] | ‘canon’ | [kənón-ik] | ‘canonical’ |
| | [tótém] | ‘totem’ | [tuté-m-ik] | ‘totemic’ |

The question of vacuously-derived environments arises because this lowering happens to a stressed vowel before a pre-stressing suffix, even if that vowel would be stressed anyway in the unaffixed base:

- | | | | | |
|------|--------|------------|-----------|-----------|
| (24) | [króm] | ‘chromium’ | [króm-ik] | ‘chromic’ |
| | [iβér] | ‘Iberian’ | [iβér-jə] | ‘Iberia’ |

Lowering therefore appears to apply even under vacuous pre-stressing. However, according to Mascaró (2003), the argument does not in fact go through. In Catalan paroxytone and proparoxytone stems with stressed mid vowels, those vowels evidently tend to be lowered [ɔ, ɛ] rather than unlowered [o, e] anyway (Fabra 1912, 1956), so lowering in the examples above can be seen as a reflex not of vacuous pre-stressing but

of the stressed syllable's position in the word (see also Kiparsky 1993a for a similar argument).

The prediction that vacuous *phonological* derivation 'doesn't count' for NDEB is thus almost certainly correct. A more contentious issue is that of environments that are vacuously derived morphologically. Following McCarthy (2003b), I will refer to instances of this possibly hypothetical pattern as *pseudo-DEEs*. In a pseudo-DEE, a process fails to apply in *root* and does apply in *root+affix*, even though the addition of *affix* does not contribute in any plausible way to making the process harmonically-improving. Descriptively, pseudo-DEEs take the form of phonological processes which apply only in affixed words, regardless of whether the affix's presence contributes to the conditioning environment for the process. In OT terms, this translates to the assumption that there are markedness constraints which apply only in affixed words, not in unaffixed ones (or which are ranked above faithfulness only if an affixed word is being evaluated: Dinnsen & McGarrity 1999, 2004, Burzio 2000, 2002a, Yu 2000).

Before moving on to specific putative example of pseudo-DEEs, a couple of important general points can be noted. First, even if pseudo-DEEs do exist, there are DEEs effects which are clearly not pseudo. In Finnish, for example, 'order-PAST', which is underlyingly /tilat-i/, surfaces as [tilasi] and not as [silasi]. If assibilation in Finnish took the form of a constraint "[*ti] in affixed words", there would be no way to explain why assibilation affects the root-final /t/ but not the root-initial one. Therefore, even if pseudo-DEEs exist, an independent account will be still be required of non-pseudo DEEs, as in Finnish assibilation or the Ndjébbana stop alternations which we'll look at in the next section.

Second, an approach to NDEB based on markedness constraints applicable only in affixed words cannot generalize to DEEs involving phonologically-derived (as opposed to morphologically-derived) environments (Łubowicz 2002). Consider the two following examples (repeated from earlier) involving palatalization and spirantization of /g/ in Polish:

- (25) dron[g]-ik-ĭ → drõw[ž]-ek ‘pole-diminutive’
 bri[j]-ik-ĭ → bri[j]-ek ‘bridge-diminutive’

Underlying /g/ palatalizes and then spirantizes before the vowel of the diminutive suffix, but underlying /j/ is retained faithfully in exactly the same environment. Because this DEE involves different behavior of derived [j] (avoided) vs. underived [j] (allowed) in words that have the exact same diminutive morphology, there is no way to obtain the DEE from a constraint “*[j] in affixed words”. The obvious problem is that this constraint would be expected to trigger the spirantization of the underlying /j/ of ‘bridge’. The OT-CC approach to NDEB accomodates the Polish example easily, as the analysis presented earlier demonstrates. By contrast, to an approach based on affixed-word markedness constraints, the Polish facts are a mystery.

Let’s now consider the evidence that has been marshaled in favor of the existence of pseudo-DEEs. The first case noted in the literature also came from Catalan (Mascaró 1976). This concerns the rule of Vowel Reduction, which turns /o, ə/ into [u] and /a, e, ε/ into [ə] in unstressed syllables. The activity of the rule can be observed in alternations like the following, where stress shifts under affixation:

- (26) [póp] ‘octopus’ [pup-ét] ‘octopus-DIMINUTIVE’
 [əkstrém] ‘extreme’ [əkstrəm-á] ‘to make extreme’

Certain roots have unstressed vowels that exceptionally fail to undergo Vowel Reduction if the root is unaffixed, but which *do* undergo the rule if the root receives derivational affixation:

- | | | | | |
|------|-------------------|---------|-----------------------------|------------|
| (27) | [kánon], *[kánun] | ‘canon’ | [kənun-idzá], *[kənon-idzá] | ‘canonize’ |
| | [tótem], *[tótəm] | ‘totem’ | [tutəm-ízmə], *[tutem-ízmə] | ‘totemism’ |

In Mascaró (1976), this is analyzed as a DEE: addition of the affix results in stress re-applying and the unstressed root vowel being (vacuously) re-marked as unstressed. Because the property of unstressedness is now derived, the Strict Cycle Condition allows the vowels to reduce. In OT-CC, this analysis would be impossible to recapitulate because the vowels in question remain unstressed throughout the derivation, both before and after the addition of derivational affixes. Since being unstressed is the only precondition for undergoing Vowel Reduction, it’s not the case that reduction would be crucially preceded by affixation.

Another analysis of such cases is, however, possible. As Kiparsky (1993a) points out, the Catalan words in question appear to be mostly loans or learned vocabulary, and so the fact that they undergo a process only when affixed can be seen as an example of loss of exceptionality under derivation (also the conclusion of Mascaró 2003). The original argument for this device (Kiparsky 1973a) concerned the phenomenon of French *h aspiré*, in which certain vowel-initial words behave as if they were consonant-initial, e.g. by taking the *le/la* forms of the definite article, rather than the *l’* that is normal before a vowel-initial word.⁸⁹ Pairs like *le Hitler* [lə.t.lɛʁ] ‘the Hitler’ vs. *l’hitlérien* [lit.lɛʁ.jɛ̃] ‘the hitlerite’ show that the exceptional *h aspiré* property can be lost under

⁸⁹ See Boersma (2007) for an OT treatment of *h aspiré* and an extensive review of the previous literature on the topic.

derivation. This loss is easily understandable if exceptionality is marked by a diacritic feature carried by the root (which in OT might take the form of an index to a lexically specific constraint: Kraska-Szelenk 1997, 1999, Fukuzawa 1999, Itô & Mester 1999, 2001, Pater 2000, 2004, 2006, to appear, Ota 2004, Tessier 2007, Becker 2008), and if this feature fails to percolate up in a derived word:

(28) a.
$$\begin{array}{c} \text{Word}_{[+h \text{ aspiré}]} \\ | \\ \sqrt{\text{itlɛʁ}}_{[+h \text{ aspiré}]} \end{array}$$

b.
$$\begin{array}{c} \text{Word} \\ / \quad \backslash \\ \sqrt{\text{itlɛʁ}}_{[+h \text{ aspiré}]} \quad \text{ijẽ} \end{array}$$

This failure to percolate follows on the view that the derivational affix is the head of the constituent labelled *Word* above. This could follow either from some version of the Righthand Head Rule (Williams 1981, Selkirk 1982), or from the assumption that category-assigning affixes like French *-ien* are heads of nP, vP, and aP projections (Marantz 1997, 2001, Arad 2005, Embick & Marantz 2008; see also Acquaviva 2008 on the treatment of such issues in Distributed Morphology). The loss-of-exceptionality-under-derivation analysis thus provides a workable alternative for Catalan Vowel Reduction (Kiparsky 1993a, Mascaró 2003).

Appealing to an analysis of the Catalan Vowel Reduction (and *h aspiré*) facts based upon the assumption that roots can lose exceptional properties in morphologically derived contexts is attractive insofar as this assumption is independently necessary outside of phonological derivations. For example, denominal verbs (at least in English) have been observed to uniformly take regular past tenses,

even if a verbal form containing the same root is irregular: *stand* ~ *stood* but *grandstand* ~ *grandstanded* (**grandstood*). Likewise, irregular roots revert to taking regular inflection if used with a nonliteral or other noncanonical meaning: *the birds flew* but *the batter flied* (**flew*) *out to center field*. These and related facts are discussed by Kiparsky (1982a,b), Pinker & Prince (1988), Pinker (1999) and Acquaviva (2008), among others. It also seems possible for exceptionality in grapheme-segment mappings to be lost under derivation. For example, I, and I suspect many other English speakers, have an alternation between *Quixote* [kij.hó.te], with a semi-Spanish grapheme-segment mapping, and *quixotic* [kwík.zá.rík], with a nativized English grapheme-segment mapping.

A few other examples of pseudo-DEEs have been suggested, which I'll now review. Catalan presents another case which can straightforwardly be treated as loss of exceptionality under derivation (Mascaró 2003): certain loans from Spanish have [θ] in underived forms which alternates with [s] in morphological derivatives of the root, e.g. [θerβántes] 'Cervantes' ~ [sərβəntí] 'Cervantian'.

Burzio (1994, 2000) argues that English displays an effect that he calls Generalized Shortening, which shortens long vowels in affixed words. He argues that this assumption makes it possible to subsume within a single analysis a variety of different vowel shortening patterns in English. These include well-known patterns like Trisyllabic Shortening (Chomsky & Halle 1968, Kiparsky 1968, 1973a, 1982a,b, Myers 1987, Lahiri & Fikkert 1999) which does seem to show the behavior of a standard, non-pseudo DEE:

(29) *Trisyllabic Shortening*

$\sigma \rightarrow \text{short} / _ \sigma \sigma$

Applies in derived environment: *di.v[ai]ne* ~ *di.v[ɪ]ni.ty*

Blocked in underived environment: *d[ai].no.saur*, *n[ai].tin.gale*

However, Burzio argues, English goes beyond this to display an across-the-board pressure to shorten in derived words, regardless of whether (or where) the affix adds syllables, or of whether it causes stress to shift. He suggests (1994: §10.3) that all cases of vowel shortening in English can be reduced to one of three categories:

<i>shortening pattern</i>	<i>example</i>	<i>stress preserved between base and derivative?</i>	<i>generalized shortening occurs?</i>
a. trisyllabic shortening	di.v[áɪ]ne ~ di.v[ɪ]ni.ty	Yes	Yes
b. shortening in unstressed syllable	def[éɪ]m ~ def[ə]mátion	No	Yes
c. “morphological” shortening	blasph[íj]me ~ blásph[ə]mous	No	Yes
	<i>but:</i> des[áɪ]re ~ des[áɪ]rous	Yes	No

Table 4.1. English vowel-shortening patterns as classified by Burzio (1994)

As mentioned, case (a), trisyllabic shortening, displays the behavior of a standard NDEB effect. Likewise, examples like (b) occur in non-vacuously derived environments to the extent that the presence of the syllable contributed by the affix serves to condition the locus of stress. Both of these patterns are, Burzio says, systematic in English, in contrast to the case (c), which, as illustrated, does not apply consistently.

Paradoxically enough, it is the unsystematic class of alternations (c) which is said to make the empirical case for Generalized Shortening. Burzio’s argument (2000) is that patterns (a)-(c) are governed by two OT constraints which are unranked with respect to one another: Generalized Shortening (GS), and Stress Preservation (SP),

which demands that the base and the affixed form have stress in the same location. Shortening is systematic in (a) because both GS and SP can be satisfied (as *divíne* ~ *divínity* shows). In case (b), shortening would require stress shift, but satisfaction of SP is impossible anyway because forms with non-shifted stress like **defámation* would be metrically ill-formed in English. Hence there is no incentive not to perform GS. Unsystematicity arises in (c) because there are two options that would be metrically well-formed in English: shorten and shift stress (as in *blasphéme* ~ *blásphemous*) or keep stress the same, but don't shorten (as in *desíre* ~ *desírous*). That is, one or the other of GS and SP must be violated. Since these constraints are unranked, individual lexical items can idiosyncratically select one or the other option of resolving the inconsistency (thus assuming basically the same theory of morpheme-specific phonology in Anttila 2002).

The paradoxical aspect of this argument thus is that the case for an across-the-board Generalized Shortening pressure (as opposed to standard NDEB, and simple unstressed-vowel reduction) is made on the basis of those cases where GS would be in part lexically idiosyncratic. This invites the objection that lexical idiosyncrasy in English stress/quantity interactions is not limited to case (c). These include well-known exceptions to trisyllabic shortening like *ob[íj]se* ~ *ob[íj]sity* (discussed in regard to the GS proposal by Kager 1995), which Burzio (2000) proposes to treat as listed allomorphy. Considerations like this make it somewhat difficult to separate the case for the existence of GS as a pseudo-DEE effect from the general background of idiosyncratic alternations in the English stress/quantity system.⁹⁰

⁹⁰ Burzio (1994: 323, fn. 7) also entertains the idea that Generalized Shortening could be treated as loss of exception features under derivation (assuming that preservation of input-specified vowel length in English is due to some kind of diacritic feature, e.g. an index to a morpheme-specific IDENT(length) constraint).

Kiparsky (1993a) cites Steriade (1987) as arguing for the existence of a pseudo-DEE pattern in Yakan (Behrens 1973). The phenomenon in question is this: in suffixed words, underlying /a/ in syllables preceding the stressed syllable becomes [e]. This, however, can be understood as a standard DEE, because stress in Yakan is uniformly penultimate. That means that suffixation always causes stress to shift (Behrens 1973: 25), provided of course that the suffix contains a vowel—as all of the examples cited by Behrens indeed do. The assignment of surface penultimate stress is therefore always preceded by the insertion of any and all suffixes (since such suffixes must be present to know which syllable is to be the penult). Consequently, any phonological process conditioned by the location of stress is also, by transitivity, preceded by suffixation in suffixed words.⁹¹

Lastly, pseudo-DEEs have also been argued to occur in child language. Dinnsen & McGarrity (1999, 2004) discuss data from two children who appear to have such a pattern. Child 15 (5;1) changes /s, z/ into [θ, ð] in suffixed words:

- | | | | | |
|------|--------|--------|----------|------------|
| (30) | [sup] | 'soup' | [θupi] | 'soupy' |
| | [swim] | 'swim' | [θwimɪn] | 'swimming' |
| | [bʌz] | 'buzz' | [bʌðɪŋ] | 'buzzing' |

Interestingly, Child 33 (6;6) does exactly the reverse:

- | | | | | |
|------|--------|---------|----------|------------|
| (31) | [θup] | 'soup' | [supi] | 'soupy' |
| | [θwɪp] | 'sleep' | [swɪpɪŋ] | 'sleeping' |

⁹¹ This argument assumes that Yakan roots are not lexically stored with stress lying in the position that it has in the affixed form. If the stress was underlyingly in this position, then there would be no LUM of stress placement in the affixed form of the root, and raising of underlying pretonic /a/s would violate PREC(stress, raising). While strictly speaking Richness of the Base forces us to contemplate the possibility of such roots, there may be (Becker 2008) reasons to think that learners assume by default that the UR of a root is identical to its citation surface form. In that case, surface-penult stress in suffixed words is always placed by an unfaithful mapping.

Both of these children have phonological delays, however, so we perhaps may want to be hesitant in extrapolating theoretical conclusions from their data.⁹²

In sum, then, the empirical case for the existence of pseudo-DEEs in natural languages is not great. Those examples which are more convincing, such as the cases of Catalan Vowel Raising and of *h aspiré*, can quite plausibly be treated as loss of exceptionality under derivation. We thus can conclude that the OI/OT-CC approach to NDEB is correct in predicting that NDEBed processes cannot become un-blocked in vacuously derived environments.

The topic of pseudo-DEEs will be raised again in section 4.3, where the specific analytic devices adopted by Burzio (2000) and Yu (2000) in response to argued cases of pseudo-DEEs are discussed.

4.2.3 Environments can be derived via removal of a blocking condition

In this section I'll show that OI/OT-CC admits a class of DEEs which are predicted to be impossible in certain other models, particularly Comparative Markedness (McCarthy 2003b,c). The first example comes from the Australian language Ndjébbana (McKay 1984, 2000), and is argued by Kurisu (2007) to represent a case of a pseudo-DEE; the second comes from German (Itô & Mester 2003b).

⁹² A different NDEB-like effect is reported from the speech of a non-delayed child by Matthei (1989). In general, what seems to occur is that two-word utterances are subject to restrictions similar to those which the child at the same stage imposes on single words in isolation. So for instance, two-word utterances are limited to two syllables, with each word being truncated to one syllable; likewise, an obstruent in the onset of the second syllable of a single word or of a two word utterance tends to be voiceless. While these patterns have the flavor of markedness pressures applying only to words in juncture (vacuously derived context), it might be equally possible to assume that the child at this stage was simply parsing utterances as a single (prosodic and/or morphosyntactic) word, accounting for the parallel phonological restrictions imposed on one- and two-word utterances.

Ndjébbana has a single phonemic stop series. Generally, stops are voiced in onsets and voiceless in codas. Onset stops can, however, be voiceless following a preceding voiceless stop. This results in near-minimal pairs like the following (McKay 2000), which are identical except that one has a singleton voiced stop and the other has a voiceless geminate:

- (32) [gabála] '(s)he ate it'
 [gappála] 'boat'

In this language, root-initial /b/ and /j/ undergo two alternations when preceded by a vowel-final prefix. If the root-initial syllable is stressed in the prefixed word, the stops geminate and devoice to [pp] and [cc], respectively; if the root-initial syllable is unstressed, they lenite to [w] and [j], respectively:

- (33) *Root-initial stop alternations in Ndjébbana*
- | | | | |
|------------|---------------|------------------------------|----------------------|
| /jawé/ | | /bíttabo/ | |
| jawé-la | 'be sick' | (no unprefixing forms cited) | |
| ka-jawé-la | 'he was sick' | ɲá-wottabo | 'I am following him' |
| ka-ccúwa | 'he is sick' | ɲa-ja-ppíttaba | 'I will follow him' |

These can both be understood as cases of NDEB in that root-internal /b/ and /j/ are not subject to the alternations:

- (34) *No gemination or gliding of root-medial stops*
- | | | |
|---------------|-----------------|--------------------------|
| gabála | *gappála | '(s)he ate it' |
| ɲá-wottabo | *ɲá-wottawo | 'I am following him' |
| jíja | *jíja | 'man' |
| bi-ri-ɲijí-na | *bi-ri-ɲiccí-na | 'the two of them talked' |

Kurisu (2007) contends that the NDEBed gemination and gliding processes in Ndjébbana are pseudo-DEEs because, he claims, the presence of the prefix does not serve to condition the two alternations. It does seem to be true that the presence of a prefix

does not, in general, serve to determine stress placement, as stress in Ndjébbana is contrastive (McKay 2000, §2.1.6). Additionally, the one sub-pattern of predictable stress that McKay (2000) mentions will not always be dependent on prefixes. “Certain forms of verbs and some nominals” have stress on the root-final syllable, unless there are no suffixes (i.e., unless the root-final syllable would be word-final), in which case stress is initial. Consequently, as long as there is at least one vowel-containing suffix, the prefixes play no role in deriving the context for stress placement (since, in that case they neither carry stress nor need to be present to determine which syllable is the stressable one).

Despite this, it is by no means clear that the vowel-final prefixes have no role to play in deriving the contexts for root-initial gemination and gliding. The gliding of /b/ and /j/ can easily be understood as intervocalic lenition. Gliding is thus a DEE of the typical kind: intervocalic /b, j/ become [w, j] intervocalically, but only if they’ve become intervocalic through morph concatenation. Gliding also needs to be blocked in the onset of stressed syllables, which can straightforwardly be understood as resulting from the constraint favoring gemination of stressed-syllable onsets, to which we’ll turn in a moment, being ranked above the constraint that favors gliding.

For gemination, the story is a bit more complicated. To understand Ndjébbana gemination as a non-pseudo DEE, it needs to be the case that gemination is blocked just in case it would only be harmonically improving to geminate after the addition of a prefix. This will indeed be the case if we assume that the *absence* of a prefix makes it harmonically disimproving to geminate a stop.

Our analysis will have three parts. First we need to account for why gemination of the stop in the onset of a stressed syllable should be favored. Geminate have been argued in several languages to contribute weight to the syllable of the following vowel, both word-initially and word-medially (see esp. Davis 1999, Topintzi to appear, and references cited there). Assuming this is true in Ndjébbana as well, geminating the onset of a stressed syllable will be favored by the Stress-to-Weight Principle (Prince 1990) which demands that stressed syllables be heavy.⁹³

(35) *Geminating onset of stressed syllable is harmonically improving medially*

abá	SWP	IDENT(length)
abbá <i>Is more harmonic than:</i>		1
abá	1	

Devoicing of the geminate from /bb/ to [pp] presumably happens at a subsequent step, in keeping with the absence of voiced geminates in Ndjébbana.

Second, we can assume that gemination of stressed-syllable onsets is blocked in word-initial position by a constraint against word-initial geminates. Such a constraint is typologically motivated by the numerous languages (including Ndjébbana itself) which allow geminates medially but not initially:

⁹³ Topintzi (to appear) argues that medial weight-contributing geminates are syllabified as onsets, which is at odds with McKay's (1984, 2005) description of Njébbana geminates as always syllabified heterosyllabically. The main phonological argument for this is that geminates, like non-geminate intervocalic stop clusters, are both constrained to consist only of voiceless consonants. However, even if geminates are syllabified as onsets, a pressure to devoice them is still available, as voiced (and, more generally, more sonorous) geminates are avoided in many languages (Kawahara 2006, 2007).

(36) *Gemination not harmonically improving initially*

/bá/	*INITIALGEM	SWP	IDENT(length)
bá <i>Is more harmonic than:</i>		1	
bbá	1		1

Gemination is therefore not harmonically improving if the stop in question is the initial segment of an unprefixated root. However, if we add a prefix to our example root /bá/, then it becomes harmonically improving to geminate, since *INITIALGEM is now irrelevant:

(37) *Addition of prefix makes it harmonically-improving to geminate root-initially*

/ŋa-bá/	*INITIALGEM	SWP	IDENT(length)
ŋa-bbá <i>Is more harmonic than:</i>			1
ŋa-bá		1	

Prefixation thus ‘derives’ the context for gemination because it renders the stop intervocalic, thereby removing the barrier to gemination of the stop posed by *INITIALGEM. Now that the analytic strategy has been established, it becomes possible to see why I’m assuming that the root-initial stops geminate first, and then devoice. Simply put, there’s no reason to think that any language would only allow devoicing intervocalically (given that intervocalic voicing is a typologically common process). If gemination is the first step, then a sensible account is readily at hand of why the initial alternations depend on the intervocalic context created by prefixation.⁹⁴

⁹⁴ The fact that gemination only occurs in root-initial syllables preceded by a *vowel-final* prefix can be explained by looking at the cluster phonotactics of the language. Intervocalic C+geminate clusters are generally allowed only if the C is a liquid (McKay 2000), and the examples cited by McKay and Kurisu of gemination failing to occur following a consonant-final prefix all involve prefixes that end in a nasal, e.g. [n-bókka] ‘bad.MASC’.

The third part of our analysis will be to ensure that gemination applies only in environments derived by prefixation. Following our previous analyses of NDEB effects, we can posit a constraint $\text{PREC}(\text{insert-prefix}, \text{IDENT}(\text{long}))$, which will have to be ranked above the SWP in order to block gemination in unprefixated contexts. To illustrate why gemination will be blocked for medial consonants, let's consider a hypothetical prefixed word / $\eta\text{a-tabá}$ /. Because the /b/ which is in a stressed-syllable onset is medial, *INITIALGEM will have no objection to geminating it, so it will be harmonically improving to geminate it either before or after the insertion of the prefix. The chains which we have to consider are then the following (with gemination and geminate devoicing conflated into a single step for ease of illustration):

- (38) a. $\langle \text{AF-ROOT}, \text{AF-tabá}, \text{AF-tappá}, \eta\text{a-tappá} \rangle$
LUMSeq: $\langle \text{insert-root}, \text{IDENT}(\text{length}), \text{insert-prefix} \rangle$
- b. $\langle \text{AF-ROOT}, \text{AF-tabá}, \eta\text{a-tabá}, \eta\text{a-tappá} \rangle$
LUMSeq: $\langle \text{insert-root}, \text{insert-prefix}, \text{IDENT}(\text{length}) \rangle$
- c. $\langle \text{AF-ROOT}, \text{AF-tabá}, \eta\text{a-tabá} \rangle$
LUMSeq: $\langle \text{insert-root}, \text{insert-prefix} \rangle$

Chains (a) and (c) are convergent, so they will be merged into a single chain with the rLUMSeq $\{ \langle \text{insert-root}, \text{insert-prefix} \rangle, \langle \text{insert-root}, \text{IDENT}(\text{length}) \rangle \}$. In this rLUMSeq, no assertion is made of an ordering relation between gemination and the insertion of the affix. This is because, as just mentioned, gemination of a medial consonant is harmonically improving both before and after the insertion of the affix. Because the merged chain with gemination does not have affixation occurring prior to deletion in its rLUMSeq, the gemination chain will violate $\text{PREC}(\text{insert-prefix},$

IDENT(long)). As a result, the merged chain with gemination will lose to chain (c), which doesn't geminate:

(39) *Gemination blocked root-medially*

//AF-ROOT//	PREC (insert-prefix, IDENT(lgth))	SWP	IDENT (lgth)
[ŋa-tappá] rLUMSeq: {<insert-root, insert-affix>, <insert-root, IDENT(length)>}	W ₁	L	W ₁
☞ [ŋa-tabá] rLUMSeq: <insert-root, insert-affix>		1	

Now let's consider by contrast a hypothetical word /ŋa-báta/ where the /b/ that's in the onset of the stressed syllable is root-initial. Here, owing to the ranking *INITIALGEM » SWP, it won't be harmonically-improving to geminate the /b/ until after the prefix is added. As a result, we now have only two chains, neither of which converges with the other:

- (40) a. <AF-ROOT, AF-báta, ŋa-báta, ŋa-ppáta>
LUMSeq: <insert-root, insert-prefix, IDENT(length)>
- b. <AF-ROOT, AF-báta, ŋa-báta>
LUMSeq: <insert-root, insert-prefix>

Since both chains are nonconvergent, each undergoes merger vacuously, leaving a chain with an rLUMSeq identical to the original LUMSeq. Both of the converged chains satisfy PREC(insert-prefix, IDENT(length)). Chain (b) satisfies it vacuously because there is no IDENT(length)-violating LUM. Chain (a) satisfies it because its IDENT(length)-violating LUM is preceded by affix insertion. Consequently, as PREC(insert-prefix, IDENT(length)) is indifferent to the choice between these two

candidates, the matter is passed along to the pro-gemination constraint SWP, which will decide in favor of [ɲappáta]:

(41) *Gemination allowed root-initially*

//AF-ROOT//	PREC (insert-prefix, IDENT(lgth))	SWP	IDENT (lgth)
☞ [ɲa-ppáta] rLUMSeq: <insert-root, insert-af, IDENT(length)>			1
[ɲa-báta] rLUMSeq: <insert-root, insert-af>		W ₁	L

In Ndjébbana, then, prefixation derives the environment for gemination to occur not because it creates the impetus for gemination (i.e., the stop being in the onset of the stressed syllable) but because it removes a condition which blocks gemination (i.e., the stop being word-initial). As I emphasized earlier, in OI/OT-CC a process α can be said to occur in a derived environment if α didn't become harmonically-improving until after some other process β had occurred. The Ndjébbana example shows that a process α can become harmonically-improving through the occurrence of β even if the markedness constraint that motivates α was violated even before β occurred. In a root with initial stress and an initial singleton stop (e.g. /báta/), SWP is violated both before and after the addition of a V-final prefix. However, gemination is harmonically-improving only after the addition of the prefix, because prefixation removes the gemination-inhibiting effect of top-ranked *INITIALGEM.

Thus, what counts in the OI/OT-CC account of NDEB is not simply when the markedness constraint that motivates the process is violated, but rather when it is and isn't harmonically improving to perform the process. This property of OT-CC, and the

theory's consequent ability to analyze languages like Ndjébbana, distinguishes it from other theories of NDEB such as Comparative Markedness (hereafter abbreviated CM: McCarthy 2003b,c; see also Kurisu 2007 on CM's difficulties with Ndjébbana specifically).

We can illustrate CM's assumptions and its strategy for dealing with DEEs using the Polish example. In CM, markedness constraints come in two types: 'old' and 'new'. Old-markedness constraints penalize marked structures which the candidate in question shares with the fully faithful candidate, while new-markedness constraints penalize structures which the candidate under consideration does not share with the fully faithful candidate. For example, with an input like /gi/, the fully faithful candidate (FFC) is [gi]. In an unfaithful candidate [ji], which has palatalized the /g/, there is an instance of the segment [j] and a concomitant violation of a *j constraint. Because the [j] in question is not shared with the FFC, the candidate /gi/ → [ji] violates the new-markedness constraint $_N^*j$, rather than its old-markedness counterpart $_O^*j$.

Now consider an input with an underlying /j/ like /ji/. Here the FFC is [ji]. Because the FFC necessarily shares all of its marked structures with itself, it can only violate old-markedness constraints, and in particular the FFC [ji] violates $_O^*j$ but not $_N^*j$. Intuitively, old-markedness constraints penalize underived markedness violations and new-markedness constraints penalize derived ones. In a case like that of Polish, where underived [j]s but not derived ones are allowed to surface, we can model the DEE in CM by ranking new-markedness, but not old-markedness, above the relevant faithfulness constraint:

(42) *Comparative Markedness analysis of Polish /g/-spirantization DEE*

/gi/	_N *j	IDENT[contin]	_o *j
a. [ži]		1	
b. [ji]	W ₁	L	

/ji/	_N *j	IDENT[contin]	_o *j
a. [ji]			1
b. [ži]		W ₁	L

In CM, then, a DEE can only arise if the markedness violation that motivates the DEE process is ‘new’ rather than ‘old’, i.e. if the violation does not occur in the FFC. Ndjébbana gemination does not have this property. In CM, DEEs involving morphologically derived environments are handled by assuming that the FFC is a fully-faithful realization of the bare, unaffixed root (McCarthy 2003b). For a morphological DEE to occur, the relevant marked structure must be present in the affixed form but be absent in the unaffixed form. In Ndjébbana, this isn’t the case: for a form like /ja-bóka/ → [ja-ppóka], the FFC would be [bóka]. The trouble is that _oSWP is violated in the FFC, and consequently also in the losing candidate *[ja-bóka]. In order for *[ja-bóka] to lose to [ja-ppóka], _oSWP must be ranked above IDENT[length]:

(43)

/ja-bóka/	_o SWP	IDENT[length]
a. [ja-ppóka]		1
b. [ja-bóka]	W ₁	L

This, however, cannot be the actual ranking in Ndjébbana, as it incorrectly predicts that all underlying stops in stressed-syllable onsets should geminate, regardless of whether the syllable is root-initial or root-medial, or of whether or not there is a prefix:

(44)

/bujúluŋ/	_o SWP	IDENT[length]
a. \bullet^* [buccúluŋ]		1
b. re (FFC) [bujúluŋ]	W_1	L

The difference between CM and OI/OT-CC is that the former theory can model NDEB effects only if the *markedness violation* that motivates the process is derived. The latter theory can model NDEB effects, like Ndjébbana gemination, where it's instead the *absence of a blocking condition* on the process that's derived. As such NDEB effects are attested, CM is over-restrictive, and the OI/OT-CC approach to NDEB should be judged preferable.

Ndjébbana is not alone in presenting an NDEB effect in which the derived environment is derived through the removal of a blocking condition. Another example is found in the German varieties discussed by Itô & Mester (2003b). German famously devoices obstruents in coda position. In the standard variety of the language, underlying /g/ in coda position does not only devoice: if preceded by the vowel /ɪ/, it also spirantizes. The spirantized segment appears as [ç] rather than [x] due to the allophonic alternation (*ich-laut/ach-laut*) between those two fricatives: [x] appears following back vowels, and [ç] elsewhere:

- (45) *Post-[ɪ] spirantization of underlying /g/ in Standard German*
 /kø:nɪg/ → [kø:nɪç] 'king'
 /ho:nɪg/ → [ho:nɪç] 'honey'

In the colloquial speech of northern Germany, spirantization of underlying /g/ applies not only after /l/, but in all coda contexts:⁹⁵

- (46) *Spirantization of underlying coda /g/ in colloquial N. German*
 /tru:g/ → [tru:x] 'carried'
 /tsvɛrg/ → [tsvɛrç] 'dwarf'

This is a DEE because there is no spirantization of underlying /k/ in coda position:

- (47) *No spirantization of underlying /k/*
 plasti[k], *plasti[ç] 'plastic'

In derivational terms, then, it can be said that spirantization of /k/ applies only to /k/s derived from underlying /g/ through coda devoicing.

This pattern is theoretically challenging for CM because it is difficult to see why devoicing a coda segment should create a new markedness violation which can be called on to trigger spirantization. Typology supplies no obvious motivation for assuming that there could be a markedness constraint favoring the spirantization of voiceless velars, but not of voiced ones. However, we can understand the northern German pattern in terms of devoicing deriving the environment for spirantization by removing a condition which blocks spirantization. Specifically, we can assume that colloquial northern German has the following ranking:

- (48) *γ » *VELARSTOP/CODA » IDENT(contin)

The constraint *VELARSTOP/CODA drives spirantization by assigning a violation-mark to every velar stop in coda position. The existence of such a constraint is

⁹⁵ McCarthy (2003b), citing personal communication from Andries Coetzee, reports that much the same happens in Afrikaans.

typologically supported by the existence of at least two other languages where dorsals, but not other stops, spirantize in coda position: Kirchner's (1998) survey of lenition processes cites this as occurring in Uighur (Hahn 1991) and Quechua (Whitley 1978).⁹⁶ The ranking $*\text{VELARSTOP/CODA} \gg \text{IDENT}(\text{contin})$ makes it harmonically improving to spirantize a coda /k/. However, the ranking $*\gamma \gg * \text{VELARSTOP/CODA}$ means that it will not be harmonically improving to spirantize a coda /g/, since this will result in [ɣ]. The German varieties discussed by Itô & Mester never have [ɣ] on the surface, so we can safely assume $*\gamma$ to have as high a rank as may be required. All of this means that spirantization of an underlying /g/ will not be harmonically-improving until after it is devoiced to /k/, allowing it to be spirantized into [x] rather than [ɣ]. (If not preceded by a back vowel, the [x] will subsequently become [ç], as mentioned.)⁹⁷

In terms of chain merger, we can visualize this analysis in the following terms.

There are two possible pathways from /g/ to [x]:

- (49) $g \rightarrow \gamma \rightarrow x$ (spirantization, then devoicing)
 $g \rightarrow k \rightarrow x$ (devoicing, then spirantization)

If the effect of $*\gamma$ were ignored, we'd expect to find chains which did spirantization and devoicing in either of the two orders shown, meaning that no pairwise order between those two processes would survive chain merger. However, the hypothesized high-ranked status of $*\gamma$ means that the mapping $g \rightarrow \gamma$ is not harmonically improving. This leaves $g \rightarrow k \rightarrow x$ as the only available pathway from /g/ to [x]. That is, in a candidate

⁹⁶ There are at least two other cases in which a spirantization process targets only velar stops: postvocalic spirantization in Tigrinya (Schein 1981, Kenstowicz 1982, Hayes 1986, Schein & Steriade 1986) and intervocalic spirantization in Cherokee (Flemming 2005).

⁹⁷ For German dialects which do have onset [ɣ], where $*\gamma$ would have to rank below $\text{IDENT}(\text{contin})$, spirantization of /g/ but not /k/ in coda position could be analyzed using $*\gamma/\text{CODA}$ as the top-ranked constraint. The analysis of such a dialect would run along the same lines as that given in the main text for the northern dialects: coda /g/ must devoice before spirantizing, because the ranking $*\gamma/\text{CODA} \gg * \text{VELARSTOP/CODA}$ means that a /Vg/ → [Vɣ.] mapping will not be harmonically improving.

where underlying /g/ surfaces as [x], the candidate's rLUMSeq will always have devoicing ordered before spirantization.

All we need to do now is to ensure that spirantization can only happen to /k/s that are derivedly voiceless (i.e., derived from underlying /g/) and not to those that are underlyingly voiceless. To accomplish that, we simply have to assume that *VELARSTOP/CODA is dominated by PREC(IDENT(voice), IDENT(contin)):

(50) *Spirantization of underlying /g/ allowed*

/ug/	PREC (IDENT(voice), IDENT(contin))	*γ	*VELARSTOP/ CODA	IDENT (contin)
☞ <ug, uk, ux> rLUMSeq: <IDENT(voi), IDENT(contin)>				1
<ug, uk> rLUMSeq: <IDENT(voi)>			W ₁	L
<ug> rLUMSeq: <>			W ₁	L

(51) *Spirantization of underlying /k/ blocked*

/uk/	PREC (IDENT(voice), IDENT(contin))	*γ	*VELARSTOP/ CODA	IDENT (contin)
☞ <uk> rLUMSeq: <>			1	
<uk, ux> rLUMSeq: <IDENT(contin)>	W ₁		L	W ₁

For underlying /ug/, spirantization can only follow devoicing, since the ranking *γ » *VELARSTOP/CODA means that it isn't harmonically improving to go from /ug/ to /uy/. As such, the candidate with spirantization doesn't violate the PREC constraint, and it

beats its non-spirantizing competitors because of the ranking *VELARSTOP/CODA » IDENT(contin). For underlying /uk/, the picture is different. With the coda velar stop being voiceless underlyingly, there is no possibility of spirantization being preceded by devoicing. Therefore the chain with spirantization violates PREC(IDENT(voice), IDENT(contin)), and as a result it loses.

4.2.4 DEEs can apply in only one kind of derived environment⁹⁸

The most basic description of NDEB effects is “a process applies in derived environments, but not in underived ones.” For at least some languages, this formulation is incomplete in that the environment for a process can be derived in more than one way. If this is the case, does the process apply in all derived environments, or only if its environment is derived in certain ways? In particular, is it possible for both phonological and morphological derivation to license the application of the DEE?

The two classic examples which have been used to argue that both phonologically- and morphologically-derived environments can “count” for deriving the environment of application of a DEE come originally from Kiparsky (1973a). The first (which is probably the best-known example of NDEB in any language) is that of Finnish assibilation. As we saw in chapter 1, a /ti/ sequence in Finnish that’s derived through affixation undergoes assibilation to become [si], but root-internal /ti/ sequences surface faithfully:

⁹⁸ I’m very grateful to Donca Steriade for pointing out the prediction discussed in this section.

- (52) *Finnish assibilation in morphologically-derived contexts*
 /halut-i/ → [halusi] ‘want-PAST’
 (cf. /halut-a/ → [haluta] ‘want-INFINITIVE’)
 /koti/ → [koti], *[kosi] ‘home’
 /vaati-vat/ → [vaativat], *[vaasivat] ‘demand-3PL’
 /tilat-i/ → [tilasi], *[silasi] ‘order-PAST’

Kiparsky (1973a *et seq.*) argues that assibilation also applies to /ti/ sequences that are derived through a process of word-final raising of /e/ to [i]:

- (53) *Finnish assibilation in phonologically-derived context*
 /vete/ → veti → vesi ‘water’

The other example of an NDEBed process applying in both phonologically- and morphologically-derived environments is that of the Sanskrit *ruki* rule. As the rule’s mnemonic name implies, it causes dental /ṣ/ to become retroflex [ʂ] when it’s preceded by any of /r/, /u/, /k/, or /i/. *Ruki* is a DEE, as it fails to apply root-internally:

- (54) *Sanskrit: No retroflexion in underived ruki contexts*
- | | | | |
|----------|---------------------|---------|----------|
| kiṣālaya | ‘sprout’ | puṣṭaka | ‘book’ |
| biṣa | ‘lotus’ | kuṣuma | ‘flower’ |
| barṣva | ‘socket of a tooth’ | buṣa | ‘mist’ |

However, *ruki* does apply in environments derived morphologically, e.g. in compounds (Kiparsky 1982b) and in perfect reduplication (Steriade 1982, 1988, Kiparsky 2007a):

- (55) *Sanskrit: Retroflexion in morphologically-derived ruki contexts*
- | | | | |
|--------|-------------|-------------|------------------|
| [ṣad] | ‘sitting’ | [pari-ṣad] | ‘convention’ |
| [ṣjnc] | ‘sprinkle’ | [abhi-ṣjnc] | ‘annoint’ |
| [ṣnih] | ‘be sticky’ | [si-ṣnih] | ‘be sticky.PERF’ |
| [ṣtu] | ‘praise’ | [tu-ṣtu] | ‘praise.PERF’ |

The *ruki* rule also applies in contexts that are derived phonologically, most particularly by weak-grade ablaut. The deletion or raising of certain vowels in ablaut contexts can create new *ruki* contexts, and the rule is then able to apply (Kiparsky 1982b):

(56) *Retroflexion in ruki context derived by weak-grade ablaut*

UR	/śa:ṣ-ta/
Ablaut	śiṣ-ta
<i>ruki</i>	śiṣ-ta
SR	[śiṣ-t̪a]
	'taught'

What does OI have to say about the possibility of languages like these? On the face of it, Finnish as it is analyzed in Kiparsky (1973a) is predicted to be impossible in OI. In OI, the general schema for DEEs is for the markedness constraint favoring application of the DEE process to be outranked by a PREC constraint which will assign a mark if the process applies in the underived context. In Finnish, two different processes (affixation and raising) derive the context for assibilation to occur, so we will need two PREC constraints: PREC(insert-affix, IDENT(contin)) and PREC(IDENT(high), IDENT(contin)).

The problem that our analysis faces is this: ranking both of these PREC constraints above the assibilation-triggering constraint *ti means that assibilation will be blocked in environments derived just by affixation or just by raising. In environments derived by affixation, assibilation will be blocked because PREC(IDENT(high), IDENT(contin)) is violated; and likewise, in environments derived by raising, assibilation will be blocked because PREC(insert-affix, IDENT(contin)) is violated:

(57) *With multiple PREC constraints, DEE process is always blocked*

//ROOT-AF//	PREC (IDENT(high), IDENT(contin))	PREC (insert-affix, IDENT(contin))	*ti	IDENT (contin)
a. [ti] <ROOT-AF, tilat-AF, tilati>			1	
b. <ROOT-AF, tilat-AF, tilati, tilasi>	W_1		L	W_1

/vete/	PREC (IDENT(high), IDENT(contin))	PREC (insert-affix, IDENT(contin))	*ti	IDENT (contin)
a. [ti] <vete, veti>			1	
b. <vete, veti, vesi>		W_1	L	W_1

To speak in general terms, the OI analysis of Finnish fails because $\text{PREC}(A, B)$ constraints give a penalty if a B-violating process applies in an environment not derived by an A-violating process. This is a problem because the set of environments not derived by A-violation includes both underived environments as well as environments derived by something other than A-violation. Therefore, if $\text{PREC}(A, B)$ can block B-violation from occurring in underived environments, it will also block it in environments derived by anything besides A-violation. As such, OI predicts (under the tacit assumptions we've made so far about how PREC constraints refer to operations) that any given DEE process will only be able to apply in environments derived by some other single, specific process.

If we accept the description of Finnish in Kiparsky (1973a), then this prediction is falsified. However, there do seem to be grounds for re-analyzing the data in which

assibilation appears to apply in contexts derived by raising (Hammond 1992). Hammond notes, citing Keyser & Kiparsky (1984), that Finnish words that are greater than disyllabic do not show raising of final /e/; the /e/ instead deletes in these words, resulting in alternating paradigms like [sammal] ‘moss-NOM.SG’ ~ [sammale-t] ‘moss-NOM.PL’.

In disyllabic stems like /vete/, as we’ve seen, the stem-final /e/ alternates with [i] rather than zero:

<i>Nom. s.g.</i>	<i>Nom. pl.</i>	
vesi	vede-t	‘water’
nimi	nime-t	‘name’
lumi	lume-t	‘snow’

Table 4.2. [e]~[i] alternations in Finnish disyllabic noun stems

Hammond (1992) proposes that this the stem-final /e/ deletes for these roots too, and that the final [i] seen in the nominative singular is in fact a nominative singular suffix. Finally, he suggests that this /-i/ suffix is not seen in the nominative singular forms of longer stems because it is constrained to attach only to monosyllabic bases; longer bases can be assumed to take a zero-allomorph of the nom.sg.:⁹⁹

(58)	<i>Re-analysis of [e]~[i] alternation as deletion + affixation</i>		
	UR of root	/sammale/	/nime/
	final-/e/ deletion	sammal	nim
	Nom.sg. allomorph selection	sammal-∅	nim-i
	SR	[sammal]	[nimi]

Under this reanalysis, there is no need to assume a process of final /e/-raising, and the word-final [i] of such words as [vesi] is a suffix. The assibilation environment in these words would now be derived morphologically, meaning that Finnish assibilation applies only in environments derived by suffixation.

⁹⁹ Similar patterns of suppletive allomorphy are found in other languages, e.g. in Tzeltal (Walsh Dickey 1999, Paster 2006, to appear), the perfective is [-oh] with monosyllabic bases, and [-eh] with longer bases.

Hammond (1992) adduces an independent line of argumentation for the reanalysis of [i] as a suffix. Certain roots which appear with a final [i] in the nominative singular arguably are in fact consonant-final. The relevant evidence comes from the allomorphy of the partitive suffix, which is [-a]~[-ä] in vowel-final stems, but [-ta]~[-tä] in consonant-final stems:

<i>Nom. Sg.</i>	<i>Part. Sg.</i>	
kuppi	kuppi-a	‘cup’
kynä	kynä-ä	‘pencil’
talo	talo-a	‘house’
kylpy	kylpy-a	‘bath’
olut	olut-ta	‘beer’
kallis	kallis-ta	‘expensive’
sisar	sisar-ta	‘sister’

Table 4.3. Finnish partitive allomorphy

Disyllabic stems that end in [i] in the nominative singular do not behave uniformly with respect to partitive allomorphy: some act as if they’re vowel-final, others as if they’re consonant-final:

<i>Nom. sg.</i>	<i>Part. sg.</i>	
suomi	suome-a	‘Finland’
nimi	nime-ä	‘name’
savi	save-a	‘clay’
kieli	kiel-tä	‘language’
lumi	lum-ta	‘snow’
vesi	vet-tä	‘water’

Table 4.4. Allomorphic split in Finnish disyllabic [i]-stems

If the final [i] seen in the nominative singular is part of the stem, then this split is mysterious. If, however, it’s a suffix, a simple analysis becomes possible. The roots that take /-ta/ in the partitive can be assumed to be underlyingly C-final: /kiel/, /lum/, /vet/, etc. Meanwhile, the roots that take /-a/ in the partitive singular would be

underlyingly V-final: /suome/, /nime/, /save/. As depicted above, these roots' final [e] deletes in the nominative singular prior to the insertion of the /-i/ suffix, accounting for why their nominative singular forms are e.g. [nimi] and not *[nimei]. One last point that has to be explained in the proposed reanalysis is why an underlyingly C-final stem like /lum/ should have an [e] in the nominative plural: [lume-t], *[lumt]. Hammond (1992) argues that this vowel is epenthetic. Alternatively, we could posit two distinct allomorphs of the plural suffix: monosyllabic C-final roots take /-et/, and other stems take /-t/.

An additional reason to be suspicious of examples like /vete/ → [vesi] as evidence for assibilation being able to apply in environments derived by raising comes from Anttila (2006). He notes that Finnish nouns for the most part do not undergo assibilation at all, something which can straightforwardly be analyzed via an appeal to high-ranked noun faithfulness (Smith 1997, 1998a,b, 1999, 2001). Noun roots that do assibilate, such as /vete/ 'water' are a closed class, and, interestingly, all end in [-e] in the nominative singular. Consequently, another option for dealing with data like [vesi] is to assume that roots in this closed class simply have multiple memorized allomorphs (/vet-/ , /ves-/), and that the apparent assibilation that they display is not actually productive phonology but simply memorized allomorphy. On this view, as with the morphological re-analysis of the final [-i], the evidence for assibilation applying in environments derived by raising evaporates.

In addition to raising, there is one other phonological process which feeds assibilation, namely the deletion of root-final /a/ before suffix-initial /-i/ (Anttila 2006):

(59)	<i>Pre-[i] vowel deletion feeds assibilation</i>	
	UR	/hu:ta-i/
	Hiatus resolution	hu:ti
	Assibilation	hu:si
	SR	[hu:si]
		'shout-PAST'

This is not actually a problem, however, because the deletion of final /a/ is crucially preceded by insertion of the past tense suffix /-i/. Consequently, Assibilation, being preceded by /a/-deletion, is also by transitivity preceded by suffixation. This means that $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$ is satisfied in examples like [hu:si].

Much the same explanation will also allow us to deal with the putative examples of the *ruki* rule applying in phonologically-derived environments. Here too, the relevant environments can be traced back to affixation. Specifically, we can assume that zero-grade ablaut is triggered on the stem vowel by a following accented suffix (Halle & Kiparsky 1981) or that Sanskrit ablaut is itself a morphological mutation process (Hammond 1992, Lahne 2006). Under the first option, ablaut is always preceded by affixation, and under the second, ablaut *is* affixation. Under either view, application of the *ruki* rule in environments derived by ablaut will be crucially preceded by affixation, so a single constraint $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{retroflex}))$ will do all the work we need in Sanskrit.

Aside from the classic Finnish and Sanskrit examples, only one other possible example is known to me of a DEE which appears to apply in both phonologically- and morphologically-derived environments. This is that of so-called surface velar palatalization in Polish (Rubach 1984, Kiparsky 1985, Łubowicz 2002, 2003a, Čavar 2004, 2005). In the /j/-spirantization example which began this chapter, we saw the operation of the rule that Rubach (1984) calls First Velar Palatalization, which converts

/k g x/ to alveopalatal [č ʒ š] before front vocoids at certain morphological junctures. In addition to this, Polish has a second rule by which velars undergo a secondary palatalization before front vocoids: /k g x/ → [kʰ gʰ xʰ]. This rule also appears to be NDEBed in that it applies systematically in two contexts: at morphological junctures (a) and before yers (b); however, it does not apply root-internally (c):

(60)

<i>Secondary palatalization at juncture:</i>	[wrog'-jem] 'enemy-INST.SG'
<i>Secondary palatalization before yer:</i>	[g'jez] 'gadfly' (cf. [gz-i] 'gadfly-PL')
<i>No secondary palatalization root-internally:</i>	[kelner] 'waiter'

Rubach (1984: 176-177) therefore characterizes secondary palatalization as a rule which applies in environments derived both morphologically (by affixation) and phonologically (by lowering/vocalization of yers); see also Čavar (2004, 2005) for discussion. If we accept this analysis, then Polish secondary palatalization is a counterexample to the prediction that DEEs can be licensed in only one type of derived environment.

However, because this example involves yers, we may be able to regard it as the exception that proves the rule. Many analyses of yers regard them as latent segments which are prosodically defective in some way; they are somehow not fully incorporated into the precedence structure of the root, e.g. by lacking a timing slot (e.g. Rubach 1986). If something like this is correct, then there is a sense in which vocalizing a yer and inserting an affix involve the same operation. Both involve incorporating underlying segments into the precedence structure of the representation being computed: either incorporating a yer with the other segments of the root or an affix with a base. This characterization is obviously very preliminary, but it nevertheless

does appear that yer-incorporation and affixation can be regarded as forming a natural class of operations (and hence as being referable to by a single PREC constraint) in a way that, for example, affixation and /e/-raising would not. The yer example is thus at best a quite limited threat to the theory of NDEB being proposed here.

To sum up our conclusions so far in this section, the class *X* of processes which un-block an DEE process *Y* by deriving an environment in which it's harmonically improving must be able to be referred to simultaneously by a single constraint PREC(*X*, *Y*). Whether this is possible will, obviously, depend on the vocabulary by which PREC constraints refer to LUMs. Following McCarthy (2007a), I've been assuming so far that phonological LUMs are referred to by the 'basic faithfulness constraint' that they violate. Since morph-insertion doesn't involve unfaithfulness, there is, in general, no *X* through which a single PREC constraint can refer to phonological and morphological LUMs simultaneously.

This much allows us to conclude that there is no language in which both phonologically and morphologically derived environments count equally for un-blocking a DEE process (except cases like Polish secondary palatalization, where the phonological and morphological processes plausibly form a natural class). There is still one last issue we have to consider with regard to what collection of operations can unblock the same DEE process: we need to consider examples where some, but not all, affixes of the appropriate phonological shape are able to trigger the process. Once again, Finnish assibilation supplies an instructive example. It turns out that not all /i/-initial suffixes trigger assibilation of a preceding /t/. Anttila (2006), citing Karlsson (1982), reports that assibilation is triggered by past tense /-i/, plural /-i/, and

superlative /-impA/, but not by conditional /-isi/ or by the derivational suffix /-ime/, which Anttila glosses as ‘instrument’.¹⁰⁰

Clearly, an analysis of Finnish that relies on separate constraints $\text{PREC}(\text{insert-past}, \text{IDENT}(\text{contin}))$, $\text{PREC}(\text{insert-plural}, \text{IDENT}(\text{contin}))$, etc., will fail, for the reasons that we saw earlier. What is our alternative? Two options present themselves. First, imagine that the morphs which do trigger assibilation formed a morphosyntactic natural class, such that these morphs, and no others, contained a morphosyntactic feature X. Assuming that PREC constraints refer to morph-insertions by the morphosyntactic features that the morphs contain,¹⁰¹ we could then call on a single constraint $\text{PREC}(\text{insert-X}, \text{IDENT}(\text{contin}))$ in order to block assibilation in all contexts other than those derived by one of these affixes. This strategy is unlikely to be right for Finnish, though, because it’s quite improbable that past tense, plural, and superlative form a natural class in any language. However, this strategy may be workable for other instances of DEEs in other languages.

The second option, which is more likely for Finnish, is that there is a single constraint $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$, and that suffixes like the conditional fail to trigger assibilation because they counterfeed it. That is, the assibilation-triggering constraint *ti will be dominated not just by $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$, but also by constraints like $\text{PREC}(\text{IDENT}(\text{contin}), \text{insert-conditional})$. The former constraint will be responsible for blocking assibilation in contrasts that are not derived by affixation. The

¹⁰⁰ Polish palatalization is similar in that it applies at some but not all morphological junctures (Szpyra 1985, 1989).

¹⁰¹ In what follows, I’m assuming that some set of morphosyntactic features distinguish all roots from all affixes, allowing PREC constraints to refer to ‘insert-affix’ as a natural class of operations. The idea that affixes form a natural class distinct from roots will hopefully be uncontroversial.

latter constraint will block assibilation in contexts that are derived through conditional affixation.

To make this proposal concrete, let's consider the case of a word like /tunte-isi/ → [tunt-isi] 'would feel', in which assibilation doesn't happen to the [ti] sequence at the root-affix juncture. The two chains we need to consider are as follows:

- (61) a. <ROOT-CONDITIONAL, tunte-CONDITIONAL, tunte-isi, tunt-isi>
 rLUMSeq: insert-root, insert-conditional, MAX-V>
- b. <ROOT-CONDITIONAL, tunte-CONDITIONAL, tunte-isi, tunt-isi, tuns-isi>
 rLUMSeq: insert-root, insert-conditional, MAX-V, IDENT(conti)n>

Assibilation occurs in chain (b) but not in chain (a). In the chain where assibilation does occur, it occurs after the insertion of the conditional morph /-isi/, because it is this morph that contributes the /i/ that makes assibilation harmonically improving. As a result, chain (b) incurs a violation of PREC(IDENT(conti)n, insert-conditional), which will assign a mark if insertion of the conditional is followed by an IDENT(conti)n-violating LUM. If that constraint is ranked above *ti, then the chain without assibilation will win:

(62) *Assibilation is counterfed by conditional suffixation*

	PREC (ID(cont), insert- conditional)	PREC (insert-affix, ID(cont))	*ti	IDENT (contn)
a. \mathbb{E} <..., tunt-AFF, tuntisi>			₁	
b. <..., tunt-AFF, tunt-isi, tuns-isi>	W ₂		L	W ₁

The appeal to counterfeeding thus makes it possible for an unnatural class of affixes to trigger the DEE. However, given our hypotheses about how PREC constraints refer to

LUMs, it remains (correctly) impossible for a DEE to apply in both phonologically and morphologically derived environments.¹⁰²

Suppose now that genuine counterexamples to this prediction were found, for instance, if it were indisputably shown that Finnish did have a synchronically active process of final /e/-raising and that assibilation applied in environments derived by that process. Even if such examples arose, they would not be fatal to the OI account of NDEB as such: at most they would force a revision of my current assumptions about the vocabulary by which PREC constraints refer to operations. It might be that phonological and morphological operations were grouped in inheritance classes (e.g. MAX-V violation \in deletion operations \subseteq phonological operations \subseteq all operations) and that PREC constraints can refer to any level of the hierarchy of operations (e.g. there could be a constraint PREC(any operation, IDENT(contin))). In case the class of operations which are able to feed a DEE process did not form a natural class in the inheritance hierarchy, we could appeal (as we've just seen) to counterfeeding in order to obtain the application of the DEE in the unnatural class of contexts. The OI/OT-CC approach to NDEB is thus not inescapably tied to the prediction that DEEs can occur in only one type of derived environment. However, this prediction, if correct, *can* be made to fall out in OI. As we'll see in section 4.3, this prediction cannot be obtained in other theories of NDEB on the market.

One last matter remains to be considered in this section. The restrictive prediction that DEEs can apply in only one type of derived environment comes with an

¹⁰² Incidentally, the fact that we can construct this analysis demonstrates by example that the OI/OT-CC account of NDEB allows for DEE processes to be counterfed. One of the liabilities of Comparative Markedness is that it predicts counterfeeding of DEEs to be impossible, despite cases of this being attested: see Wier (2004) for an example and theoretical discussion.

additional prediction of a possible type of NDEB effect whose correctness is at the moment unclear. Joe Pater points out that while the attempted analysis of Finnish in (57), using two PREC constraints, may fail to allow assibilation in environments derived only by affixation or only by raising, it will allow assibilation in environments derived by *both* affixation and raising. This could arise if there were a suffix that had the underlying shape /-e/, which then underwent raising. Assibilation of a root-final /t/ would then be crucially preceded by both affixation and raising. Both PREC constraints are then satisfied, and assibilation is allowed:

(63)

//ROOT-AF//	PREC (ID(hi), ID(cont))	PREC (ins-af, ID(cont))	*ti	ID (cont)
a. $\text{[ti]} < \text{ROOT-AF, tilat-AF, tilat-e, tilat-i, tilas-i}>$ rLUMSeq: <insert-root, insert-aff, Ident(high), IDENT(contin)>				1
b. <ROOT-AF, tilat-AF, tilat-e, tilat-i> rLUMSeq: <insert-root, insert-aff, Ident(high)>			W_1	L

The PREC-based theory of DEEs is thus capable of modeling ‘non-doubly-derived environment blocking’, wherein a process (here, assibilation) is allowed to apply just in case *two* previous processes (here, affixation and raising) have applied. By adding more PREC constraints, we could extrapolate further to DEEs which required three, four, five or for that matter any number of preceding processes to occur (limited only by the number of PREC constraints made available by CON).

Are there any cases of non-doubly-derived environment blocking? Two possible examples are known to me. The first is a child-language case discussed by Farris (2007).

Amahl Smith (Smith 1973) passed through a stage in which he devoiced final obstruents (*bed* /bɛd/ → [b̥ɛt]) and occlusivized coda /s/ (*bus* /bʌs/ → [b̥ʌt]). Given these two processes, a reasonable expectation would be for final /z/ to surface as [t]. But instead it deletes: *noise* /nɔɪz/ → [nɔɪ], *[nɔɪt]. This pattern could be described as follows: final /t/ deletes just in case it's derived through both devoicing and occlusivization, but it doesn't delete if it's derived through just one or the other.

A theoretical remark: to give an analysis along these lines in OT-CC, we have to assume (similar to McCarthy's [to appear a] account of coda reduction) that deleting an underlying /z/ involves deleting its [continuant] and [voice] features prior to deleting the root node. If it were possible for underlying /z/ to map directly to zero, then the deletion LUM would never be preceded by earlier LUMs of devoicing or occlusivization, and the PREC constraints requiring that deletion be preceded by devoicing and by occlusivization would always be violated, meaning that deletion would never happen.

The second possible example comes from Steriade's (2000b) and Burzio's (2002a) analyses of English CiV lengthening. As mentioned earlier, CiV lengthening does not apply consistently in morphologically underived contexts (c[æ]meo, *c[éi]meo). Steriade and Burzio suggest that not just affixation but also stress shift is required for lengthening: compare l[é]vy ~ l[é]viable (no stress shift, and no lengthening) with rém[ə]dy ~ rem[íj]diable (stress shift, and lengthening). Some additional contrasts involving place names can also be cited:

- (64) *Stress shift, tensing:*
 Can[ə]da ~ Can[éɪ]dian
 Jord[ə]n ~ Jord[éɪ]nian
 Germ[ə]ny ~ Germ[éɪ]nium
No stress shift, no tensing:
 Mal[á]wi ~ Mal[á]wian (*Mal[éɪ]wian)
 Kent[ʌ]ky ~ Kent[ʌ]kian (*Kent[úw]kian)

Assuming that these alternating roots are lexically stored with their citation stress, stress shift under affixation will violate IO-IDENT(stress). (Because stress is contrastive in some languages, there must be such a constraint). We could then hypothesize that the markedness constraint favoring CiV lengthening is dominated by both PREC(insert-affix, IDENT(long)) and PREC(IDENT(stress), IDENT(long)): CiV lengthening is blocked except in environments derived by both affixation and stress shift. Examples like *leivable*, *Malawian*, *Kentuckian* may represent evidence that affixation alone is insufficient. (However, the generalization isn't perfect, as there are examples where CiV lengthening does occur in the absence of stress shift, e.g. *Alab[æ]ma* ~ *Alab[éɪ]mian*, and others where lengthening fails to occur even though stress does shift, e.g. *Trínid[æ]d* ~ *Trinid[æ]dian*, **Trinid[éɪ]dian*.) To complete the argument, we would need evidence that IDENT(stress) violation alone was insufficient. This might be demonstrated by showing that CiV lengthening did not systematically apply in nonce words to which speakers had to assign a stress (if the word was truly nonce and the speaker had no lexically-listed underlying stress for it, assigning any stress would violate IDENT(stress)). Doing this would of course require an experiment, but it would be entirely unsurprising if CiV lengthening didn't apply in nonce words: the existence of the very items which argue for CiV lengthening being a DEE (*cameo*, *patio*, *stereo*) hints that words are not systematically subjected to CiV lengthening when they enter the English lexicon.

4.2.5 Once NDEBed, always NDEBed¹⁰³

Suppose that some language has the following rule, which is restricted to apply only in derived environments:

(65) [+cons] → [labial] / _ [+round]

That is, consonants are labialized before round vowels, but only in derived environments.

Suppose that we have a root in this language whose underlying form is /tu/. We have an underived /tu/ sequence in this word, and so we expect the /t/ to remain [t], instead of becoming [p]. Now suppose further that the language has a suffix /-o/, and that /uo/ sequences are reduced by deleting the /u/. So, in a word formed from this root and suffix, we expect the following derivation:

(66)	UR of root	/tu/
	Affixation	tu-o
	Hiatus resolution	to

At this point in the derivation, we have a theoretical question to ask: should the /to/ sequence that's derived by /u/-deletion now undergo the labialization rule?

Different theories of NDEB make different predictions on this count. In rule-based phonology, the Strict Cycle Condition would seem to predict that it should, since the /to/ sequence satisfies the structural description of the rule, but was not present in the underlying representation. In OI/OT-CC, on the other hand, it's predicted that the NDEBed labialization rule should not apply in this context.

¹⁰³ I'm very grateful to Donca Steriade for pointing out the prediction discussed in this section.

Let's examine why. For the word /tu-o/, the following are the chains we need to consider:

- (67)
- a. <ROOT-AF, tu-AF, tu-o, to>
LUMSeq: <insert-root, insert-af, MAXV>
 - b. <ROOT-AF, tu-AF, tu-o, to, po>
LUMSeq: <insert-root, insert-af, MAXV, IDENT(place)>
 - c. <ROOT-AF, tu-AF, tu-o, pu-o, po>
LUMSeq: <insert-root, insert-af, IDENT(place), MAXV>
 - d. <ROOT-AF, tu-AF, pu-AF, pu-o, po>
LUMSeq: <insert-root, IDENT(place), insert-af, MAXV>

(I'll assume that chains terminating in [tuo] or [puo] are eliminated from contention due to undominated *HIATUS, and that chains that fail to insert either of the two morphs are ruled out by undominated MAX-M(FS).)

The last three chains above all perform the labialization process, and all converge on [po], so they'll merge. In the rLUMSeq of the merged chain, the labialization of the root's /t/ will not be preceded by anything other than the insertion of the root itself. This is because the /t/ is followed by a round vowel at every point in the derivation, so it's always harmonically improving to labialize it, regardless of what else has happened yet. We can labialize the /t/ after hiatus resolution (b), after affixation but before hiatus resolution (c) or before both affixation and hiatus resolution (d). As such, the merged chain will look like this:

- (68) [po]
rLUMSeq: {<insert-root, insert-af, MAXV>, <insert-root, IDENT(place)>}

When this candidate competes with the nonlabializing alternative (a), labialization will be ruled out by PREC(MAXV, IDENT(place)):

(69) *Labialization blocked in 're-derived' context*

//ROOT-AF//	PREC (MAXV, IDENT(place))	*[-lab][+round]	IDENT(place)
a. [to] rLUMSeq: <insert-root, insert-af, MAXV>		L	
b. [po] rLUMSeq: <{insert-root, insert-af, MAXV}, <insert-root, IDENT(place)>>	W ₁	₁	W ₁

Labialization fails to apply in our example because it would be harmonically improving to labialize either before or after vowel deletion, and so no ordering relation between deletion and labialization is asserted in the rLUMSeq of any chain. So even though deletion can create a new labialization context /to/, labialization is still blocked because it's harmonically improving do do it in both the new context /to/ and the old context /tu/. In OI, what counts is not deriving a new 'context of application', but deriving the harmonically-improving status of a process. The OI/OT-CC account of NDEB thus predicts that a process that's blocked in some underived context will continue to be blocked in all contexts derived from it, or (to paraphrase Blumenfeld 2003b), 'once non-derived-environment blocked, always non-derived-environment blocked'. For abbreviatory convenience, I will call this prediction the 'once/always generalization'.

Is the once/always generalization correct? Steriade (2008) presents an example from Romanian which does instantiate the once/always pattern. Several declension classes in Romanian mark the plural and second person singular with a suffix /-j/. In derived environments, /k/ and /g/ palatalize before the front vocoids /e, i, j/:

- (70) *Romanian velar palatalization in morphologically-derived environment*
- | | | | |
|----------|------------|-----------|-------------|
| [fi:k-ʌ] | ‘daughter’ | [fi:tʃ-e] | ‘daughters’ |
| [alg-ʌ] | ‘seaweed’ | [aldʒ-e] | ‘seaweeds’ |
| [mak] | ‘poppy’ | [matʃ] | ‘poppies’ |
| [fug] | ‘I flee’ | [fudʒ] | ‘you flee’ |

However, pre-[j] palatalization does not occur root-internally:

- (71) [unkj], *[untʃj] ‘uncle’
 [ungj], *[undʒj] ‘angle’

The once/always effect arises when we look at roots which take the suffix [-e] in the singular and the suffix [-j] in the plural. This class includes roots that end in /k/, and in these roots, there is no palatalization in the plural:

- (72) [urekⁱe] ‘ear’ [vegⁱe] ‘vigil’
 [urekj], *[uretʃj] ‘ears’ [vegj], *[vedʒj] ‘vigils’

Assuming that the plurals are derived from the singulars¹⁰⁴ (with insertion of /j/ and deletion of the /e/), then we have a once/always effect. Because both [e] and [j] are palatalization triggers in Romanian, it will be harmonically-improving to palatalize either before or after the addition of the plural morphonology. So, even though plural morphology derives /kj/ and /gj/ sequences which weren’t there previously, OT-CC’s once/always generalization predicts that no palatalization will occur.

Finnish also supplies a possible example of a once/always pattern. Several /i/-initial suffixes in Finnish (plural /-i/, superlative /-in/, past-tense /-i/, and conditional

¹⁰⁴ This assumption is not as problematic for OI as it may seem at first glance. On at least some theories of number features, ‘plural’ consists of a proper superset of the features of ‘singular’. For instance, in Harley’s (1994) feature geometry, ‘singular’ is morphosyntactically a node INDIVIDUATION and ‘plural’ is INDIVIDUATION plus a dependent node GROUP. On this particular view of features, we could assume that Romanian /-e/ spells out INDIVIDUATION and that GROUP is spelled out by /j/ (or perhaps by a bundle of floating features that mutate /-e/ into [j]). On this analysis, the apparent singular morph would indeed make an appearance in plural words. (For a somewhat different view of number features which would still admit a version of this analysis, see Harley & Ritter 2002).

/-isi/) cause deletion of a preceding short non-round vowel (subject to various complications: see Anttila 2002, Karlsson 2008: §4.2, Pater to appear for more details):

- (73) /tule-i/ → [tuli] 'came'
 /ki:ttä-i/ → [ki:tti] 'thanked'

Consistent with this pattern, roots ending in a short /-i/ (or in a diphthong that ends in /i/), reduce the junctural /i-i/ sequence to a single /i/:

- (74) /oppi-i/ → [oppi] 'learned'
 /etsi-isi/ → [etsisi] 'would look for'
 /ui-i/ → [ui] 'swam'
 /nai-isi/ → [naisi] 'would marry'

In principle it's impossible to judge from the surface data which of the two /i/s is deleted, but given the behavior of these suffixes with preceding vowels other than /i/, it's reasonable to generalize that the first of the two /i/s (the one belonging to the root) is the one that's dropped.

When one of these suffixes is added to a root that ends in /...ti/, the deletion of the root's final /i/ does not feed assibilation (Kiparsky 1993a, Karlsson 2008):

- (75) /va:ti-i/ → [va:ti] 'demanded'

Even though underlying /ti₁i₂/ surfaces as [ti₂] in these examples, creating an assibilation environment different from the underlying one (/ti₁/), assibilation is not permitted to occur. This, again, is because the process would have been harmonically improving in both the old environment and in the new one, and consequently no chain's rLUMSeq will be able to assert an ordering relation between affixation and assibilation.

I do not know of any counterexamples to the once/always generalization. The closest thing I know to one comes from Chimwi:ni (Kenstowicz & Kisseberth 1977,

Selkirk 1986). This language shortens long vowels if the next vowel is long, but there are some exceptional roots in which two consecutive vowels are long. However, both vowels shorten if the final vowel is lengthened by a pre-lengthening suffix:

(76)	[ka:.ba:.ti]	‘cupboard’	[ka.ba.ʔi:.ni]	‘in the cupboard’
	[fa:.nu:.si]	‘lamp’	[fa.nu.si:.ni]	‘in the lamp’
	[ba:.ko:.ra]	‘walking stick’	[ba.ko.ra:.nde]	‘a long walking stick’

The first long vowel is protected by NDEB from shortening in the unaffixed forms, but does shorten in the affixed form. This is not a counter-example to the once/always generalization, however, because there are actually two markedness constraints on vowel length involved. Not only are long vowels disallowed before another long vowel, but long vowels are also banned in any position other than penultimate or antepenultimate in the phonological phrase. (In these examples of words in citation form, the phonological phrase is coextensive with the individual words). While it is true that shortening the first vowel after affixation violates $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{long}))$, shortening of this vowel is still allowed because the PREC constraint is dominated by the constraint responsible for pre-antepenultimate shortening.

To be explicit, we can begin by setting out the valid chains for ‘a long walking stick’. These will be the following, given the simplifying assumption that a sequence of two long vowels is always resolved by shortening the first one:

(77)

a. <ROOT-AF, ba:.ko:.ra-AF, ba:.ko:.ra:.nde, ba:.ko.ra:.nde, ba.ko.ra:.nde>
 (insert root, insert affix, pre-length shortening of second root vowel,
 preantepenultimate shortening of first root vowel)
 rLUMSeq: <insert-root, insert-affix, IDENT(long)@4, IDENT(long)@2>

b. <ROOT-AF, ba:.ko:.ra-AF, ba:.ko:.ra:.nde, ba.ko:.ra:.nde, ba.ko.ra:.nde>
 (insert root, insert affix, preantepenultimate shortening of first root vowel,
 pre-length shortening of second root vowel)
 rLUMSeq: <insert-root, insert-affix, IDENT(long)@2, IDENT(long)@4>

- c. <ROOT-AF, ba:.ko:.ra-AF, ba.ko:.ra-AF, ba.ko:.ra:.nde, ba.ko.ra:.nde>
 (insert root, pre-length shortening of first root vowel, insert affix, pre-length shortening of second root vowel)
 rLUMSeq: <insert-root, IDENT(long)@2, insert-affix, IDENT(long)@4>
- d. <ROOT-AF, ba:.ko:.ra-AF, ba:.ko:.ra:.nde, ba.ko:.ra:.nde, ba.ko.ra:.nde>
 (insert root, insert affix, pre-length shortening of first root vowel, pre-length shortening of second root vowel)
 rLUMSeq: <insert-root, insert-affix, IDENT(long)@2, IDENT(long)@4>
- e. <ROOT-AF, ba:.ko:.ra-AF, ba:.ko:.ra:.nde, ba:.ko.ra:.nde>
 (insert root, insert affix, pre-length shortening of second root vowel)
 <insert-root, insert-affix, IDENT(long)@4>

(Notation: '@' is used to distinguish between IDENT(long) violations on different segments. @2 is the first root vowel and @4 is the second root vowel.) The first three chains are convergent on [ba.ko.ra:.nde], so they'll be merged. The resulting rLUMSeq will assert no ordering relation between IDENT(long)@2 and insertion of the affix. This is because it is harmonically-improving to shorten the first root vowel both before affixation (because it's before another long vowel) as well as after affixation (because it's in pre-antepenultimate position, as well as initially still being before another long vowel). The merged chain that ends in [ba.ko.ra:.nde] therefore violates PREC(insert-affix, IDENT(long)). However, like any other OT constraint, that PREC constraint is violable. The chain ending in [ba.ko.ra:.nde] will still beat chain (e), ending in [ba:.ko.ra:.nde], if PREC(insert-affix, IDENT(long)) is dominated by a constraint forbidding long vowels in pre-antepenultimate position:

(78)

//root-af//	*V:/PREANTEPU	PREC (insert-affix, IDENT(long))
a. [ba.ko.ra.nde]		1
b. [ba:.ko.ra.nde]	W ₁	L

Intuitively, we can say that pre-long-vowel shortening is NDEBed in Chimwiini, and that pre-antepenultimate shortening is not. While shortening of the first root vowel is NDEBed in the underived environment, shortening *can* apply in a re-derived environment because an additional, high-ranked pro-shortening constraint is applicable in the re-derived environment.

4.3 Problems with competing theories of NDEB

Earlier in this section, we've already looked at the empirical advantages of OI vis à vis one other competing theory of NDEB, namely Comparative Markedness. In this section, I'll briefly review arguments for preferring the OI approach to NDEB over that of several other competing theories: immunity-by-prespecification (Inkelas & Cho 1993, Kiparsky 1993a, Inkelas 2000), local conjunction of markedness and faithfulness (Łubowicz 2002), contrast preservation theory (Łubowicz 2003), faithfulness-based solutions (Itô & Mester 1996, Polgárdi 1998, Pater 1999, van Oostendorp 2007, Anttila to appear), Stratal OT, OO-faithfulness and kindred approaches (Anttila & Cho 1999, Dinnsen & McGarrity 1999, 2004, Burzio 2000, 2002a, Yu 2000, Čavar 2004, 2005, Cho to appear), and rule-based devices like the Revised Alternation Condition (Kiparsky 1973a, Iverson 1987, 1992, 1993, 2004, Iverson & Wheeler 1988, Eckman & Iverson 1997, 2000,

Eckman, Elreyes & Iverson 2001, 2003), the Strict Cycle Condition (Kean 1974, Mascaró 1976) and the Elsewhere Condition (Kiparsky 1983, Giegerich 1988).

4.3.1 Immunity-by-prespecification

The prespecification account of NDEB assumes that, owing to some form of underspecification being at work, segments which alternate in derived environments are unspecified for the alternating feature, while segments which do not alternate *are* underlyingly specified for the alternating feature. For example, in the Finnish root meaning ‘order’, the underlying form would be something like /tilaT/. The initial [t] is underlyingly specified as [-continuant], and hence cannot alternate in continuancy. The root-final segment, however, is underspecified for continuancy, and therefore the phonology is free to give it a specification for that feature, which will be [+continuant] (resulting in [s]) before [i], and [-continuant] (resulting in [t]) elsewhere.

The most basic problem of the prespecification approach is that it provides no explanation whatsoever of why DEEs should apply pervasively in a language, as opposed to applying only to a closed class of lexical items that happen to have the underspecified UR. Under the prespecification view, any given morph that undergoes a DEE does so only because the learner has, on the basis of the observed alternations, posited for that morph an underlying form that will allow the alternation to happen. However, this means that the DEE should be a wholly idiosyncratic effect displayed only by the specific morphs that a learner has so far observed to alternate. There is no expectation that a DEE should extend to nonce words, loans, or, for that matter, to native words which the learner has accidentally not yet encountered in the alternating

context. This is not merely a theoretical worry, as there are DEE processes, including Turkish velar deletion (Zimmer & Abbott 1978) and English Velar Softening (Pierrehumbert 2006) which have been found in experimental tasks to apply productively to nonce items.

The generalization issue is made all the more severe given that some DEEs can apply in contexts derived by juncture of separate words. For instance, Slovak pre-sonorant voicing (Rubach 1993) applies both at ‘strong’ morph junctures and across word boundaries (data from Blaho 2003):

- (79) *Slovak pre-sonorant voicing in environment derived by word juncture*
vojak-a ‘soldier-GEN.SG.’
vojag ide ‘the soldier goes’

Similar examples of processes that apply in juncturally-derived contexts but not in underived ones include a number of processes in Igbo (Clark 1990), and, in Vedic (though not classical) Sanskrit, the *ruki* rule (Kiparsky 1993a). Such examples show that learners must generalize DEEs not just to segments that are capable of occurring in a (possibly limited) number of potentially alternation-conditioning inflectional positions, but also to all segments that can occur in an open class of relevant phrasal contexts.

For the prespecification view, there is no way to ensure that learners generalize DEEs in the way that we’ve just seen that they must do, other than to assume that learners obey some form of analogical principle in setting up underlying forms (as Inkelas 2000 in fact proposes). In OI, on the other hand, no independent mechanism of analogy is needed, because NDEB is a property of the grammar and how it serially relates processes, not an idiosyncratic property of the underlying forms of specific morphs.

In addition to the foundational problem of generalizability, the prespecification account of NDEB faces more narrow difficulties in modeling certain specific DEEs, even if we granted that the underlying forms had come out right. One problem comes from Velar Softening in English (Chomsky & Halle 1968, Anderson 1981, Halle & Mohanan 1985, Hammond 1992, Burzio 2000, Pierrehumbert 2006). This is process by which /k/ becomes [s] before certain suffixes that begin with nonlow front vowels:

- (80) *Velar softening in derived environments*
- | | | |
|------------------------------|---|---------------------------------------|
| <i>opaque</i> [ow.peɪk] | ~ | <i>opacity</i> [o.pæ.sɪ.rɪj] |
| <i>electric</i> [ə.lɛk.tɹɪk] | ~ | <i>electricity</i> [ə.lɛk.tɹɪ.sɪ.rɪj] |
| <i>critic</i> [kɹɪ.tɪk] | ~ | <i>criticize</i> [kɹɪ.tɪ.saɪz] |

Velar Softening is a DEE in that the [k] ~ [s] alternation does not apply in root-internal contexts:

- (81) *No velar softening in underived environments*
- | | |
|-------------|-------------------|
| <i>king</i> | [kɪŋ], *[sɪŋ] |
| <i>kind</i> | [kaɪnd], *[saɪnd] |

The alternation is between [k] and [s], so the segments that alternate, such as the last segment of *electric*, must be underspecified for all features that distinguish between [k] and [s]. The problem is that [k, s] is not a natural class in English. These two segments differ in at least place and continuancy, so it follows that the segments that alternate in velar softening environments are unspecified for both of those features. Such segments will be specified for the features that [k] and [s] do share: [+cons, -voc, -son, -voi, ...]. However, there are segments besides [k] and [s] in the English consonant inventory, namely [p, t, ʃ, θ, h], that are also consistent with this underspecified feature-set. Given this, the prespecification theory must explain why the underspecified final segment of *electric* is filled in as [k] rather than as [t] in non-velar-

softening contexts. Some markedness constraint would need to prefer [ə.lək.tɪk] over alternatives like *[ə.lək.tɪt], but it's by no means clear that such a constraint exists. Dorsal place is more marked than coronal place, and there is moreover nothing in particular about word-final position that would be expected to favor dorsality over coronality. Therefore, the fact that velar softening affects velars is unexplainable in the prespecification theory.¹⁰⁵

A related problem (Kiparsky 1993a: §6.2, Kager to appear) is that underspecification cannot distinguish alternating from nonalternating segments when the distinction in question is one of length, which is standardly assumed to be represented privatively (using morae for vowel length, and either morae or root nodes for consonant length). For instance, in Ndjébbana, root-initial stops show a singleton/geminate alternation in derived environments, so they would have to be underspecified for length. But 'underspecified for length' means having just a single root node, which is the same representation that we would have to assume for root-medial singletons, which don't alternate. One could perhaps assume that word-medial stops came with a floating empty mora, accounting for their ability to geminate in prefixed, stressed contexts. This, however, would involve invoking highly abstract URs, which (besides any intrinsic undesirability) demonstrate the extent to which the prespecification approach would have to divorce itself from any independently-

¹⁰⁵ Velarization (and velar epenthesis) could be favored in vowel-adjacent contexts (Howe 2004) on the view that all vowels are [dorsal] (Halle, Vaux & Wolfe 2000, Halle 2003). However, this is unlikely to explain why the placeless archiphoneme required in Velar Softening contexts is filled in as [dorsal] rather than [coronal]. Except possibly for the linking [l] of Bristol English (Wells 1982, Gick 1999), which may not actually be epenthetic (Bermúdez-Otero & Börjars 2003) no English dialect I know of epenthesizes a dorsal in hiatus contexts, rather than glottal [ʔ] or coronal [ɹ]. This can be taken as an indication that any constraints favoring dorsality adjacent to a vowel are ranked below *[dorsal] in English.

motivated theory of underspecification. As NDEB arises also in processes involving vowel length (such as English Trisyllabic Shortening), this challenge to the prespecification model is far from isolated.¹⁰⁶

A final problem is posed by the NDEB scenario found in Makassarese. Recall that in that language, glottal stop epenthesis occurs after word-final epenthetic copy vowels (/rantas/ → rantasa → [rántasaʔ] ‘dirty’), but not after underlying final vowels ([lómpo], *[lómpoʔ] ‘big’). The relevant distinction is between the underlying presence or absence of any final vowel at all, so underspecification gets us no traction whatsoever.

4.3.2 Local conjunction

Łubowicz (2002, 2005) proposes that NDEB effects are triggered by constraints formed by the local conjunction (Smolensky 1993, 1995, 1997) of a markedness constraint and a faithfulness constraint. The proposal can briefly be illustrated by reprising her analysis of the Polish DEE that began this chapter. Recall that in Polish underlying /g/ before a front vocoid both palatalizes and spirantizes, becoming [ʒ], while underlying /j/ in the same context does not spirantize, and instead simply surfaces faithfully. In derivational terms, we can say that derived /j/ undergoes spirantization, but underlying /j/ does not.

¹⁰⁶ Kiparsky (1993a), following Itô (1990), suggests that syllables can be lexically specified as short by endowing them with prespecified underlying syllable structure, which blocks the application of syllabification rules. It’s far from clear that this would work in OT, given that the (near-)nonexistence of contrastive syllabification (Clements 1986, Hayes 1989a, Blevins 1989, McCarthy 2003a, cf. Elfner 2006) entails the absence of IO-faithfulness to syllable structure (including, presumably, to the input lightness of the syllable).

To account for the place alternation (/g/ becomes alveopalatal before a front vocoid) we can, as we did earlier, assume that a constraint which assigns a mark to velar-front V sequences (call it *KE) dominates faithfulness to the underlying place specification of /g/. What we then have to explain is why underlying /g/ in such contexts not only changes its place from dorsal to coronal, but also changes its continuancy, mapping to [ʒ] rather than [j̥]. Łubowicz's (2002) proposal is that this is due to the following conjoined constraint:

(82)

$[\text{*j̥} \ \& \ \text{IDENT}(\text{coronal})]_{\text{seg}}$
 Assign a violation-mark if *j̥ and IDENT(coronal) are both violated in the domain of a single segment.

Under the original definition of Local Conjunction (Smolensky 1993, 1995, 1997), a conjoined $[A \ \& \ B]_{\text{D}}$ is violated *iff* constraint A and constraint B are both violated in a domain D. If A is violated and B is not (or B is violated and A is not), then $[A \ \& \ B]_{\text{D}}$ is not violated. Intuitively, $[A \ \& \ B]_{\text{D}}$ pressures candidates to obey A *iff* they violate B (and to obey B *iff* they violate A).

Łubowicz (2002)'s $[\text{*j̥} \ \& \ \text{IDENT}(\text{coronal})]_{\text{seg}}$ is a local conjunction of a markedness constraint and a faithfulness constraint. It will assign a mark if and only if it detects a segment which both is /j̥/ (and hence violates *j̥) and corresponds to an underlying noncoronal (and hence violates IDENT(coronal)). The conjoined constraint is thus, in effect, a markedness constraint against derived /j̥/s, because it is silent on the question of underlying /j̥/s. A [j̥] that corresponds to an input /j̥/ violates *j̥ but not IDENT(coronal), and therefore it doesn't violate the conjoined constraint. Local

Conjunction thus can analyze NDEB because it gives us a tool to create markedness constraints which are active only in derived contexts:

(83) [M&F] analysis of Polish /g/-spirantization DEE

a. Conjoined constraint forces derivedly-coronal segment to spirantize and avoid being [j]

/gi/	[*j & IDENT(coronal)] _{seg}	IDENT(contin)	*j
☞ ži		1	
ji	W ₁	L	W ₁

b. With conjoined constraint indifferent, faithfulness blocks spirantization of underlying /j/

/j/	[*j & IDENT(coronal)] _{seg}	IDENT(contin)	*j
☞ j			1
ž		W ₁	L

The main empirical problems with the M&F approach arise from morphological DEE processes. Since adding an affix doesn't create an unfaithful IO-mapping, it's not clear what we should conjoin with the markedness constraint. Łubowicz's (2002) proposal is that morphological DEEs like Finnish assibilation result from conjoining a markedness constraint with an alignment constraint which demands that syllable boundaries coincide with morph boundaries:

(84) *[M&ALIGN] analysis of Finnish assibilation DEE*

/tilat/	$[*ti \& \text{ALIGN}(\text{root}, \text{R}, \text{syll}, \text{R})]_{\sigma}$	IDENT(contin)	*ti
☞ ti.lat			1
si.lat		W_1	L

/tilat-i/	$[*ti \& \text{ALIGN}(\text{root}, \text{R}, \text{syll}, \text{R})]_{\sigma}$	IDENT(contin)	*ti
☞ ti.la.si		1	1
ti.la.ti	W_1	L	W_2
si.la.ti	W_1	1	1
si.la.si		W_2	L

In the unsuffixed root /tilat/, the conjoined constraint is always satisfied, since the root is the only morph present and therefore no syllables straddle a morph boundary. The ranking of IDENT(contin) over *ti then ensures that no assibilation occurs.

In the suffixed word /tilat-i/, things become more complicated. The suffix is V-initial and causes resyllabification of the root-final consonant. As a result, the last syllable in each of the candidates depicted violates ALIGN(root, R, syll, R). As a result, those syllables will also violate the top-ranked conjoined constraint if they also contain violations of *ti. This results in the elimination of the candidates [ti.la.ti] and [si.la.ti], which fail to assibilate at the root-suffix boundary and therefore violate both conjuncts of $[*ti \& \text{ALIGN}(\text{root}, \text{R}, \text{syll}, \text{R})]_{\sigma}$. This leaves [ti.la.si] and [si.la.si] as contenders; the former wins because it better satisfies the next-highest-ranked constraint, IDENT(contin).

As Łubowicz (2002) notes, this line of analysis predicts that morphological DEEs can only arise when an affix triggers resyllabification or some other kind of misalignment between morphological and prosodic constituents. As several authors have noted, however (Inkelas 2000, Blaho 2003, Anttila to appear), this prediction is not correct. Particularly worrisome are cases of NDEB that arise in phrase-level juncture, like the Slovak pre-sonorant voicing example in the last section. It's not clear, for instance, that there is any misalignment in collocations like [dozd' lenivý] 'quite lazy' (Rubach 1993: 282).

Another undergeneration problem of the [M&F] approach comes from DEEs in which the unfaithful mapping that derives the derived environment is a deletion process. For example, in Estonian (Kenstowicz & Kisseberth 1970, Kiparsky 1973a, Hammond 1992), the consonant gradation system deletes certain intervocalic stops in particular morphological contexts, including genitive case. This results in derived VV sequences. If one of these vowels is high, it lowers:

- (85) *Estonian: High vowels in derived hiatus lower*
- | | | | | | |
|--------|---|-----|---|-------|------------------|
| /tuba/ | → | tua | → | [toa] | 'room-GENITIVE' |
| /viga/ | → | via | → | [vea] | 'fault-GENITIVE' |
| /lugu/ | → | luu | → | [loo] | 'story-GENITIVE' |

However, high vowels that are underlyingly adjacent to another vowel don't lower:

- (86) *Estonian: High vowels in underived hiatus don't lower*
- | | | | |
|-------|---|-------|-----------------|
| /luu/ | → | [luu] | 'bone.GENITIVE' |
|-------|---|-------|-----------------|

In order to handle this effect in the [M&F] framework, we would have to conjoin a markedness constraint against high vowels in hiatus with the anti-deletion constraint

MAX. This, however, won't actually work: MAX evaluates only over the domain of the input, as it tests for the presence of input segments that lack output correspondents. Therefore, there is no domain of conjunction in the output in which MAX could be violated (Moreton & Smolensky 2002), so the conjunction of MAX with a markedness constraint would never do any work. Therefore, the [M&F] approach cannot model the Estonian DEE effect, nor any other DEE in which the derived environment arises through deletion.

Not only does the local conjunction approach undergenerate; it also overgenerates. As McCarthy (2003b) points out, a number of implausible effects can be modeled by it. For example, suppose that we have the ranking $[\ast[\text{dorsal}] \ \& \ \text{ALIGN}(\text{Root}, \text{R}, \text{syll}, \text{R})]_o \gg \text{IDENT}(\text{dorsal}) \gg \ast[\text{dorsal}]$. This allows us to model a language in which dorsality is eliminated in the root-final syllable whenever root/syllable alignment is disrupted by the addition of a suffix:

(87) *[M&ALIGN] predicts DEE applying when irrelevantly proximate to affix*

/paka-n/	$[\ast[\text{dorsal}] \ \& \ \text{ALIGN}(\text{Root}, \text{R}, \text{syll}, \text{R})]_o$	IDENT(dorsal)	$\ast[\text{dorsal}]$
pa.tan		₁	
pa.kan	W_1	L	W_1

The problem here is that adding a coda to a stem-final syllable, and thus making the root's right edge no longer coincide with a syllable edge has no substantive connection with any pressure to avoid dorsality in the same syllable. This is emblematic of a more general problem with Local Conjunction (Kawahara 2006, McCarthy 2007a, Wolf 2007b): it can compel or forbid totally unrelated processes to co-occur, simply because of their being conditioned in the same segment or prosodic constituent.

A related problem, identified by Itô & Mester (1998), is that [M&F] conjunction predicts an unattested pattern which they dub *markedness reversal*. For example, a conjoined constraint [NoCODA & IDENT(voice)]_{seg} will be violated just in case a given segment is both (a) syllabified as a coda, and (b) undergoes a change in voicing from input to output. Such a constraint thus functions as a positional faithfulness constraint to codas, and its existence would allow us to model an unattested language which had a voicing contrast in codas but not in onsets:

(88) [M&F] conjunction protects voicing in codas while onsets neutralize

/bad/	[NoCODA & IDENT(voice)] _{seg}	*[+voice]	IDENT(voice)
a. [pad]		1	1
b. [pat]	W_1	L	W_2
c. [bat]	W_1	1	1
d. [bad]		W_2	L

Several solutions to the markedness-reversal prediction and related problems have been proposed in the literature on Local Conjunction, but all raise difficulties of their own for the Local Conjunction analysis of DEEs. Baković (2000) proposes to rule out the markedness-reversal scenario by stipulating that a markedness constraint and a faithfulness constraint cannot be conjoined unless they are ‘co-relevant’; that is, roughly, that there must be some feature which is mentioned in the definitions of both of the conjoined constraints. While this would rule out the conjunction of NoCODA and IDENT(voice), it would also rule out the conjunction of, for example, IDENT(voice) with *VELARSTOP/CODA, which is what we would need to analyze the German /g/-spirantization DEE. A different proposal for formalizing ‘relevance’ is found in Łubowicz (2005), who suggests that a markedness constraint and a faithfulness

constraint can only be conjoined if violating the faithfulness constraint can cause the markedness constraint to be violated. (There is a clear affinity between this proposal and the notion of crucial and non-crucial interaction.) As she notes, however (fn. 6), this restriction also runs into trouble with the German example, depending on the nature of the markedness constraint which forces spirantization. Unless that constraint penalizes [k] in coda position but not [g], then devoicing underlying /g/ does not result in violation of the markedness constraint. The proposal in Hewitt & Crowhurst (1996) that conjoined constraints must share an argument faces basically the same problem, and also would rule out conjoining segmental markedness constraints like *ti with anchoring or alignment constraints, thereby preventing a conjunction-based analysis of morphological DEEs. Fukazawa & Miglio (1998) propose that only constraints from the same ‘family’ can be conjoined, but this bars the conjunction of markedness and faithfulness (as noted by Łubowicz 2005). Lastly, it should be noted that all of these proposals are basically stipulative in the limits which they place on the generality of constraint conjunction.

A final drawback of the local conjunction approach is that it fails to predict the once/always generalization. In Finnish, a candidate /va:ti₁-i₂/ → [va∅.ti₂] violates both *ti and ALIGN(Root, R, syll, R), so it should lose to its assibilating competitor *[va:.si₂]:

(89)

/va:ti ₁ -i ₂ /	[*ti & ALIGN(root, R, syll, R)] _σ	IDENT(contin)	*ti
↳ va:.si ₂		1	
va:ti ₂	W ₁	L	W ₁

4.3.3 Contrast preservation

Łubowicz (2003a) proposes that a variety of phonological phenomena, including counter-feeding opacity (chain shifts) and DEEs, arise from a pressure to preserve underlying contrasts. This proposal requires that the candidates of the phonology consist not just of an input \rightarrow output mapping for the underlying form of the word whose pronunciation the speaker is computing, but also I \rightarrow O mappings for a set of ‘nearby’ URs. For Łubowicz, this set includes all strings of length $2n+1$, if the UR has length n ; a different proposal for generating the set of neighbors is made by Tessier (2004).¹⁰⁷ For present purposes, we can informally think of this set as including all possible minimal pairs of the word’s underlying form. Constraints of a family PRESERVECONTRAST(X~Y) penalize candidates in which two inputs that differ only in having X vs. Y map to identical outputs.

To see how the model works, we can consider the example of underlying /g/ in Polish. If /g/ simply palatalized to [j], a violation of PC(coronal) would be incurred, since underlying /g/ and /j/ would merge into surface [j]. Therefore, ranking PC(coronal) above IDENT(contin) can be called on to force /g/ to map to [ʒ] instead of [j]:

(90) *Contrast preservation analysis of Polish /g/-spirantization DEE*

UR: /gi/ Set of neighbors: /ji/...	PC(coronal)	IDENT(contin)
a. [ʒi] /gi/ \rightarrow [ʒi] /ji/ \rightarrow [ji]		1
b. /gi/ \rightarrow [ji] /ji/ \rightarrow [ji]	W_1	L

¹⁰⁷ See also Łubowicz (2006, in press) for an application of contrast-preservation theory to opaque allomorph selection, and Flack (2007b) for an extension of the proposal to syntax.

Thus, on this analysis, the neutralized place contrast between /gi/ and /ji/ is displaced onto a continuancy contrast between [ži] and [ji].

The contrast-preservation model suffers from at least two identifiable drawbacks. One (McCarthy 2007a) is that, if we change the faithfulness constraint that's dominated by the PC constraint, the contrast in question can be displaced onto something totally unrelated. For instance, under the ranking PC(coronal) » DEP-C, words with underlying /gi/ sequences will epenthesize a consonant in order to avoid neutralizing a contrast with their /ji/ minimal pairs:

(91) *Preservation of underlying [coronal] contrast through epenthesis*

UR: /gi/ Set of neighbors: /ji/...	PC(coronal)	DEP-C
a. $\text{[gi]} \rightarrow \text{[ji?]}$ $\text{[ji]} \rightarrow \text{[ji]}$		1
b. $\text{[gi]} \rightarrow \text{[ji]}$ $\text{[ji]} \rightarrow \text{[ji]}$	W_1	L

On this analysis, the underlying coronality contrast is displaced onto a surface [?]~∅ contrast. This scenario is bizarre and certainly unattested, suggesting that contrast-preservation theory suffers from an excess of descriptive power. Put somewhat differently, the contrast-preservation theory radically underlimits what kind of phonological processes can occur as DEEs, and predicts that there should be processes which never occur, except as a DEE. Spirantizing /j/ to [ž] is a perfectly sensible process which we would not be surprised to see applying across the board in some language. However, there is certainly no language in which we observe [?]-epenthesis just in words that contain a [j], regardless of whether this happens with all [j]s or only with derived ones.

A second way in which contrast-preservation theory overgenerates goes beyond the types of DEEs it predicts. As shown by Barrie (2006), contrast-preservation theory is capable of modeling circular chain shifts. As these are also almost certainly unattested (Anderson & Browne 1972, McCawley 1974, Moreton 1999, Alderete 1999, 2001, Myers & Tsay 2002, Zhang, Lai & Turnbull-Sailor 2006, Wolf 2007a, b), we have another strong reason to be skeptical of contrast preservation theory.¹⁰⁸

4.3.4 Faithfulness-based approaches

NDEB descriptively involves an unfaithful mapping being blocked from applying in certain kinds of environments. Since blocking unfaithful mappings is the *raison d'être* of faithfulness constraints, it is tempting to seek an account of NDEB based on positing faithfulness constraints which will protect structures in the 'underived' contexts from undergoing the relevant DEE process. Crucially, such accounts must involve defining the notion 'derived environment' in terms of structural loci: the loci which the relevant faithfulness constraints don't protect are the 'derived environments'. The basic idea running through these accounts is that strings falling within a single morphological domain are 'underived', and that strings at the edge of a domain or which straddle the juncture of two domains are 'derived'. In critically reviewing the predictions of these theories, we'll see that they both undergenerate and overgenerate *vis à vis* the OT-CC approach. This suggests that the approach advocated in this chapter is correct in defining the (non-)derivedness of a process's environment in terms of the process's

¹⁰⁸ Circular chain shifts can also be modeled using Comparative Markedness (see McCarthy 2003b).

place in a derivation, rather than in terms of where in the phonological string the process occurs.

The first faithfulness-based account of NDEB comes from Itô & Mester (1996). They propose a constraint NEIGHBORHOOD which is violated if two segments or features belonging to the same morph are adjacent in the input but not adjacent in the output. Because root-medial segments have neighbors on both sides while root-peripheral segments have neighbors on only one side, changing or deleting medial segments incurs more violations of NEIGHBORHOOD than changing or deleting peripheral segments. By locally conjoining NEIGHBORHOOD with itself, alternations can then be blocked root-medially but allowed root-peripherally. (I illustrate this using a violation tableau rather than a comparative tableau in order to make it easier to annotate the sources of the violation-marks):

(92) *NEIGHBORHOOD analysis of Turkish intervocalic velar deletion*

/sok ₁ ak ₂ -a/	NEIGHBORHOOD ²	*VKV	NEIGHBORHOOD
a. [sok ₁ aa]		*	* (neighbor of k ₂)
b. [sok ₁ ak ₂ a]		**!	
c. [soak ₂ a]	*! (two violations at k ₁)	*	** (neighbors of k ₁)
d. [soaa]	*! (two violations at k ₁)		** (neighbors of k ₁) * (neighbor of k ₂)

The chief drawback of this approach, as pointed out by Inkelas (2000), is that it incorrectly conflates derived environments with root-peripheral environments. In Emai, for instance, junctural hiatus is resolved by deleting one of the two vowels (Schaefer 1987, Casali 1997). Hiatus deletion in this language is a DEE because underlying tautomorphic VV sequences can and do surface faithfully. This includes

VV sequences at the edge of a root: [émae] ‘food’. Deleting the final /e/ of this word would incur only one violation of NEIGHBORHOOD, and hence no violations of self-conjoined NEIGHBORHOOD², because the root-final /e/ has only one neighbor. Because deletion does not affect the final VV sequence of [émae], this example shows that ‘derived environments’ cannot be equated with ‘environments where NEIGHBORHOOD would be violated only once.’

A different faithfulness-based strategy for dealing with NDEB is advocated by Anttila (to appear), who discusses the Finnish Vowel Coalescence. This process changes a sequence of two dissimilar heterosyllabic vowels into a single long vowel, if the second underlying vowel is [+low], e.g. /ea/ → [e:]. He shows that this process applies more readily across root-suffix boundaries than it does within roots, an effect which he attributes to constraints enforcing faithfulness to underlying vowel quality of root segments (McCarthy & Prince 1995, Casali 1997, Beckman 1998). As Anttila (to appear) notes, this is unlikely to be the general solution to DEEs, for the simple reason that there are many DEEs (Finnish assibilation, *ruki*, Turkish /k/-deletion, etc.) in which root segments are changed or deleted. This means that constraints against changing or deleting root structure do not appropriately separate structures that alternate in NDEB contexts from those that don’t.

A more promising positional-faithfulness-based strategy is proposed by Pater (1999) in the context of an analysis of Indonesian nasal substitution. When the prefix /mən-/ is attached to a root that begins with a voiceless stop, the final nasal of the prefix and the stop fuse into a nasal segment homorganic with the underlying stop, as

in (a); however nasal substitution does not occur with root-internal nasal-stop sequences, as seen in (b):

- (93)
a. /mən-pilih/ → [məmilih] 'to choose, to vote'
b. /əmpat/ → [əmpat], *[əmat] 'four'

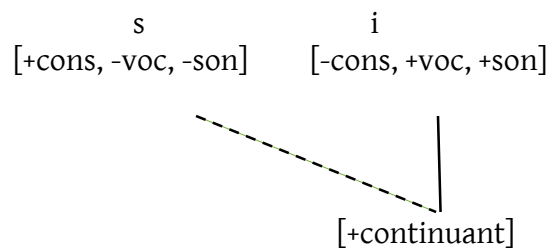
Pater (1999) suggests that this asymmetry is due to a constraint $LINEARITY_{root}$, which protects root-internal segmental precedence relations. Assuming that segmental precedence is not reflexive, fusing two segments into one disrupts their underlying precedence. For instance, in a mapping $/N_1p_2/ \rightarrow [m_{1,2}]$, input $/N_1/$ precedes $/p_2/$, but $/N_1/$'s output correspondent $[m_{1,2}]$ does not precede $/p_2/$'s output correspondent (also $[m_{1,2}]$), because no segment can precede itself. Under this analysis, fusion of two root segments disrupts root-internal precedence, and hence violates $LINEARITY_{root}$, but fusion of a root segment with an affix segment does not. (However, see Pater 2001 for a different analysis of the Indonesian data.)

Pater (1999) suggests that this line of analysis be extended to other cases like that of Finnish assibilation by invoking faithfulness constraints against root-internal feature-spreading. A similar approach to DEEs in vowel harmony is proposed by Polgárdi (1998), who posits a constraint which is violated if the trigger and target of harmony occur within the same level of morphological bracketing.

The most recent (and most formally explicit) working-out of this strategy comes from van Oostendorp (2007), who proposes an analysis of DEEs based on the idea that output phonological structures are 'colored', i.e. labeled as to their morphological affiliation. Every morph(eme) has a unique color, and epenthetic structures, lacking as they do any morphological affiliation, are colorless. Van Oostendorp's (2007) analysis of

DEEs adds two key assumptions to this basic idea: first, that association lines are representational objects and not merely relations, which means that they can have colors; and second, that all DEEs involve feature-spreading. For many DEEs, the assumption that spreading is at work is not at all implausible, depending on the theory of features that we have. For instance, Finnish assibilation (/ti/ → [si]) might involve the spreading of a continuancy feature from the vowel to the consonant:

(94)



In the example above, the solid line is the underlying (colored) association line between the [i] and its [+continuant] feature. The dotted line is an epenthetic (colorless) association line between the feature and the [s] (erstwhile /t/) which the feature spreads to.

Van Oostendorp (2007) proposes that spreading is restricted to derived environments by the following constraint on association lines:

(95) ALTERNATION

If an association line links two elements of color α , the line should also have color α .

Suppose that the configuration in (90) involves root /t/ and suffix /i/. In that case, the root node of the /t/ and the [+continuant] feature of the suffix have different colors, and ALTERNATION imposes no condition on the colorless (epenthetic) association line linking them. Now suppose instead that the /ti/ sequence is root-internal, such that the

[+continuant] feature and the /t/'s root node both have the same color. The colorless association line would thus be linking two colorful elements of the same color, resulting in violation of ALTERNATION. As such, ALTERNATION penalizes spreading within morphs but not spreading across morph boundaries.

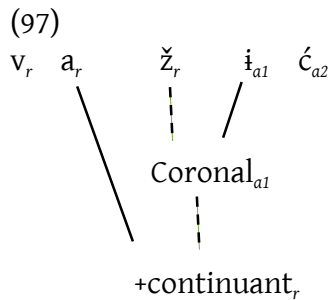
Van Oostendorp (2007) also argues that the ALTERNATION approach can also extend to the Polish /j/-spirantization DEE, which occurs in a phonologically-derived rather than morphologically-derived environment. Recall that velars become alveopalatals before front vocoids across root/affix boundaries. The voiced velar stop /g/ does not merely undergo palatalization to become [j]; it also spirantizes to [ž]. Conceived in derivational terms, the palatalization and spirantization of underlying /g/ would go like this:

(96)

UR	/vag-i-ć/
Palatalization: [dorsal] → [postalveolar] / _ [-cons, -back]	vajić
Spirantization: j → [+contin] /	važić
...	
SR	[važić]

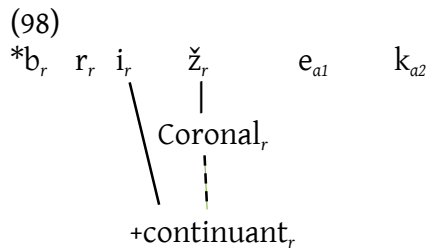
Van Oostendorp (2007) proposes that velar palatalization involves spreading of a [coronal] feature from the front vowel of the affix to the underlying /g/ of the root. If this is so, then the place node of the [ž] has the morphological color of the affix rather than the root. Van Oostendorp (2007) also proposes that the spirantization which occurs in Polish examples like this involves spreading [+continuant] from the preceding (root) vowel to the erstwhile /g/. Assuming that [+continuant] is a dependent of a

segment's major place node (Padgett 1991), this means that in a form like [važić], all of the epenthetic (and therefore colorless) association lines link elements of unlike color:



In the illustration above, subscript r indicates elements with the root color and subscript $a1$ and $a2$ indicate elements with the color of each of the two affixes, respectively. As before, underlying association lines are solid and epenthetic (colorless) association lines are dashed. Notice that both of the epenthetic association lines link elements of unlike color: one connects the root node of the the [ž] (erstwhile /g/), which has the root color, to a Coronal feature which has the $a1$ color; the other links that Coronal feature to the [+continuant] feature, which has the root color. Because there are no colorless association lines which connect two elements of the same color, ALTERNATION is not violated.

Now consider what would happen to an underlying /j/. Unlike underlying /g/s which undergo palatalization, underlying /j/s are coronal in the input, so their Coronal features have the root color. Spreading [+continuant] from the preceding vowel to the Coronal node of an underlying /j/ therefore would involve inserting a colorless association that connected two features which both have the root color:



This situation violates ALTERNATION. That constraint is therefore violated by the spirantization of an underlying /j/, but not by the spirantization of an underlying /g/.

Three problems with the ALTERNATION approach to DEEs can be identified. First, it's far from clear that all DEEs involve autosegmental spreading. In particular (as noted by Polgárdi 1998: 70, fn. 15), DEEs involving deletion (e.g. of segments in Turkish, Emai, and Daga; of morae in English trisyllabic shortening) cannot obviously be analyzed as spreading of any kind. DEEs involving outright epenthesis pose a similar challenge: it's not clear how postvocalic [ʔ]-epenthesis in Makassarese or root-initial gemination in Ndjébbana could be construed as a spreading process. Likewise, DEEs involving dissimilation at a distance, such as Chimwi:ni vowel shortening, seem most unlikely to be analyzable as spreading.

There also seem to be cases of DEES in phonologically-derived environments which are in direct tension with the feature-geometric solution which Van Oostendorp (2007) proposes for Polish. The German /g/-spirantization DEE is an example. Recall that spirantization of coda velars applies only to velars which are derivedly as opposed to underlyingly voiceless. If an example like /tru:g/ → [tru:x] is seen as a spreading of [+continuant] from the vowel to the erstwhile /g/, ALTERNATION would be violated, because the Dorsal feature of the underlying /g/ has the same color as the [+continuant] feature supplied by the vowel [u:]. We could hypothetically try to resolve

this problem by assuming that [+continuant] in German was a dependent of [±voice], but this take us well outside the assumptions of any independently-motivated theory of feature geometry.

Second, the colored containment analysis does not predict the once/always generalization. In Finnish /...t₁-i₂/ contexts, /i₁/ has the same color as the /t/ but the affixal /i₂/ does not. Therefore, if /i₁/ deletes, ALTERNATION will have no objection to spreading between /i₂/ and the /t/. But as we saw, this is not what happens.

Third, the colored containment analysis also fails to predict that only one way of deriving an environment can count. ALTERNATION will allow both affixal and epenthetic segments to spread a feature to a root segment, since in both cases the colorless association line will be linking objects of unlike colors.

A final variant of the idea that NDEB involves spreading being allowed between morphological domains but not within a morphological domain is proposed by Cho (1998, 1999, 2001) and Bradley (2007). These works assume that phonological representations directly encode timing relations between articulatory gestures, as in Articulatory Phonology (Browman & Goldstein 1986 *et seq.*). The idea here is that timing relationships between the gestures of a single morph are specified underlyingly, but that two gestures belonging to different morphs have no underlying timing relation, because they belong to different lexical entries. As such, overlap of underlying gestures belonging to a the same morph comes at faithfulness cost (because underlying timing relations are altered in doing so), but overlap of gestures belonging to different morphs is without faithfulness cost (because there is no underlying timing relationship to alter).

The gestural version of the ‘no spreading within a domain’ approach to NDEB is subject to many of the same objections raised above in reference to the autosegmental version of this idea. First, many DEEs involving epenthesis, deletion, or dissimilation are difficult if not impossible to understand as the result of any sort of gestural overlap. Second, the gestural account, like any account which attributes DEEs to tautomorphemic and heteromorphemic sequences being treated differently in some way, can’t explain DEEs which occur in phonologically-derived rather than morphologically-derived environments. A final worry (raised by McCarthy 2003b) is that this approach is arguably inconsistent with Richness of the Base. Even if phonological representations are built of gestural scores, we can’t assume that all morphs have underlying forms which include fully-specified timing relations.

The various faithfulness-based approaches discussed in this section all ultimately fail because they all rest on an attempt to define the notion ‘derived environment’ in terms of the environment’s locus in the representation. That is, they invoke faithfulness constraints which treat junctural environments differently from domain-internal environments. The OI/OT-CC model achieves better results because it defines the (non-)derivedness of a process’s environment in terms of where in a derivation the process applies, not in terms of where in the phonological string the process applies. For example, the fact that DEEs can apply in phonologically-derived environments (Polish, German, Tiberian Hebrew, Campidanian Sardinian) strongly hints that DEEs are more fruitfully described in terms of whether or not some other process has crucially preceded, rather than in terms of whether a morphological juncture occurs at the site of the process.

Likewise, the failure of ‘no spreading within a domain’ approaches to derive the once/always generalization or the ‘only one way of deriving counts’ prediction, while OT-CC does, is unsurprising. The OT-CC approach predicts the once/always generalization owing to the way that chain merger filters out non-crucial orderings. Likewise, the expectation that ‘only one way of deriving counts’ is a direct result of using PREC constraints to penalize candidates which perform the DEE process in a nonderived environment: the process will always be blocked if there are multiple PREC constraints at work. Because these predictions flow directly from the details of the serial account of DEEs which OT-CC makes possible, we should not be surprised that we fail to find any analogous predictions in models of NDEB which define ‘derived environment’ in representational rather than derivational terms.

4.3.5 Stratal OT and OO-faithfulness

Yu (2000) argues for an analysis of NDEB effects in a Stratal OT framework. The phenomenon he is concerned with is that of stress assignment in Tohono O’odham. This language stresses odd-numbered syllables from left to right, with initial main stress. Words of odd parity will not get secondary stress on the last syllable if they’re unsuffixed roots; only suffixed words are allowed to get final secondary stresses:

(99) *Tohono O’odham: No final stress in odd-parity unaffixed words*

ʔá.su.gal	‘sugar’
sí.min.ǰu	‘cemetery’

(100) *Final stress allowed in odd-parity suffixed words*

ʔá.su.gàl-t	‘to make sugar’
čík.pan-dàm	‘worker’
pí.mi.àn.do-màd	‘adding pepper’

Yu's (2000) proposal is that there are two phonological strata, one for the root level and one for the word level. In keeping with Inkelas & Orgun's (1995) principle of Level Economy, he assumes that words make a pass through the word level only if they get morphology at that level. Assuming that the constraint ranking at the root level does not assign final stress but that the ranking at the word level will assign final stress, it follows on his proposal that only affixed words get final stress on the surface:

(101)

	'sugar'	'to make sugar'
<i>Root level</i>		
<i>Input:</i>	/ʔasugal/	/ʔasugal/
<i>Output:</i>	[ʔá.su.gal]	[ʔá.su.gal]
<i>Word level</i>		
<i>Input:</i>	n/a	/ʔá.su.gal-t/
<i>Output:</i>	n/a	[ʔá.su.gàlt]

Although couched within a different theoretical vocabulary, Yu's (2000) proposal is nearly equivalent¹⁰⁹ to the one proposed by Burzio (2000) to accommodate pseudo-DEEs. Recall that Burzio (1994, 2000) argues that English has a process of Generalized Shortening, whereby vowels are pressured to shorten if they occur in an affixed word. He proposes to capture this by assuming that only morphologically simplex forms bear an IO-correspondence relation to an input. Affixed words, by contrast, bear an OO-correspondence relation to the surface form of their base, but not any IO-correspondence relation to the input form of any root:¹¹⁰

¹⁰⁹ The difference is this: Yu's (2000) proposal allows the ranking of markedness constraints to differ between one level and another (as his analysis of Tohono O'odham in fact assumes). Burzio's (2000) proposal is more restrictive in that it only allows for the ranking of faithfulness constraints to differ from one level to another. The restriction that only faithfulness constraints can be re-ranked from one stratum to another is suggested for Stratal OT by Kiparsky (1997: 17).

¹¹⁰ Dinnsen & McGarrity (1999, 2000) make a similar assumption in their analysis of the apparent pseudo-DEEs in child language that were discussed earlier, as does Benua (1995) in her analysis of base-identity effects in English hypocoristic truncation.

(102)

/blæsfijm/
↑
℞-IO
↓
[blæs.fijm] ← ℞-OO → [blæs.fə.məs]

Generalized Shortening then can be modeled using the following ranking:

(103) IO-IDENT(length) » *V: » OO-IDENT(length)

That is, the anti-long-vowel constraint *V: is overruled by faithfulness in simplex words (where IO-faith is relevant), but *V: overrules faithfulness in complex words (where OO-faith is relevant).

Yu's and Burzio's proposals are similar in that both propose that morphologically simplex words are derived from underlying forms (root level; IO-mapping) whereas morphologically complex words are derived from the surface forms of simplex words (word level; OO-mapping). If the two mappings are mediated by different sets of constraints with different rankings, then simplex and complex words will be able to display different phonological behavior.

As hinted at earlier, this proposal suffers from one main deficiency as a theory of NDEB effects, namely that it cannot model DEEs of the non-pseudo variety. In the case of Finnish assibilation, for instance, we could try positing a ranking of IDENT(contin) over *ti at the root level and the opposite ranking at the word level. This can't be right, though, because root-internal /ti/ sequences don't assibilate, even if the word they're in has affixes: 'order-PAST', underlyingly /tilat-i/, surfaces as [tilasi] and not as *[silasi]. If this word passes through a word-level phonology with the ranking *ti » IDENT(contin), however, *[silasi] is exactly what we expect.

Burzio (2000) proposes a fix for this problem. He suggests that faithfulness constraints can refer to sequences of segments. For Finnish, the relevant ranking would be this:

(104) OO-FAITH(ti) » *ti » OO-FAITH(t)

For a word like /tilat-i/, the root-internal /ti/ sequence comes from the surface form of the base [tilat], so it's protected from assibilation by top-ranked OO-FAITH(ti). By contrast, the /t-i/ sequence at the juncture is not protected by OO-FAITH(ti), because the sequence is not contained within the base: the /t/ comes from the base, but the /i/ comes from the input form of the suffix, so it's outside the scope of OO-faithfulness.¹¹¹

Łubowicz (2002) points out that allowing faithfulness constraints to refer to sequences predicts that marked segments will be allowed to surface only just in case they occur within some marked string. For instance, a hypothetical ranking IO-FAITH(xu) » *u » IO-FAITH(u) predicts an improbable language where high back unrounded vowels are allowed to surface only when preceded by a velar fricative. Absent an worked-out theory of what kind of strings can be referred to by faithfulness constraints, the string-faithfulness proposal will radically underlimit the typological space of possible phonotactic restrictions.

Furthermore, even if the ranking OO-FAITH(ti) » *ti » OO-FAITH(t) did hold in actual Finnish, the string-faithfulness theory still would admit hypothetical Finnish', with the ranking IO-FAITH(ti) » *ti » OO-FAITH(ti). This ranking would predict across-the-

¹¹¹ Similar accounts of NDEB are independently proposed by Čavar (2004, 2005), who uses markedness constraints which apply only to strings that don't occur in the base of the paradigm, and by Anttila & Cho (1999) and Cho (to appear), who use IO faithfulness constraints that apply only to underived words. (See also Iverson 2004 for discussion of the latter proposal.) The use of OO-faithfulness to sequences contained wholly in the base also bears a clear resemblance to the domain-internal IO-faithfulness accounts discussed in §4.3.4.

board assibilation in affixed words: /tilat-i/ → [silasi]. As we saw earlier, however, the evidence for pseudo-DEEs like this in natural languages is scant at best. This means that the OO-faith approach to NDEB will continue to over-generate, even if augmented by the string-faithfulness proposal.

Another related issue is that the Stratal OT approach fails to predict the once/always generalization. If the Finnish word-level stratum has the ranking *ti » IDENT(contin), then an input like /va:ti-i/ ‘demand-PAST’ should surface as *[va:si], against what’s actually observed:

(105) *Stratal OT approach doesn’t predict once/always generalization*

/va:ti-i/	*ti	ONSET	IDENT(contin)	MAX-V
a. va:si			1	1
b. va:si.i		W ₁	1	L
c. va:ti.i	W ₁	W ₁	L	L
d. va:ti	W ₁		L	1

(no raising at root level because IDENT(contin) » *ti)

Lastly, as we also noted earlier, a Stratal OT approach cannot model DEEs which occur in phonologically-derived rather than morphologically-derived environments (a point also made in Łubowicz 2002). Underlying /j/s in Polish are protected from spirantization across the board, even in affixed words. In the stratal OT approach, words with different morphological make-ups can undergo different phonology because they make passes through different strata. There is, however, no way for that approach to distinguish between underlying vs. derived /j/s in the pair /drɔŋg-ĭk-ĭ/ → [drɔŋžek] ‘pole-DIM’ vs. /brĭj-ĭk-ĭ/ → [brĭjek] ‘bridge-DIM’, because these words contain

the exact same affixes and therefore pass through the exact same strata with the exact same rankings.

This leaves only the question of how we can account for Tohono O'odham stress without recourse to Stratal OT. Perhaps the easiest strategy is proposed by Fitzgerald (1996, 1997, 2001) in the form the Morpheme-to-Stress Principle (MSP), a constraint which requires every morph(eme) to coincide with a stressed syllable. Ranking the MSP above whichever constraint(s) disfavor PWD-final stress will result in a stress on the last syllable of a suffixed word, in order to provide the outermost suffix with stress. A minor complication is posed by suffixes like /-t/, which, as in [ʔá.su.gàlt], induce the final syllable to be stressed, even though /-t/ itself doesn't bear the stress because it doesn't contain a vowel. All that this requires, though, is to formulate the MSP such that it calls for every morph to overlap with at least one stressed syllable (as Fitzgerald 2001 does), rather than for every morph to bear a stress. This formulation obviates Yu's (2000) objections to an earlier version of the MSP which assumes a form of feature-percolation from affixes to syllables.

4.3.6 Rule-based approaches

Two main approaches to NDEB (besides prespecification, which we've already discussed) were entertained in rule-based phonology. The first is to stipulate that rules of a certain type cannot apply in non-derived environments. Within this approach, the relevant class of rules has been variously identified as those which are neutralizing or structure-preserving (the Revised Alternation Condition: Kiparsky 1973a, Iverson 1987, 1992, 1993, 2004, Iverson & Wheeler 1988), those which are cyclic (the Strict Cycle

Condition: Kean 1974, Mascaró 1976), and those which are structure-building as opposed to structure-changing (Kiparsky 1982b, Harris 1983). The other approach was to dispense with such stipulations and to seek to derive NDEB effects from a particular interpretation of the Elsewhere Condition (Kiparsky 1973b, applied to NDEB by Kiparsky 1983). As we emphasized earlier, Markovian rule ordering as assumed in *SPE* cannot model NDEB (Kenstowicz & Kisseberth 1970, 1977), so rule-based phonology must import some additional principle to be able to model NDEB. However, as is already well-established (see especially Kiparsky 1993a), none of these augmentations of the *SPE* rule-ordering model is empirically adequate.

Consider first the suggestion that NDEB is a property of neutralizing or structure-preserving rules. Kiparsky (1973a) attributes NDEB to the Revised Alternation Condition, which states that non-automatic neutralization rules apply only in derived environments. A counterexample to the RAC is cited by Anderson (1981) from Faroese. This language has a process of intervocalic /g/-deletion which must be assumed to apply in underived environments in order to obtain alternations like [fa:vør] ‘beautiful.MASC.NOM.SG’ ~ [fagran] ‘beautiful.MASC.ACC.SING’:

(106) *Faroese /g/-deletion applies in non-derived environment*

UR	/fagur/	/fagur-an/
syncope	<i>doesn't apply</i>	fagran
g-deletion	faur	<i>doesn't apply</i>
glide insertion	fawur	<i>doesn't apply</i>
(other rules)
SR	[fa:vør]	[fagran]

In underived /fagur/, intervocalic /g/ is deleted, feeding a rule of intervocalic glide insertion; the glide later hardens to [v], yielding [fa:vør]. Meanwhile, in affixed /fagur-an/, a rule of syncope bleeds /g/-deletion by virtue of making the /g/ non-intervocalic.

The /g/ therefore surfaces in affixed [fagan]. On this analysis, the rule of /g/-deletion must apply to underived /fagur/. It does this despite being neutralizing (it neutralizes /g/ with zero) and being non-automatic (in that it has lexical exceptions such as [sɔnago:ga] ‘synagogue’, which surface with intervocalic [g]). Faroese thus presents a case of exactly what the RAC bans.

An adaptation of the RAC is advocated in work by Iverson (1987, 1992, 1993, 2004), Iverson & Wheeler (1988), Eckman & Iverson (1997, 2000), and Eckman, Elreyes & Iverson (2001, 2003). In Iverson (2004) the principle responsible for NDEB, dubbed the Derived Environment constraint, states that “Structure-preserving obligatory rule applications are restricted to derived environments.” The DEC is presumably not susceptible to the Faroese objection to the RAC, because Faroese /g/-deletion has lexical exceptions and therefore presumably doesn’t count as “obligatory”. However, the DEC does seem to be inconsistent with the numerous attested examples of positional neutralization rules which apply in underived environments despite being neutralizing. For instance, in German, final devoicing must apply to underived forms like /bɔnd/ ‘federation’ (yielding [bɔnt]), even though this means neutralizing that input with /bɔnt/ ‘multi-colored’. The segments /t/ and /d/ most both be underlying segments of German, and yet the final devoicing rule that converts /d/ to [t] applies to underived forms. Therefore, neutralizing/structure-preserving status of a rule does not entail that the rule is NDEBed.

By the same token, a rule’s being NDEBed does not entail that it is structure-preserving. Iverson (2004) himself cites instrumental investigations by Cho (1999, 2001) finding that Korean /n/-palatalization applies more strongly across morph boundaries

than within morphs. That is, the degree of coarticulation in an underlying /ni/ sequence is larger in cases like /pan+i/ ‘class-NOMINATIVE’ than in cases like /pani/ (a name). The strong palatalization of underlying /n/ in derived contexts is non-structure-preserving because Korean does not have the palatal nasal /ɲ/ as a contrastive phoneme. Despite this, palatalization is NDEB in that it applies less fully in tautomorphemic environments. Iverson (2004) suggests that the DEC is not falsified by this data because /n+i/ coarticulation belongs to the phonetics, not the phonology. But even if this move of strictly separating phonetic and phonological modules were adopted, we would be obliged to explain why some phonetic rules show NDEB while others do not, and the DEC will not help us with this.¹¹²

Besides the DEC, the other direct intellectual successor to the RAC is the Strict Cycle Condition. The SCC was originally proposed in syntax (Chomsky 1973), and was extended to phonology by Kean (1974) and Mascaró (1976). The SCC states that cyclic rules can only apply in environments derived on the current cycle. As shown by Kiparsky (1993a), however, there are cyclic rules that are not subject to NDEB. An example is the Finnish vowel coalescence process mentioned in the last section. This rule would have to be cyclic, because it’s ordered before the selection of the allomorphs of certain suffixes. For instance, the illative singular is /-se:n/ after a long vowel, and /-(h)Vn/ elsewhere. When the root has undergone optional coalescence, the /-se:n/ allomorph is used, showing that coalescence must be ordered among the cyclic rules:

¹¹² This objection is in addition to the deeper matter of whether removing sub-contrastive phonetic detail from the purview of the phonology is desirable or even possible. For example, if gradient processes can show cyclic or paradigm-uniformity effects (Bloomfield 1933, Steriade 2000a, Yu 2007), then it would seem that sub-contrastive detail is part of the phonology proper.

(107)	‘dark-ILLATIVE.SING’	
	/pimeä/	/pimeä/
Cycle 1 coalescence (optional)	pime: or pimeä	
Cycle 2 morphology	pime:-se:n	pimeä-hän

While Coalescence must be cyclic, it isn’t subject to NDEB, because it does apply within roots, as illustrated in this example.¹¹³ Additionally, Kiparsky (1993a) notes that there are post-cyclic rules, both word-level and post-lexical, which show NDEB. The Sanskrit *ruki* rule, for instance, applies at the word-level across clitic boundaries (on which see also Selkirk 1980). In Vedic (though not Classical) Sanskrit, *ruki* also applied ‘more rarely’ across word boundaries, indicating that in Vedic the *ruki* rule was post-lexical. Łubowciz (2002) notes that Campidanian Sardinian postvocalic lenition is also a counter-example, because it shows NDEB effects despite applying across word boundaries and hence being postlexical. The Slovak pre-sonorant voicing rule which we saw earlier is a third example. Because we find cases both of cyclic rules that aren’t NDEBed and of NDEBed rules that aren’t cyclic, the SCC is inescapably falsified.¹¹⁴

The third and final proposal in the literature about which class of rules is subject to NDEB is that structure-changing rules are restricted to derived environments, whereas structure-building rules can apply in non-derived environments. The motivation for this proposal (Harris 1983) comes from the fact that underived words are syllabified and receive stress, even in languages where

¹¹³ Additional examples of non-NDEBed cyclic rules are discussed in Hargus (1988, 1989).

¹¹⁴ For additional cases of arguably post-cyclic or post-lexical rules which show NDEB, see Mascaró (1976), Shaw (1985), Kaisse (1986, 1990), Hargus (1988, 1989), Iverson & Wheeler (1988), Rice (1988), Hualde (1989), Clark (1990), and Kiparsky (1993a).

syllabification and stress assignment would have to apply cyclically. The SCC would seem to block such rules from applying to underived words, contrary to fact. Hence, Harris (1983) and Kiparsky (1982b) propose that rules like syllabification, which simply add structure without altering underlying structure, can apply in non-derived environments.

This proposal, however, fares no better at accurately separating NDEBed from non NDEBed rules. First, there are many examples of structure-building rules which are NDEBed, for instance Makassarese ʔ -epenthesis. Second, there are also numerous cases of structure-changing rules which aren't NDEBed. Faroese intervocalic /g/ deletion and German final devoicing (to cite just two examples discussed above) both must apply to underived roots, even though they delete or alter structure, rather than merely adding structure. Moreover, in connection with arguing for a prespecification account of NDEB, Kiparsky (1993a) argues that structure-changing rules never show NDEB (because on this view NDEB is a property of default rules which fill in the feature-values of underspecified segments).

Thus, there is no successful account of NDEB yet proposed which relies on a stipulation to the effect that rules having some property (structure-preservation, cyclicity, structure-changing) are always NDEBed. A very different tack is taken by Kiparsky (1983), who proposes that the SCC can be dispensed with and its effects derived from the Elsewhere Condition (Kiparsky 1973b). The idea here is that every underived lexical item L is instantiated in the form of a lexical insertion rule ' $\emptyset \rightarrow L$ '. On the assumption that the application of a more-specific rule blocks the application of less-specific rules (i.e., the Elsewhere Condition), the application of the ' $\emptyset \rightarrow L$ ' rule on

the cycle where L is inserted will block the application of any rule which would modify the internal contents of L. The ' $\emptyset \rightarrow L$ ' rule is radically specific to L, and therefore can be counted on to be more specific than any productive phonological rule of the language.¹¹⁵

The possible objections to this strategy for analyzing NDEB are both conceptual and empirical. First, it is somewhat unclear how the ' $\emptyset \rightarrow L$ ' rule is supposed to work within the interleaved phonology/morphology system assumed in Lexical Phonology. A lexical insertion rule presumably belongs to the morphology rather than the phonology, so it's unclear why (even assuming the Elsewhere Condition) the application of a morphological rule should preclude the application of a phonological one, since they belong to separate components. This issue might be resolved by invoking not a lexical insertion rule but a phonological identity rule ' $L \rightarrow L$ ' which maps every underived root onto itself. But it's not clear that this will work either. It's perfectly reasonable to think that every lexical item must be associated with an insertion ' $\emptyset \rightarrow L$ ' (since without that rule L would never appear). However, there's no reason in principle that every lexical item would have to be associated with an identity rule ' $L \rightarrow L$ '. It would seem to be necessary to stipulate that a distinct ' $L \rightarrow L$ ' rule exists for every word of every language. The problem with ' $L \rightarrow L$ ' is thus akin to that with the immunity-by-prespecification approach: an account of NDEB based on arbitrary properties of individual lexical items requires stipulation to achieve generality. This should lead us to seek instead an account based on principles of a more general character.

¹¹⁵ A similar proposal is independently developed by Giegerich (1988).

The empirical problems for the effort to derive the SCC from the Elsewhere Condition are basically the same as those which we observed above to afflict the SCC itself (Kiparsky 1993a). Assuming that the ‘ $\emptyset \rightarrow L$ ’ strategy worked, then by the Elsewhere Condition ‘ $\emptyset \rightarrow L$ ’ should block all lexical rules from applying in nonderived environments. However, as we just saw, Finnish Vowel Coalescence must apply cyclically, implying that it’s a lexical rule, but it also applies in nonderived environments. The ‘ $\emptyset \rightarrow L$ ’ strategy gives no explanation of why Vowel Coalescence should fail to be blocked. Further, because the ‘ $\emptyset \rightarrow L$ ’ rule is a lexical rule, it should be unable to block application of postlexical rules in nonderived environments: ‘ $\emptyset \rightarrow L$ ’ isn’t part of the postlexical component, so it doesn’t compete with postlexical rules to get the Elsewhere Condition’s permission to apply. But, as we saw, Slovak, Vedic Sanskrit, Campidanian Sardinian, and a number of other languages provide evidence that postlexical rules can be subject to NDEB, which means that the ‘ $\emptyset \rightarrow L$ ’ account of NDEB is insufficiently general.¹¹⁶

The failure of all of these theories NDEB in rule-based phonology means that *SPE*-style Markovian rule ordering is in a real bind. Rule ordering itself provides no possible account of NDEB (Kenstowicz & Kisseberth 1970, 1977), and needs to be augmented with something else. However, as we’ve seen, none of the options on the intellectual market are empirically satisfactory. Given the possibility of a restrictive theory of NDEB in OI/OT-CC, we find ourselves confronted with a situation in which (a version of) OT actually fares better than rule-based phonology in analyzing a particular kind of opacity. (See Baković 2007 for other types of opacity where this is true). An

¹¹⁶ See also Iverson & Wheeler (1988) for some criticisms of the Elsewhere Condition account of NDEB.

additional advantage of OT-CC, which is worth stressing again, is that all it needs to analyze NDEB are PREC constraints and merger of convergent chains, which are the exact same formal machinery called on for counterfeeding and counterbleeding opacity. Even if, say, the SCC were empirically adequate as an account of NDEB, rule-based phonology would still need the SCC as a *sui generis* principle to deal with NDEB, while rule ordering itself was used for counterfeeding and counterbleeding. OT-CC thus has an upper hand on rule-based phonology not only in empirical coverage but also in economy, since OT-CC needs no extra devices specific to NDEB.

OT-CC, and the subtheory of OI cast within OT-CC's broader assumptions, thus should not be regarded as grudging concessions to rule-based phonology that some form of serialism is required, even in OT. Our examination of NDEB prompts the conclusion that OT-CC is a *better* theory of serial process-interaction than any version of rule-based phonology yet proposed.

4.4 On discarding the $F_2 \gg \text{PREC}(F_1, F_2)$ ranking metaconstraint

4.4.1 Obligatorially-counterbleeding processes

In this final subsection, I will address a change to the theoretical assumptions of McCarthy (2007a) which the analysis of NDEB effects has required. Recall that the general schema for NDEB in OI/OT-CC is as follows:

(108) *Ranking schema for NDEB in OT-CC*
 $\text{PREC}(F_1, F_2) \gg M \gg F_2$

This ranking schema involves ranking $\text{PREC}(F_1, F_2)$ above F_2 . That's essential, because it must be thus in order for $\text{PREC}(F_1, F_2)$ to be able to overrule any markedness constraint

M which would favor doing the F_2 -violating process in contexts not derived by F_1 -violation. However, this ranking schema violates the metaconstraint proposed in McCarthy (2007a) to the effect that F_2 universally dominates $\text{PREC}(F_1, F_2)$. After explaining the type of hypothetical scenario which McCarthy (2007a) proposes this fixed ranking to rule out, I'll proceed to argue that such scenarios are in fact attested.

The scenario which the $F_2 \gg \text{PREC}(F_1, F_2)$ metaconstraint is meant to exclude arises from the analysis of counterfeeding opacity in OT-CC. For example, recall from chapter 1 that in Bedouin Hijazi Arabic, syncope of certain underlying /i/s counterbleeds the palatalization of underlying pre-/i/ velars:

(109)	UR	/ħa:kimi:n/
	syllabification	ħa:ki.mi:n
	palatalization	ħa:kʲi.mi:n
	syncope	ħa:kʲ.mi:n
	SR	[ħa:kʲ.mi:n]

In OT-CC, counterbleeding order between palatalization and deletion can be attributed to $\text{PREC}(\text{IDENT}(\text{back}), \text{MAX})$. This constraint will assign a violation-mark every time that a MAX -violating LUM is not preceded by an $\text{IDENT}(\text{back})$ -violating LUM. As such, this constraint will always be violated if MAX -violating LUMs occur in words that contain no pre-/i/ velars, where there is no possibility of harmonically-improving $\text{IDENT}(\text{back})$ -violating LUMs occurring. Consequently, in words without underlying pre-/i/ velars, $\text{PREC}(\text{IDENT}(\text{back}), \text{MAX})$ will serve to discourage doing syncope. If $\text{PREC}(\text{IDENT}(\text{back}), \text{MAX})$ is ranked above the markedness constraint that favors syncope, then syncope will be blocked just in case there is no palatalization for syncope to counterbleed:

(110) *Syncope blocked if there's no palatalization to be counterbled (example from McCarthy 2007a)*

/ʃarib-at/	PREC (ID(bk), MAX)	*ki	'SYNCOPATE'	MAX	Id[back]
a. [ʃarib-at]			1		
b. [ʃaribat, ʃarbat]	W_1		L	1	

The $F_2 \gg \text{PREC}(F_1, F_2)$ ranking metaconstraint rules out this scenario by ensuring that $\text{PREC}(\text{IDENT}(\text{back}), \text{MAX})$ is universally ranked below MAX , and hence by transitivity below any markedness constraint that can trigger MAX -violation.

Consequently, discarding the $F_2 \gg \text{PREC}(F_1, F_2)$ fixed ranking in the service of analyzing NDEB effects predicts the existence of languages with the following property:

(111) *Prediction: Obligatorily counterbleeding processes*

A B-violating process occurs just in case it would counterbleed an A-violating process. If no A-violating process occurs, the B-violating process does not occur.

This prediction may be borne out by a phenomenon in Chimwi:ni which represented one of the main arguments for adding global rules to phonological theory. The remainder of this subsection will discuss the Chimwi:ni case. The following subsections will discuss additional possible reasons for discarding the ranking metaconstraint arising from the analysis of emergent opacity in child language.

The phenomenon of interest from Chimwi:ni is described by Kisseberth & Abasheikh (1975) and also discussed by Kenstowicz & Kisseberth (1977) and Hyman (1993). The perfective suffix in this language is $/-i:\text{ɬ}e/$, with an initial long vowel. (The consonant written here as $/\text{ɬ}/$ is a lateral flap.) The perfective suffix triggers spirantization of certain preceding consonants:

- (112) /p, t, t̥/ → [s]
 /k/ → [ʃ]
 /ʎ/ → [z]

When these alternations occur, the initial vowel of the perfective shortens:

- (113) [ku-ʎipa] 'to pay' /ʎip-i:ʎe/ → [ʎis-iʎe] 'he paid'
 [ku-laʎa] 'to let go' /laʎ-i:ʎe/ → [las-iʎe] 'he let go'
 [x-ʃi:ka] 'to hold' /ʃi:k-i:ʎe/ → [ʃi:ʃiʎe] 'he held'
 [x-kuʎa] 'to grow' /kuʎ-i:ʎe/ → [kuziʎe] 'he grew'

However, the suffix vowel fails to shorten just in case it's not preceded by a consonant that undergoes spirantization. This can arise in three situations: a) the preceding segment is one that doesn't participate in the alternation; b) the preceding segment is underlyingly a sibilant to begin with; and c) the preceding segment is one of /p, t, t̥, k, ʎ/, but it fails to spirantize, owing to it being part of a root that exceptionally resists the process:

- (114) a. /pamb-i:ʎe/ → [pamb-i:ʎe] 'he decorated'
 b. /kos-i:ʎe/ → [kos-e:ze] 'he made a mistake'
 (cf. x-kosa 'to make a mistake')
 c. /set-i:ʎe/ → [set-e:ʎe] 'he stamped on'

The conclusion that shortening occurs just in case spirantization has occurred, and cannot be conditioned by the underlying or surface identity of the preceding consonant, is further underlined by the fact that a few stems with final consonants other than /p, t, t̥, k, ʎ/ exceptionally *do* undergo spirantization, and with such stems, shortening indeed does occur:

- (115) /big-i:ʎe/ → [biš-iʎe] 'he hit'
 /law-i:ʎe/ → [laz-iʎe] 'he went out'

Assuming that the longness of the vowel somehow serves to condition spirantization of the preceding consonants, then Chimwi:ni presents a counterbleeding interaction between spirantization and shortening: shortening removes the conditioning context for spirantization, but spirantization happens anyway. Further, crucially, this particular case of shortening is blocked just in case there is no spirantization for it to counterbleed.

Chimwi:ni therefore supplies the missing sort of interaction which the B » PREC(A,B) metaconstraint was meant to rule out, provided that the longness of the perfective's initial vowel serves in some way to make it harmonically improving to spirantize the preceding consonants. Is there any reason to think this is true? Perhaps. Voids' ability to induce assibilation of a preceding consonant arguably shows a positive correlation with their height (Hall & Hamann 2006, Hall, Hamann & Zygis 2006, Telfer 2006). Additionally, long vowels often tend over time to become higher (Labov 1994), as exemplified most famously by the Great English Vowel Shift. Raising long vowels also has a plausible functional basis (Gussenhoven 2007). Higher vowels have less intrinsic duration than lower vowels, owing to their articulatory settings being nearer to those of flanking consonants (Lehiste 1970, Catford 1977, Keating 1985, Flemming 2004). Gussenhoven (2007) found that listeners compensate for this difference by perceiving high vowels as longer than they objectively are. The existence of that effect means in turn that raising a long vowel serves to enhance the vowel's perceived longness. In light of all this, it is not implausible to suppose that long [i:] functions as phonologically higher than short [i] in Chimwi:ni. If so, then longness of the vowel would represent a prerequisite for the vowel's being able to trigger

assibilation of preceding consonants. This account does make a certain amount of diachronic sense for the Chimwi:ni example, since the spirantizations triggered by the perfective's /i:/ correspond to those induced by the super-close /j/ of Proto-Bantu (Hyman 1993).

We may thus conjecture that long /i:/ counts as 'high enough' to trigger the root-final spirantizations in Chimwi:ni, but that short /i/ does not. If so, then shortening indeed counterbleeds spirantization, and Chimwi:ni supplies our desired example of an obligatorily counterbleeding process.¹¹⁷ All that would be left to explain is why mutation is only observed with the [i:] of the perfective suffix. That, however, is no problem: it just amounts to assuming that pre-[i:] spirantization is a DEE, and can only apply in environments derived by the perfective suffix.

4.4.2 Spontaneous opacity in child language

Discarding the $F_2 \gg \text{PREC}(F_1, F_2)$ metaconstraint may be desirable for a third reason, namely that the metaconstraint, combined with standard assumptions about learning in OT, makes it impossible to call on PREC constraints to account for emergent, non-target-like opacity in child language.

The assurance of end-state restrictiveness in the learning of OT grammars has long been recognized to require that learners have a bias for ranking markedness constraints above input-output faithfulness constraints (Sherer 1994, Smolensky 1996, van Oostendorp 2000, Hayes 2004, Prince & Tesar 2004). The argument, in brief, is that,

¹¹⁷ A somewhat different analysis could follow a suggestion by Hyman (1993) that the vowel of the perfective is an underlying glide + vowel sequence /ji/. In keeping with the implicational hierarchy regarding assibilation triggers, we could assume that /j/ but not /i:/ is high enough to trigger the observed mutations, so vocalization of /ji/ into [i:] would counterbleed mutation of the root consonant.

in order to avoid superset traps (Gold 1967, Baker 1979, Angluin 1980, Berwick 1985), learners must start from the hypothesis that all markedness constraints are fully enforced in the target language, and then shift away from this hypothesis (demote markedness below faithfulness) only to the extent that positive evidence requires. If a learning algorithm respecting such a bias can be made to operate gradually (Boersma & Hayes 2001, Tessier 2007), we can interpret non-target-like intermediate stages of child language as reflexes of the ranking bias(es) imposed by the learning algorithm, which the child has not yet altered in response to adult evidence (Demuth 1995, Pater 1997, Bernhardt & Stemberger 1998, Gnanadesikan 2004, Tessier 2007). For instance, children would be assumed to start from an initial state of Markedness » Faithfulness, and only gradually move markedness constraints below faithfulness constraints. This would be in keeping with the gradual emergence of additional target-like marked structures in child language as learning progresses (Jakobson 1968 *et seq.*).

If there are both a F_2 » $\text{PREC}(F_1, F_2)$ metaconstraint and a durable Markedness » Faithfulness bias, it follows that all PREC constraints must reside in the bottom-most stratum, below all faithfulness constraints, in the initial state (McCarthy 2007a: §3.4). Under such a regime, PREC constraints will be installed above markedness and/or faithfulness constraints (endowing them with sufficiently high rank to induce opacity) only upon the prompting of positive evidence. This might not be right, though, because child language does exhibit emergent cases of opacity that clearly aren't prompted by the learning data. The most famous example¹¹⁸ (Smith 1973, Brane 1976, Macken 1980,

¹¹⁸ For other examples and theoretical discussion of child chain shifts, see Velten (1943), Jakobson (1968), Smith (1973), Grunwell (1987), Dinnsen (1993, 1998, 2002), Dinnsen, Barlow & Morisette (1997), Dinnsen & Barlow (1998), Gierut & Champion (1999), Cho & Lee (2000), Dinnsen & O'Connor (2001), Jesney (2005, 2007), and Ettliger (to appear).

Dinnsen, O'Connor & Gierut 2001, Jesney 2005, 2007, Ettliger to appear) is Amahl Smith's 'puzzle-puddle-pickle' chain shift, wherein the occlusivization of target stridents to [t, d] in all contexts counterfeeds a second process whereby /t, d, n/ are velarized before laterals:

(116)
 puzzle /pʌzəl/ → [pʌdəl] (*→ [pʌgəl])
 puddle /pʌdəl/ → [pʌgəl]

If OT-CC is to be a fully general theory of opacity, we might prefer for it to be able to handle these data. This counterfeeding interaction requires that $\text{PREC}(\text{IDENT}(\text{place}), \text{IDENT}(\text{contin}))$ dominate the velarization-favoring constraint *TL:

(117)

/pʌzəl/	PREC (IDENT(place), IDENT(contin))	*TL	IDENT(place)
☞ <pʌzəl, pʌdəl> rLUMSeq: <IDENT(contin)>		1	
<pʌzəl, pʌdəl, pʌgəl> rLUMSeq: <IDENT(contin), IDENT(place)>	W ₁	L	W ₁

If PREC constraints are bottom-ranked in the initial state, then $\text{PREC}(\text{IDENT}(\text{place}), \text{IDENT}(\text{contin}))$ should come to dominate *TL only in response to positive evidence. But adult English data will never supply such evidence, because the occlusivization and velarization processes that Amahl is applying in counterfeeding order do not even exist in the variety of English being learned, let alone in an opaque relationship. In order for an opacity stage like this to emerge in the absence of prompting from adult evidence, the learner must have a bias for having PREC constraints above markedness constraints. But because markedness constraints must be ranked above faithfulness constraints in

the initial state, having *PREC* above markedness entails by transitivity an initial state where *PREC* is above faithfulness, which contravenes the $F_2 \gg \text{PREC}(F_1, F_2)$ metaconstraint.

Whether this result is needed or not depends upon the typological details of child-language opacity. Jesney (2005, 2007) argues that the bulk of the attested examples of child chain shifts can be handled using positional faithfulness constraints protecting segments that possess certain types of prominence in the input. If featural faithfulness is mediated by *IDENT* rather than *MAX(feature)* constraints, the same strategy is independently required in OT-CC for zero-terminating chain shifts, which cannot in that case be analyzed with *PREC* constraints (McCarthy 2007a: §3.5.3). The positional faithfulness approach to child chain shifts (combined with the assumption that *PREC* constraints are bottom-ranked in the initial state) makes highly restrictive predictions about the typology of non-target-like child opacity. Specifically, it predicts that chin shifts (counterfeeding) are the only type of spontaneous opacity that should arise, and moreover that child chain shifts will always involve the target of the first step of the shift possessing some type of prominence which would bring with it the protection of positional faithfulness constraints.

The need for *PREC* constraints being high-ranked in the initial state therefore would be demonstrated by the discovery of counterexamples to these predictions. I know of no cases of spontaneous counterbleeding,¹¹⁹ but there is a small amount of evidence for children innovating non-target-like DEEs, including in the example of Amahl's possible 'non-doubly-derived-environment blocking' discussed earlier, as well

¹¹⁹ However, segmental coalescence is well-attested in child language (see, e.g. Gnanadesikan 2004), and it has been suggested (e.g. McCarthy 2007a) that 'coalescence' is really a two-step process with feature-spreading occurring first, which is subsequently counterbled by deletion of one of the underlying segments.

as in the case of post-nasal voicing in child Greek (Drachman & Malikouti-Drachman 1973, Kiparsky & Menn 1977). In the event that it is shown that children do innovate forms of non-target-like opacity other than chain shifts, we would have an independent reason, besides the analysis of DEEs, for setting aside the $B \gg \text{PREC}(A,B)$ ranking metaconstraint.

CHAPTER 5

CYCLIC OVERAPPLICATION AND DERIVED ENVIRONMENT BLOCKING

5.1 Introduction

In chapter 4, we examined a particular kind of serial interaction between morph insertion and phonology: Nonderived Environment Blocking. NDEB arises when a phonological process is forbidden to apply unless its application is crucially preceded by the application of some other (morphological or phonological) process. As we saw, the vocabulary of OI/OT-CC's *PREC* constraints makes possible analyses that express NDEB requirements in an intuitive way which moreover leads to a number of desirable restrictive predictions.

In this chapter, I'll look at two other kinds of serial interactions between phonology and morphology. I'll argue that these, like NDEB, meet with straightforward analyses in OI theory, and that the accounts of them available in OI are empirically superior to those possible in either output-output faithfulness (Burzio 1994, 2000, Benua 1995, 1997) or stratal OT (Kiparsky 2000 and the numerous other references cited in ch. 1, fn. 4).

The first of these ordering effects is what I'll call *cyclic overapplication*. Here, a phonological process is required to occur prior to the concatenation of an affix. For instance, to reprise the example that was used in Chapter 1, in the speech of younger Seoul Korean speakers, the deletion of the final /s/ of the root /kaps/ 'price' must occur prior to the attachment of a vowel-initial suffix like /-i/ NOMINATIVE. This is because attaching the suffix would allow the /s/ to syllabify as an onset and take away the markedness motivation for /s/-deletion, namely avoiding complex codas.

The second class of effects that I'll look at is what I'll call *derived environment blocking* (DEB).¹²⁰ Here, a phonological process is forbidden from applying whenever some morphological process has previously occurred. This is attested by processes which occur morph-internally, but which fail to occur across morph boundaries. A classic example of this (Harris 1990, Borowsky 1993, Benua 1997) is found in many of the English dialects spoken in Northern Ireland, where coronal consonants are realized as dental before a tautomorphemic [ə] or [ɹ]:

- (1) *Tautomorphemic pre-rhotic dentalization in N. Irish English*
ladder [læɖəɹ], *[lædəɹ]
pillar [pɪləɹ], *[pɪləɹ]

However, dentalization fails to apply across a morph boundary created by a level 2 affix, such as the [-ə] of the agentive and comparative suffixes:

- (2) *Failure of pre-rhotic dentalization across level 2 morph boundary*
waiter [wetəɹ], *[wetɖəɹ]
louder [laʊdəɹ], [laʊɖəɹ]

One important fact about DEB is that it doesn't exclusively involve roots or stems being protected from an unfaithful mapping. There are a number of attested cases of DEB in which the process that fails to occur would have affected an affix. A simple example of DEB in affixes is also found in English (Kiparsky 1985, Borowsky 1993, Coetzee & Pater to appear): nasal place-assimilation is obligatory and categorical at the junctures of level 1 affixes (*i[m]possible*, **i[n]possible*) but applies optionally and gradiently at level 2 junctures (*u[n]believable*). As we'll see, this and similar examples pose a severe challenge to the analysis of DEB effects in OO-faithfulness theory.

¹²⁰ I've borrowed the term 'derived environment blocking' from Hall (2006).

This chapter will be organized as follows. In Section 5.2, I discuss the handling of cyclic overapplication effects like Korean cluster reduction in OI, and show that OI predicts that there can never be more than one overapplying ‘cycle’ per word (consistent with a proposal in Cole 1990). I then show that, should this prediction prove incorrect, additional ‘cycles’ can be obtained if there are PREC constraints which evaluate positively rather than negatively (i.e., which assign rewards rather than violation-marks to candidates). Since PREC constraints are guaranteed, under reasonable assumptions, to always evaluate a finite candidate set, assuming them to evaluate positively does no violence to the mathematical well-definedness of OT (as does happen if positive constraints are imagined to assess an infinite candidate set: Prince 2007). I also discuss another alternative strategy for deriving additional cycles, which is proposed in Stratal OT (Bermúdez-Otero 2007c, to appear, Collie 2007) for coping with a related problem. This is to assume that the surface forms of words (in particular high-frequency words) can be lexically stored and are available for use in morphological spellout.

In section 5.3, I turn to DEB effects. I demonstrate how these are handled in OI using the example of Northern Irish English dentalization. I then review a class of cases of DEB which can be handled in OI but not in OO-faithfulness theory, namely those in which the blocked process would have involved unfaithfulness to affix rather than base material.

Sections 5.4 and 5.5 offer critiques of two existing theories of cyclic effects on phonology: Stratal OT and the theory of phases. We will see that both face a number of empirical problems.

One final note: in this chapter, unless otherwise noted, I will be assuming that the languages under analysis respect strictly root-outwards spellout. Section 5.6 will conclude the chapter by briefly considering the matter of phonology/morphology ordering effects in a version of OI that did without a stipulated requirement of root-outwards spellout.

5.2 Cyclic overapplication

5.2.1 The empirical domain

In cyclic overapplication, a phonological process applies to a morphological unit *Stem+Affix* where there is a markedness motivation for applying the process in *Stem*, even though there is no such markedness motivation in *Stem+Affix*. Such cases provide a motivation for assuming that the phonological process applies to *Stem* at a derivational stage prior to the addition of *Affix*.

We saw a simple example of cyclic overapplication in chapter 1 from Seoul Korean (Kenstowicz 1996; see also Kim 2005, Yun 2008). Korean doesn't allow complex syllable margins, and in the standard variety this results in $C \sim \emptyset$ alternations in the paradigms of nominal roots that end in two consonants underlyingly:

- (3) a. /kaps/ → [kap] 'price'
 b. /kaps-i/ → [kap.si] 'price-NOMINATIVE'

Younger speakers show a leveling of these paradigms, such that the root always surfaces as [kap]:

- (4) a. /kaps/ → [kap] 'price'
 b. /kaps-i/ → [ka.pi] 'price-NOMINATIVE'

The theoretical challenge here is to explain why the /s/ deletes in (2)a. We can't assume that speakers of variety (2) have a constraint against heterosyllabic clusters (e.g. *CC 'no preconsonantal consonants') ranked above MAX, because these speakers show no such reduction of intervocalic clusters in verbs, e.g. [pal.k-εs.s-ε] 'be bright-PAST-INFORMAL'.

Given a ranking of *COMPLEXCODA » MAX » *CC, deleting the final /s/ of the root meaning 'price' will be harmonically improving from a string [kaps] but not from a string [kap.si]. As a result, for an input //√PRICE-NOM//, there will be well-formed chains like (3)a in which /s/-deletion occurs prior to the insertion of the nominative morph, but none in which /s/-deletion occurs after the insertion of the nominative morph:

- (5) a. <√PRICE-NOM, kaps-NOM, kap-NOM, ka.pi>
 b. <√PRICE-NOM, kaps-NOM, kap.si>

As we saw in Chapter 1, candidates like (3)a will win under a ranking of PREC(MAX, insert-nom.) » MAX:

(6)

//√PRICE-NOM//	PREC (MAX, insert-nom.)	MAX
a. ☞ <√PRICE-NOM, kaps-NOM, kap-NOM, ka.pi> rLUMSeq: <insert-root, MAX, insert-nom.>		1
b. <√PRICE-NOM, kaps-NOM, kap.si> rLUMSeq: <insert-root, insert-nom.>	W ₁	L

Chain (6)b, with no /s/-deletion, is preferred by MAX, but it loses by virtue of violating the higher-ranked PREC constraint. Candidate (6)b incurs this violation because the operation of inserting the nominative morph is not preceded by a MAX-violating LUM.

As was also noted in Chapter 1, this mode of analysis in OT-CC directly captures the intuition expressed in Blumenfeld (2003b) that cyclic overapplication is a species of

counterbleeding opacity. Introducing the nominative suffix removes the motivation for cluster reduction (i.e., renders cluster-reduction non-harmonically improving), but cluster reduction happens anyway. In derivational terms, this can be made to occur if cluster reduction happens earlier in the derivation than nominative affixation. In a hypothetical cyclic analysis of the leveling dialect of Seoul Korean, this ordering would be brought about by assuming that there is a cycle on the bare root, and that the cluster-reduction rule applies on this cycle:

- (7) Input to cycle 1: /kaps/
 Cluster reduction: kap
- Input to cycle 2: kap-i
 Cluster reduction: *does not apply: structural description not met*
- Surface form: [ka.pi]

Using the machinery of OT-CC, the OI analysis of cyclic overapplication directly expresses this same ordering requirement: a PREC constraint assigns violation-marks to candidates where the relevant affixation occurs without having been preceded by the relevant phonological process.

5.2.2 A prediction: One cycle of overapplication per word

One theoretical question which has been asked in reference to the cycle is that of how many cycles of phonology a word can undergo. In the original conception of the cycle (Chomsky, Halle & Lukoff 1956, Chomsky & Halle 1968, Brame 1974), every layer of morphological bracketing defined a potential cyclic domain, so in principle a word could undergo one cycle of rule application for every morpheme in the word. Cole (1990) notes the absence of evidence for such a rich number of cycles in any language,

and suggests an alternative generalization: words are universally limited to undergoing a maximum of two cycles. She argues that the data from a number of languages such as Chamorro (Chung 1982, Crosswhite 1999) which have been argued to exhibit more cycles than this can in fact be re-analyzed as having only two.

In the theoretical context of Cole's (1990) proposal, which is cast in a traditional rule-based framework, it is entirely a stipulation that the numerical limit should be two, rather than some other number (though one could perhaps appeal to the familiar idea that natural language grammars cannot 'count past two': Chomsky 1965: 55 *et seq.*). In this section, I'll show that Cole's two-cycles-per-word generalization can be derived in OI from the way that PREC constraints are formulated in OT-CC. In the following two subsections, I'll discuss two possible strategies for getting around this prediction, in the event that it proves wrong. The first is to make a simple formal revision to the formulation of PREC constraints, so that some of them evaluate positively rather than negatively. The second strategy is to obtain multiple apparent cycles by assuming that surface forms can be lexically stored and are available for use in morph-insertion.

To see how the standard formulation of PREC constraints excludes the possibility of more than two cycles, let's construct a hypothetical example in which the same phonological rule applies at three levels of bracketing. Suppose we have a language with the same coda-cluster-reduction process as Seoul Korean. Suppose further that this language has a word with the underlying forms and morphological bracketing [[[kaps] iks] ots]. If this word undergoes a cycle for each of its three levels of bracketing, and if the rule of cluster-reduction applies on each cycle, then we expect the surface form [ka.pi.kot]:

- (8) Input to cycle 1: /kaps/
 Cluster reduction: kap
- Input to cycle 2: kap-iks
 Cluster reduction: kapik
- Input to cycle 3: kapik-ots
 Cluster reduction: kapikot
- Surface form: [ka.pi.kot]

Let's now attempt to recapitulate this derivation in OI. Given the same ranking *COMPLEXCODA » MAX » *CC that we assumed for Korean, the following will be the valid chains in our hypothetical language (setting aside for simplicity chains in which one or more of the morphemes fails to receive a corresponding morph):

- (9)
- a. *Deletion applies to all three morphs:*
 <ROOT-AF1-AF2, kaps-AF1-AF2, kap-AF1-AF2, kapiks-AF2, kapik-AF2, kapikots, kapikot>
 rLUMSeq: <insert-root, MAX, insert-af1, MAX, insert-af2, MAX>
- b. *Deletion applies to root and af1:*
 <ROOT-AF1-AF2, kaps-AF1-AF2, kap-AF1-AF2, kapiks-AF2, kapik-AF2, kapikots>
 rLUMSeq: <insert-root, MAX, insert-af1, MAX, insert-af2>
- c. *Deletion applies to root and af2:*
 <ROOT-AF1-AF2, kaps-AF1-AF2, kap-AF1-AF2, kapiks-AF2, kapiksots, kapiksot>
 rLUMSeq: <insert-root, MAX, insert-af1, insert-af2, MAX>
- d. *Deletion applies to af1 and af2:*
 <ROOT-AF1-AF2, kaps-AF1-AF2, kapsiks-AF2, kapsik-AF2, kapsikots, kapsikot>
 rLUMSeq: <insert-root, insert-af1, MAX, insert-af2, MAX>
- e. *Deletion applies to root only:*
 <ROOT-AF1-AF2, kaps-AF1-AF2, kap-AF1-AF2, kapiks-AF2, kapiksots>
 rLUMSeq: <insert-root, MAX, insert-af2, insert-af2>
- f. *Deletion applies to af1 only:*
 <ROOT-AF1-AF2, kaps-AF1-AF2, kapsiks-AF2, kapsik-AF2, kapsikots>
 rLUMSeq: <insert-root, insert-af1, MAX, insert-af2>

g. *Deletion applies to af2 only:*

<ROOT-AF1-AF2, kaps-AF1-AF2, kapsiks-AF2, kapsiksots, kapsiksot>
 rLUMSeq: <insert-root, insert-af1, insert-af2, MAX>

h. *Deletion applies to none of the morphs:*

<ROOT-AF1-AF2, kaps-AF1-AF2, kapsiks-AF2, kapsiksots>
 rLUMSeq: <insert-root, insert-af1, insert-af2>

Our desired winner is (9)a, where cluster-reduction applies on all three ‘cycles’. The first two of these cyclic applications are opaque: reduction of the root’s final cluster is counterbled by the insertion of affix 1, and reduction of affix 1’s final cluster is counterbled by the insertion of affix 2. This means that both affix-1-insertion and affix-2-insertion must be crucially preceded by deletion. Following the example of Korean, we can attempt to enforce these two ordering relations by positing a pair of PREC constraints, PREC(MAX, af1) and PREC(MAX, af2), and ranking both of them above MAX. As it turns out, however, doing this will not make (9)a the winner—indeed our desired winner is harmonically bounded:

(10)

//ROOT-AF1-AF2//	*COMP CODA	PREC (MAX, af1)	PREC (MAX, af2)	MAX
a. ☞ <insert-root, MAX, insert-af1, MAX, insert-af2, MAX>		1	1	W ₃
b. ☞ <insert-root, MAX, insert-af1, MAX, insert-af2>	W ₁	1	L	2
c. ☞ <insert-root, MAX, insert-af1, insert-af2, MAX>		1	1	2
d. ☞ <insert-root, insert-af1, MAX, insert-af2, MAX>		W ₂	1	2
e. <insert-root, MAX, insert-af1, insert-af2>	W ₁	L	L	L ₁
f. ☞ <insert-root, insert-af1, MAX, insert-af2>	W ₁	W ₂	L	L ₁
g. <insert-root, insert-af1, insert-af2, MAX>		W ₂	W ₂	L ₁
h. <insert-root, insert-af1, insert-af2>	W ₁	1	1	L

In this tableau, the top-ranked constraint is *COMPLEXCODA. By virtue of its undominated status, it knocks out all of the candidates (b, e, f, and h) which fail to perform the transparent cluster reduction on *af2*. This markedness constraint has to be ranked above the PREC constraints, because reducing the cluster of *af2* means that the insertions of both *af1* and *af2* are being followed by MAX-violation. This violates the PREC constraints, and so *COMPLEXCODA has to dominate both of them in order for the desired winner (a) to beat candidate (e), which only reduces the cluster of the root, and therefore fully satisfies both PREC constraints.

Among the remaining candidates, the desired winner (a), which applies reduction on all three ‘cycles’, ties on the PREC constraints with (c), which reduces the cluster of the root (opaquely) and the cluster of *af2* (transparently), but which doesn’t reduce the cluster of *af1*. Because (c) performs fewer cluster reductions than (a), candidate (c) is the winner, because it has fewer violations of MAX.

Why didn’t (10)a win? The problem is that insertion of *af1* precedes insertion of *af2*, and consequently by transitivity anything that precedes *af1*-insertion also precedes *af2*-insertion. Opaquely performing cluster reduction on the root necessarily precedes *af1*-insertion, since insertion of *af1* counterbleeds cluster reduction. By transitivity, applying reduction to the root also precedes the insertion of *af2*. Therefore, as seen in (10)c, applying coda-reduction to just the root allows both of the PREC constraints to be satisfied: as can easily be seen from (10)c’s rLUMSeq, there is a MAX-violating LUM preceding the insertions of both of the affixes. Because satisfaction of both PREC constraints can be achieved by performing just this one single instance of opaque cluster-reduction, having a second opaque instance of it, as in (10)a, results in a

completely gratuitous MAX violation. Candidates like (10)a with more than one ‘cyclically’-opaque application of a process are therefore harmonically bounded owing to their unmotivated faithfulness violations.

5.2.3 Multiple cycles of overapplication from positive $\text{PREC}(\text{P},\text{M})$ constraints

Now suppose that a language with winners like (10)a were to be found. How might we modify the theory in order to make these candidates non-harmonically bounded? One simple strategy, which I’ll now explore, would be add to the theory PREC constraints which evaluated positively rather than negatively. Because the problem lies with the ‘M must be preceded by P’ clause of the PREC constraints, I will assume (for the sake of keeping the presentation maximally simple) that the positive PREC constraints include only the ‘M must be preceded by P’ clause:

- (11) $\text{PREC}(\text{MAX}, \text{af2})$ [*positive formulation*]
Assign a reward of +1 for every time that the operation of *af2*-insertion is preceded by a MAX-violating LUM.

The standard negative OT constraint¹²¹ computes pairwise preferences between two candidates by comparing the number of violation-marks it has assigned to assigned to each of them. If the candidates have received unequal numbers of violations, the constraint prefers the one with fewer violations; otherwise, if the candidates get the same number of violations, the constraint is indifferent. A positive constraint evaluates in an exactly parallel but inverse fashion. It compares the number of rewards that it’s

¹²¹ Positive constraints have previously been invoked in literature, e.g. in Flemming (2004).

assigned to each of a pair of candidates, and if these numbers are unequal, the constraint prefers the candidate with more rewards.

There is one main argument against invoking positive constraints in OT. This is the so-called ‘infinite goodness’ problem. The problem is that, given the infinite candidate sets of classic OT, there will in some contexts be no single candidate that best satisfies a positive constraint. For instance, if a constraint assigns a reward for every instance of some structure *X*, there will be no candidate that has more *X*s than any other candidate, since candidates are of unbounded size. If there is no candidate that best satisfies some constraint, then OT ceases to be a mathematically coherent theory (Prince 2007).

In OT-CC, however, it will be safe for PREC constraints, at least, to evaluate positively rather than negatively. This is because PREC constraints are not active in chain construction, only in the final comparison of candidates (McCarthy 2007a), and in OT-CC the final candidate set will always be finite in size (Becker 2005, McCarthy 2007a), obviating the infinite goodness objection. The argument for the candidate set being finite is made more complicated by the introduction of morph-insertion into the chains in OI, but it can still be made.

Let’s briefly consider why it is that OT-CC always has a finite candidate set. For all phonological and morphological operations, there will be only a finite number of ways to attempt doing the operation:

(12)

Deletion: delete one piece of structure. Only finitely many ways of doing this because intermediate forms are always finitely long, so there are only finitely many items to delete.

Feature-changing: change one distinctive feature value from + to – or vice versa. Only finitely many ways of doing this because intermediate forms contain only finitely many segments and each segment has only finitely many features.

Addition of phonological structure (epenthesis; building of prosodic constituents): Add one piece of structure from the universal representational alphabet to the representation. Only finitely many ways of doing this because the representational alphabet contains finitely many items, and for each of them, there are only a finite number of places to insert it into an existing finitely sized representation.

Morph insertion: Insert one morph. Only finitely many ways of doing this because any given language has only finitely many morphs, and there are only finitely many places to insert a morph into an existing finitely-sized representation.

For any given input, there will be one chain of length 1: the chain that performs no LUMs at all. Further, because the number of LUMs possible in any language will be (as we've just seen) finite, only a finite number of further harmonically-improving chains of length $n+1$ can be built off of an existing chain of length n . The total number of chains will therefore be finite in number provided that no chain ever becomes infinitely long. The guarantee of this depends crucially on the nature of the constraint-set rather than on the finitude of the operations set.

In a standard version of OT with morphs specified in the input and every constraint being either markedness or faithfulness, a guarantee of finite chain length (that is, of every chain reaching a point where no further LUMs would produce harmonic improvement) already follows under Moreton's (1999) proof that OT grammars with these properties are 'eventually idempotent'. Informally, the argument goes like this: every unfaithful mapping incurs an increased violation of one or more

faithfulness constraints, so unfaithful mappings are only harmonically improving if they improve performance on some markedness constraint. But because there are only finitely many markedness constraints and any given form under evaluation is only finite in size, every phonological representation incurs only a finite number of markedness violations. (This crucially assumes that markedness constraints assess negatively rather than positively.) As a result, only a finite number of markedness-improving unfaithful mappings can occur, since there are only finitely many markedness violations that could be eliminated.

Things get more complicated if we add morph-insertion to the set of operations available to the phonology, but even if we do, the candidate set likely remains finite. MAX-M constraints can only compel the insertion of so many morphs. Once all features and Fses in the input have correspondents, no MAX-M constraint will supply any incentive to insert further morphs (Trommer 2001). This leaves just the possibility of further morphs being inserted to reduce phonological markedness, as I argued in chapter 2 to be the case with Pitjatjantjara /-pa/ augmentation. However, inserting these morphs will always come with faithfulness cost. If a morph is inserted which corresponds with no input morpheme, DEP-M(FS) will be violated. The other option, since we're assuming all morphemes to already have correspondents, is to place the new morph in correspondence with a morpheme that already has at least one other correspondent. That can be assumed to violate a constraint INTEGRITY-M (the analogue of McCarthy & Prince's 1995 anti-diphthongization constraint INTEGRITY) which disfavors one-to-many morpheme-to-morph mappings. (See Noyer 1993 for the use of such a constraint in an analysis.) Moreton's (1999) argument then applies: these 'extra'

morph-insertions, being unfaithful mappings, can continue to occur only as long as performance on markedness constraints is improved, but the finite number of markedness constraints (and the finite number of violations of each one of them) at any given point in the chain means that this cannot continue forever.

We thus can conclude that, assuming markedness and faithfulness constraints to evaluate negatively, the final candidate set in OI will be finite in size. As such, there is no loss of mathematical well-definedness if (some) PREC constraints (which by hypothesis are inactive during chain construction and only evaluate the final candidate set) evaluate positively.

Let's now compare our candidates in pseudo-Korean again, this time using positive PREC constraints:

(13)

//ROOT-AF1-AF2//	*COMP CODA (<i>neg</i>)	MSTPR (MAX, af1) (<i>pos</i>)	MSTPR (MAX, af2) (<i>pos</i>)	MAX (<i>neg</i>)
a. \langle insert-root, MAX, insert-af1, MAX, insert-af2, MAX \rangle		+1	+2	-3
b. \langle insert-root, MAX, insert-af1, MAX, insert-af2 \rangle	W_{-1}	+1	+2	L_{-2}
c. \langle insert-root, MAX, insert-af1, insert-af2, MAX \rangle		+1	W_{+1}	L_{-2}
d. \langle insert-root, insert-af1, MAX, insert-af2, MAX \rangle		W	W_{+1}	L_{-2}
e. \langle insert-root, MAX, insert-af1, insert-af2 \rangle	W_{-1}	+1	W_{+1}	L_{-1}
f. \langle insert-root, insert-af1, MAX, insert-af2 \rangle	W_{-1}	W	W_{+1}	L_{-1}
g. \langle insert-root, insert-af1, insert-af2, MAX \rangle		W	W	L_{-1}
h. \langle insert-root, insert-af1, insert-af2 \rangle	W_{-1}	W	W	L

With negative PREC constraints, our problem was that candidate (a) lost to candidate (c). Performing coda reduction on just the root sufficed to satisfy both PREC constraints, because this single MAX-violating LUM occurred before *af1*-insertion and thus by transitivity before *af2*-insertion as well. With positive constraints, the picture is

different. Performing cluster reduction on the root, as in candidate (c), receives one reward from each of the *PREC* constraints, since this *MAX*-violating LUM precedes the insertion of each of the affixes. However, if we also perform coda reduction on *af1*, as in candidate (a), we get a second reward from *PREC*(*MAX*, *af2*), because this results in there being a second *MAX*-violating LUM ordered before the insertion of affix 2. Because candidate (a) has two rewards from *PREC*(*MAX*, *af2*) while candidate (c) has only one, this constraint prefers (a), which then becomes the winner.

The difference with positive *PREC*(*P*, *M*) constraints is that they give an incentive (additional rewards) for ‘cyclically’ performing phonological process *P* as many times as possible before the addition of affix *M*. A negative *PREC*(*P*, *M*) constraint, on the other hand, creates an incentive for only one ‘cyclic’ occurrence of *P*, since just one occurrence is sufficient to save a candidate from violating *PREC*(*P*, *M*). Once satisfaction of *PREC*(*P*, *M*) is assured, there’s no longer any incentive for further cyclic applications of *P*, and in fact further applications will be penalized by faithfulness constraints. As such, negative *PREC* constraints can produce only one cyclically opaque application of a process in a given form. Using negative *PREC* constraints therefore derives Cole’s (1990) proposed generalization that no language shows evidence of a cyclic process applying more than twice per word: once (opaquely) on a word-internal cycle, and once transparently on a cycle that sees the word as a whole. In the event that multiple opaque cycles in a single word are attested, however, we can avoid this limitation by adding positive *PREC* constraints to the theory.

It ought to be emphasized that, even if we were to add positive *PREC*(*P*, *M*) constraints in order to drive cyclic overapplication, we will still need negative *PREC*(*M*,

P) constraints in order to deal with NDEB. The analysis of NDEB presented in the previous section relied on candidates being penalized for doing a DEE process in a nonderived environment. In Finnish, for instance, we need candidates with root-internal assibilation like *-<koti, kosi> to violate $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$, in order to make them lose to competitors like <koti>, which do worse on *ti. If $\text{PREC}(\text{insert-affix}, \text{IDENT}(\text{contin}))$ assessed positively, giving rewards for every case of assibilation which was preceded by affixation, *-<koti, kosi> and <koti> would tie with zero rewards, and *ti would incorrectly pick *-<koti, kosi> as the winner. In the event that the existence of multiple cyclic overapplications in some language forces us to countenance positive PREC constraints, an important research question will then be to identify and rationalize which PREC constraints exist in both positive and negative versions, and which in only one or the other.

In relation to this matter, there is at least one other reason to think that $\text{PREC}(P,M)$ constraints (or at least their ‘must precede’ clause) are positive rather than negative. Specifically, the negative version predicts cases where affix spell-out is suppressed with bases which couldn’t undergo a cyclic process because they don’t have an appropriate UR. To illustrate, imagine again that we are dealing with a Seoul Korean-like language in which coda cluster reduction cyclically overapplies prior to the addition of a nominative suffix /-i/. Suppose that this language has a ranking of $\text{PREC}(\text{MAX-C}, \text{insert-nom}) \gg \text{MAX-M}(\text{nominative})$.

This ranking will produce an implausible result with regard to the nominative forms of a root like /tap/ which can’t undergo cyclic cluster reduction because it has no cluster to reduce. Assuming that there is no harmonically-improving C-deletion

process which could apply to the string /tap/, then any chain which inserts the nominative marker /-i/ onto such a root will violate a negative version of $\text{PREC}(\text{MAX-C}, \text{insert-nom})$, because nominative insertion isn't preceded by C-deletion. The ranking $\text{PREC}(\text{MAX-C}, \text{insert-nom}) \gg \text{MAX-M}(\text{nominative})$ therefore predicts that the nominative marker will be omitted with roots like /tap/, in which there is no possibility of cluster reduction for the affixation to be crucially preceded by:

(14) *Negative $\text{PREC}(P,M)$ blocks affixation in absence of conditioning environment for cyclic process*

//ROOT-NOM//	$\text{PREC}(\text{MAX-C}, \text{insert-nom})$	$\text{MAX-M}(\text{nominative})$
a. $\langle \text{ROOT-NOM}, \text{tap-NOM} \rangle$		₁
b. $\langle \text{root-NOM}, \text{tap-NOM}, \text{tapi} \rangle$	W_1	L

I am not aware of any attested language where something like this happens.

If, on the other hand, the 'must precede' clause of $\text{PREC}(\text{MAX-C}, \text{insert-nom})$ is a positive constraint, then this ceases to be a problem. In the absence of a conditioning environment for C-deletion, no candidate gets a reward from $\text{PREC}(\text{MAX-C}, \text{insert-nom})$, making that constraint indifferent as to the outcome. This lets $\text{MAX-M}(\text{nominative})$ decide in favor of the candidate which does spell out the nominative morpheme:

(15) *Positive $\text{PREC}(P,M)$ doesn't predict undesired blocking effect*

//ROOT-NOM//	$\text{PREC}(\text{MAX-C}, \text{insert-nom})$ (positive)	$\text{MAX-M}(\text{nominative})$ (negative)
a. $\langle \text{ROOT-NOM}, \text{tap-NOM} \rangle$		W_1
b. $\langle \text{root-NOM}, \text{tap-NOM}, \text{tapi} \rangle$		

This result suggests that the positive-constraint account of multiple cyclic overapplication may be on the right track. However, for the sake of keeping the terms of reference maximally familiar, I will assume for the remainder of this chapter that PREC constraints are positive rather than negative and that they include both the ‘must precede’ and ‘must not follow’ clauses.

5.2.4 ‘Cyclicity’ from lexical insertion of stored surface forms

So far in this section, we’ve seen that PREC constraints can be called on to drive cyclic overapplication, that negative PREC constraints impose a limit on the number of cyclic overapplications, and that reformulating PREC constraints as positive will allow multiple cycles. In this section, I’ll explore an alternative account of cyclic overapplication which was originally developed in connection with other models of phonology/morphology interaction (Hammond 2003, Kim 2005, Kraska-Szlenk 2006, Bermúdez-Otero 2007c, to appear, Collie 2007), but which is compatible with OI. The idea here is basically that processes can seemingly ‘overapply’ because the surface form of a morph’s citation form can be lexicalized as an underlying form, making it available for use in morph insertion. This strategy represents a possible alternative route for modeling apparent multiple cyclicity, as well as offering us a way to incorporate into OI the observation that at least some cases of cyclic overapplication are influenced by lexical frequency.

Bermúdez-Otero (2007c, to appear) proposes that stored surface forms are available for lexical insertion in order to resolve a problem for Stratal OT. The multi-stratal architecture of Stratal OT (and of rule-based Lexical Phonology) in and of itself

provides an account of interstratal cyclicity. For instance, in a word consisting of a stem plus a Level 2 suffix, the stem forms a cyclic domain because it passes through the Level 1 phonology by itself, before the addition of any Level 2 suffixes. So, for example, the fact that English *memory-less* preserves the stress of *memory* is due to the fact that *-less* is a word-level suffix, meaning that *memory* passes through the stem-level phonology by itself.

However, cyclicity can also occur *within* a single morphological stratum. In English, for instance, *-ity* is a Level 1 (stem level) suffix because it causes stress shift, as can be seen from alternations like this:

(16) *original* ~ *originality*

Despite this, there is still evidence that stress has applied on a previous cycle to the inner constituent *original*. Specifically, *originality* has secondary stress on the second syllable (the same locus as *original*'s main stress), rather than on the initial syllable, as we'd expect for a monomorphemic word with the same syllable structure (cf. *Winnepesaukee*). Hence the puzzle: the affix *-ity* is added on Level 1, so there is no earlier stratum for *original* to have passed through.

In Lexical Phonology, facts like this are handled by stipulating that strata like the English stem level are 'cyclic'. That is, if a word has multiple levels of morphological bracketing associated with the stem level, the word makes multiple passes through the Level 1 phonology:

(17) [[[*origin*]_{Stem} al]_{Stem} ity]_{Stem}

In this example, the constituents *origin*, *original*, and *originality* all have the morphological label *Stem*, so each successively-larger constituent successively

undergoes a pass through the Stem-level phonology. By contrast, other levels like the English word level (Level 2) are stipulated to be ‘non-cyclic’, meaning that no word ever makes more than one pass through the word-level phonology, even if it has more than one word-level suffix.

The cyclic vs. non-cyclic status of strata is, as mentioned, a stipulation, and so Bermúdez-Otero (2007c, to appear) seeks to derive it. He proposes that intrastratal cyclicity at the stem level results from the stem-level outputs being lexically stored and then used as inputs for further Level 1 affixation. Thus, for example, the surface form of *original* is lexically stored, with its main stress. Now suppose that the speaker is computing the pronunciation of *originality*. The stored surface form /ə.ɹí.dʒə.nɪ/ then competes with the underlying forms /ow.ɹɪdʒɪn/ and /æɪ/ for lexical insertion by the morphological component. If the stored surface form wins that competition, the result is that the input for *originality* is /ə.ɹí.dʒə.nɪtɪj/, with the ‘cyclic’ stress present in the input, rather than /ow.ɹɪdʒɪnæɪtɪj/, with no input stress.

Bermúdez-Otero (2007c, to appear) notes that this leads to a prediction about the interaction of frequency with Stem-level cyclicity. It’s long been known (Oldfield & Wingfield 1965, Rubenstein, Garfield & Millikan 1970, Forster & Chambers 1973) that frequent forms are faster to be lexically retrieved, presumably due to their having a higher level of resting activation. Assuming that faster retrieval corresponds to greater likelihood of winning the competition for lexical insertion, it follows that the stored surface form of a stem is more likely to win (with stem-level-internal cyclicity being the result) the greater its token frequency is. For English stress, at least, this seems to be correct; Bermúdez-Otero (2007c) cites the following data from Kraska-Szlenk (2007:

§8.1.2); see also Hammond (2003), Collie (2007) for similar conclusions (token frequency counts are from the British National Corpus online):

<i>Noncyclic stress:</i>	informati <u>o</u> n (38327)	in <u>fo</u> rm (286)
	con <u>ve</u> rsati <u>o</u> n (5169)	con <u>ve</u> rse (13)
<i>Cyclic stress:</i>	adv <u>a</u> ntageous (372)	adv <u>a</u> ntage (7220)
	auth <u>e</u> nticity (362)	auth <u>e</u> ntic (824)

Table 5.1. Token frequency and cyclic vs. non-cyclic stress in English

In these examples, words formed with a stem-level affix from infrequent bases like *inform* and *converse* have noncyclic stress, whereas those formed from frequent bases like *advantage* and *authentic* do have cyclic stress. On Bermúdez-Otero’s (2007c) account, this occurs because the stored surface form of the base (with its ‘cyclic’ stress) is more likely to be lexically inserted the more frequent it is. The overapplication of cluster reduction in nouns by younger Korean speakers seems to exhibit the same property: according to Kim (2005), more frequent nouns show a greater susceptibility to be leveled in this manner than do infrequent ones.

Largely this same account of frequency-sensitive cyclicity can easily be accommodated within OI. It is entirely straightforward to assume that certain surface forms are lexically stored as morphs and are therefore available for lexical insertion. We would then be obliged to explain what favors the use of stored surface forms over underlying forms. Assuming that these two kinds of morphs are distinguished from one another in the mental lexicon (such that the grammar can tell whether a given morph is a stored surface form or not), we could invoke a constraint inspired by the USELISTED constraint proposed in Zuraw (2000)’s theory of phonological exceptionality. The original USELISTED constraint demands that input form chosen to spell out a given word should consist of a single lexical entry. This formulation may not be exactly what we

want for an analysis of cyclic effects, since it will be violated if, for example, we spell out the morphosyntactic input for *originality* using the stored surface form of *original* plus the underlying form of the suffix *-ity*. A more nuanced approach, for our purposes, might be to split MAX-M constraints into two versions: a general constraint demanding that morphemes be spelled out by *some* morph, and a specific version demanding that morphemes be spelled out by a morph which is a stored surface form:

(18) *Special morpheme-morph faithfulness constraints favoring use of listed surface forms*
 MAX-M(FS)

For every FS Φ at the morpheme level, assign a violation-mark if there is not an FS Φ' at the morph level, such that $\Phi \mathfrak{R} \Phi'$.

MAX-M(FS)_{listed}

For every FS Φ at the morpheme level, assign a violation-mark if there is not an FS Φ' at the morph level, such that $\Phi \mathfrak{R} \Phi'$ and Φ' is a stored surface form.

On this proposal, morphs which are stored surface forms are more highly prized for spelling out morphemes than ordinary underlying forms, even if the whole word cannot be spelled out with a stored surface form.¹²²

The final step that we need is to explain why the likelihood of using a stored surface form increases with the form's frequency. If we take OI seriously as a performance model, then this is easily enough done by assuming that there is a time limit to Local Optimality determinations. Specifically, suppose that the grammar has the form $//\sqrt{\text{ORIGIN-A-N}}//$ (destined to surface as *originality*) and is seeking to determine what is the most harmonic (i.e. Locally Optimal) way of inserting one morph. The relevant choices for comparison are inserting the UR /owɪdzɪn/ or the stored surface

¹²² A conceptually related idea is Steriade's (2000b, 2008) principle of Lexical Conservatism, under which newly-generated candidate surface forms are pressured to be faithful to the properties of *some* stored surface form of the same stem.

form /ə.ɪ.dʒə.nl/. In order for them to be compared, GEN has to attempt both operations: it has to perform the ‘insert-/owɪdʒɪn/’ operation in order to generate the candidate <√_{ORIGIN-A-N}, owɪdʒɪn-A-N>, and it has to perform the ‘insert-/ə.ɪ.dʒə.nl/’ operation in order to generate the candidate <√_{ORIGIN-A-N}, ə.ɪ.dʒə.nl-A-N>.

Now suppose that EVAL doesn’t simply wait around for GEN to attempt every possible operation available to it and thereby generate every possible candidate. Suppose instead that EVAL has some time window during which it will accept candidates, and then, once the cut-off time is reached, EVAL chooses the Locally Optimal form from among the candidates that GEN has managed to produce during the window available to it. It may be that GEN has not succeeded in attempting every possible morph-insertion by the time the cut-off is reached. Given that lexical access is faster for more frequent words, it follows that GEN will be quicker to insert frequent surface forms than infrequent ones. Therefore, a surface form will be more likely to be inserted and added to the candidate set before EVAL’s cutoff time if the form is more frequent, because it takes GEN less time to create candidates with more frequent surface forms than with less frequent ones. As a result, a low-frequency stored surface form like /ən.fówɪm/ *inform* may fail to make it into the candidate set because it’s not accessed quickly enough. Even though using the listed surface form /ənfówɪm/ would in principle be more harmonic than using the UR /ɪnfowɪm/, the listed surface form isn’t used because GEN fails to add it to the candidate set quickly enough. This results in *information* having non-cyclic rather than cyclic stress.

Introducing a preference for using lexicalized surface forms in spell-out would come with a second benefit: it allows an account to be given in OI of cases of over- (and

under-) application which involve phonological properties being ‘copied’ from a member of a paradigm into another form of the paradigm which does not contain the source of the copying as a sub-constituent. There is some evidence that this is going on in the innovating varieties of Korean as well. As mentioned in chapter 4, Korean has a DEE process whereby /t/ palatalizes before /i/ at a morph juncture. In standard Korean, this results in alternating paradigm: a noun root which underlyingly ends in /t^h/ will show up with [c^h] before the nominative suffix /-i/, but with [t^h] before other suffixes like the locative /-e/:

(19) [pac^h-i] ‘field-NOMINATIVE’ [pat^h-e] ‘field-LOCATIVE’

According to Kim (2005), the younger speakers who overapply final cluster reduction also variably extend the palatalized form of the root to non-nominative contexts:

(20) [pac^h-i] ‘field-NOMINATIVE’ [pat^h-e]~[pac^h-e] ‘field-LOCATIVE’

Data like these are difficult to account for as cyclic overapplication of palatalization, because there is no plausible sense in which ‘field-NOMINATIVE’ could be a morphosyntactic subconstituent of ‘field-LOCATIVE’. (Indeed, in the theory of case features proposed by Halle & Vaux 1998, Nominative and Locative have completely non-overlapping feature-specifications: Nominative is [-oblique, +structural, +superior, +free], and Locative is [+oblique, -structural, -superior, -free].)

In a theory based on Output-Output faithfulness constraints (Benua 1997), data like this would be analyzed by assuming that the output of the locative input/pat^h-e/ is pressured by high-ranked OO-faithfulness constraints to resemble the surface form

[pac^h-i] of the nominative. On the other hand, in OI, we can assume that the innovating Korean speakers have (for whatever reason) stored the [pac^h-] surface form of the root, and that this is sometimes the Locally Optimal form which is used to spell out the root morpheme $\sqrt{\text{FIELD}}$. (This somewhat corresponds to Kim 2005's own account, which involves restructuring of underlying forms.)

Some cases of 'back-copying' paradigm leveling result in underapplication rather overapplication. Probably the most famous example is that of the loss of final devoicing in the noun paradigms of modern Yiddish (see Albright 2008a and the other works cited therein). Middle High German, like modern standard German, had final devoicing, resulting in alternating paradigms of the familiar variety:

(21)

/lob-Ø/	→	[lop]	'praise-NOM.SG'
/lob-ə/	→	[lobə]	'praise-NOM.PL'

In modern Yiddish, which developed from Middle High German, the final devoicing has been lost:

(22)

/loyb/	→	[loyb]	'praise-NOM.SG'
/loyb-ən/	→	[loyb-ən]	'praise-NOM.PL'

Here, we can't simply say that the paradigm became leveled because speakers began using the surface form of the root in the plural ([lob-]) to spell out $\sqrt{\text{PRAISE}}$, even in the singular. This is because the surface form of the plural ([lob-]) is the same as the underlying form (/lob/). Therefore, whichever one might be used to spell out $\sqrt{\text{PRAISE}}$ in the singular, both are equally expected to undergo final devoicing, leaving us with a paradigm that still alternates.

In order to bring cases like this of back-copying underapplication into the fold, it would seem to be necessary for us to assume that there are phonological IO faithfulness constraints which apply only to stored surface forms but not to regular URs:

(23)

Before leveling: UR used to spell out root morpheme; undergoes final devoicing

/lob/	IDENT[voi] _{SSF}	*VOICEDCODA	IDENT[voi]
a. [lop]			₁
b. [lob]		W_1	L

(24)

After leveling: Stored surface form used to spell out root morpheme; doesn't undergo final devoicing

[lob]	IDENT[voi] _{SSF}	*VOICEDCODA	IDENT[voi]
a. [lob]		₁	
b. [lop]	W_1	L	W_1

This is not exactly unprecedented, though, since some kind of special faithfulness for stored forms is needed anyway in accounts of lexical exceptionality which rely on a USELISTED-driven preference for surface forms (Zuraw 2000). Indeed, in analyses of cyclicity based on stored surface forms, it has been argued that faithfulness to the stored 'cyclic' forms and to exceptional forms necessarily go hand-in-hand (Bermúdez-Otero & McMahon 2006, Bermúdez-Otero 2007c, to appear, Kiparsky 2007b).

To be sure, there are many complicated issues raised by a stored-surface-form approach to back-copying, cyclicity, and related effects. Of particular importance is issue of what factors induce speakers to store some surface forms rather than others, and increase or decrease the likelihood of some stored form being used in spell-out:

frequency clearly plays a role, but undoubtedly other cognitive, perceptual, social and stylistic factors do as well. Nevertheless, the discussion in this section will hopefully suffice to show that OI is broadly compatible with an approach along these lines. This has a couple of attractive consequences. First, if we find convincing cases of multiple cycles of overapplication within a single word, it may be possible to explain this in OI without recourse to positive *PREC* constraints, since the lexical insertion of stored surface forms is available to serve as a supplementary source of cyclic effects. Second, the possibility of accounting for ‘back-copying’ effects in a manner compatible with OI would take away probably the strongest argument for a theory of phonology-morphology interaction which relied on identity relations between surface forms of a paradigm, and against one like OI or Lexical Phonology which relies on serial phonology/morphology interspersal in the derivation of a single member of the paradigm.

5.3 Derived Environment Blocking

5.3.1 DEB and its handling in OI

As discussed in the previous section, cyclic overapplication can be understood in OI as a type of counterbleeding: a process applies in an inner morphological constituent even though the addition of further affixal material takes away the motivation for doing the process. The topic of this section, derived environment blocking or DEB, can be understood as a kind of counterfeeding: the addition of an affix creates the phonological context for a process to apply, but the process nevertheless does not take place.

The example of Northern Irish dentalization was presented in the introduction to this chapter. In the relevant dialects, addition of agentive /-əɹ/ to a root like /laʊd/ creates a /dəɹ/ sequence which, based on monomorphemic words like *ladder*, we expect to undergo dentalization of the /d/. However, the dentalization does not occur.

Following Benua (1997), we can assume that normal application of dentalization results from the following constraint ranking:

(25) *ALVEOLAR-RHOTIC » *DENTAL » IDENT[distributed]

*ALVEOLAR-RHOTIC: Assign a violation-mark for every sequence of an alveolar consonant followed by a rhotic in the output.

*DENTAL: Assign a violation-mark for every dental consonant in the output.

IDENT[distributed]: Assign a violation-mark for every instance where an input alveolar segment maps to a surface dental segment or vice versa.

This ranking will do two things for us. First, underlying alveolar-rhotic sequences will surface as dental-rhotic sequences:

(26) *Underlying pre-rhotic alveolars dentalize*

/pɪləɹ/	*ALVEOLAR-RHOTIC	*DENTAL	IDENT[distributed]
a. $\text{p}^{\text{h}}\text{ɪ}^{\text{h}}\text{l}^{\text{h}}\text{ə}^{\text{h}}\text{ɹ}$		1	1
b. [pɪləɹ]	W ₁	L	L

Second, completing the account of the allophonic distribution of alveolars and dentals in underived environments, underlying dentals without a following rhotic will become alveolar:

(27) *Underlying non-pre-rhotic dentals alveolarize*

/wet̪/	*ALVEOLAR-RHOTIC	*DENTAL	IDENT[distributed]
a. $\text{w}^{\text{h}}\text{e}^{\text{h}}\text{t}^{\text{h}}$			1
b. [wet̪]		W ₁	L

In environments derived by ‘Level 2’ affixation, dentalization fails to apply before rhotics, resulting in surface violation of *ALVEOLAR-RHOTIC. This can be understood as a kind of counterfeeding opacity, and—in parallel with OT-CC’s approach to counterfeeding between phonological processes—we can analyze it by calling on the following PREC constraint:

- (28) PREC(IDENT[dist], L2)
 Assign a violation-mark if:
 a. The insertion of a ‘Level 2’ affix is not preceded by an IDENT[distributed]-violating LUM.
 b. The insertion of a Level 2 affix is followed by an IDENT[distributed]-violating LUM.

Because OI incorporates no notion of level ordering, expressions like like ‘level 2’ in this and other OI analyses should be understood simply as cover terms for the (possibly arbitrary) class of affixes that show the relevant type of opaque behavior.¹²³

Let’s consider the phonology of the word *louder* as an example. Given the ranking in (25), the harmonically-improving chains for input //√LOUD-COMP// will be the following:

- (29) a. <√LOUD-COMP, laʊd-COMP, laʊdəɹ>
 rLUMSeq: <insert-root, insert-af>
 b. <√LOUD-COMP, laʊd-COMP, laʊdəɹ, laʊdɹəɹ>
 rLUMSeq: <insert-root, insert-af, IDENT[dist]>

In chain (29)a, the root morph and then the comparative morph are inserted, but no dentalization takes place. Chain (29)b is the same, except that insertion of the comparative morph is followed by pre-rhotic dentalization.

¹²³ See Benua (1997) for arguments that the assignment of English affixes to Level 1 vs. Level 2 is synchronically arbitrary.

Chain (29)b will be preferred over (29)a by the markedness constraint *ALVEOLAR-RHOTIC, which assigns marks to the sequence /d̥əɹ/ found in (29)a. However, (29)b violates PREC(IDENT[dist], L2), because the insertion of the ‘level 2’ agentive morph is followed by the IDENT[distributed]-violating dentalization LUM. Because (29)a is the winner, it must be the case that PREC(IDENT[dist], L2) dominates *ALVEOLAR-RHOTIC:

(30)

//√LOUD-COMP//	PREC (IDENT[dist], L2)	*ALV- RHO
a. $\text{rLUMSeq: } \langle \text{insert-root, insert-af} \rangle$ [laʊd̥əɹ]		1
b. $\text{rLUMSeq: } \langle \text{insert-root, insert-af, IDENT[dist]} \rangle$ [laʊd̥əɹ]	W ₁	L

One last issue that we need to address arises from OT’s Richness of the Base assumption. As dentalization is allophonic and predictable, we can’t be sure whether a root like *loud* that is undentalized in isolation is underlyingly /laʊd/ or /laʊd̥/. If the latter, we need for both cyclic overapplication *and* DEB to occur: The underlying dental needs to dedentalize before the addition of the suffix, and after having done so, it needs to not re-dentalize after the addition of the suffix. Re-dentalization is just application of the process in the affix-derived environment, and we’ve already seen that that’s ruled out. Dedentalization prior to affixation is also, as it turns out, guaranteed by the ranking we already have, as we’ll now see.

If we assumed that the UR of *loud* was /laʊd̥/, then the two chains that we need to compare are these:

(31)

- a. $\langle \sqrt{\text{LOUD-COMP}}, \text{laʊd̥-COMP}, \text{laʊd-COMP}, \text{laʊd̥əɹ} \rangle$
 $\text{rLUMSeq: } \langle \text{insert-root, IDENT(dist), insert-suffix} \rangle$
- b. $\langle \sqrt{\text{LOUD-COMP}}, \text{laʊd̥-COMP}, \text{laʊd̥əɹ} \rangle$
 $\text{rLUMSeq: } \langle \text{insert-root, insert-suffix} \rangle$

The attested winner is (31a), where the underlying /d/ de-dentalizes prior to the insertion of the affix. It competes with (31b), where there is no de-dentalization. Crucially, there is no third chain $**\langle \sqrt{\text{LOUD-COMP}}, \text{laʊd-COMP}, \text{laʊd}\text{ə}\text{ɹ}, \text{laʊd}\text{ə}\text{ɹ} \rangle$ with de-dentalization after suffixation. This is because the ranking $*\text{ALVEOLAR-RHOTIC} \gg *DENTAL$ means that de-dentalizing with an immediately following rhotic is not harmonically-improving. Therefore, if the UR of the root is /laʊd/, the only chain terminating in attested [laʊdəɹ] has an IDENT(dist)-violating LUM ordered before the insertion of the suffix.

The attested winner (31a) violates both IDENT(dist) and $*\text{ALVEOLAR-RHOTIC}$, which its competitor (31b) does not. Therefore, (31b) must violate some other, higher-ranked constraint. And it indeed does: it violates $\text{PREC}(\text{L2}, \text{IDENT}[\text{dist}])$. In order to bar dentalization after affixation, we called on the “affixation is not followed by IDENT[dist]-violation” clause of the $\text{PREC}(\text{IDENT}[\text{dist}], \text{L2})$. De-dentalizing before affixation is forced because candidates like (31b) violate the other clause of the constraint: they get a violation-mark for failing to have an IDENT[dist]-violating LUM before their affix-insertion LUM:

(32) *Tableau for overapplication of de-dentalization*

$//\sqrt{\text{LOUD-COMP}}//$	$\text{PREC}(\text{IDENT}[\text{dist}], \text{L2})$	$*\text{ALV-RHO}$	$*DENTAL$	Id(dist)
a. $\langle \sqrt{\text{LOUD-COMP}}, \text{laʊd-COMP}, \text{laʊd-COMP}, \text{laʊd}\text{ə}\text{ɹ} \rangle$ rLUMSeq: $\langle \text{insert-root}, \text{IDENT}(\text{dist}), \text{insert-suffix} \rangle$		1		1
b. $\langle \sqrt{\text{LOUD-COMP}}, \text{laʊd-COMP}, \text{laʊd}\text{ə}\text{ɹ} \rangle$ rLUMSeq: $\langle \text{insert-root}, \text{insert-suffix} \rangle$	W_1	L	W_1	L

5.3.2 DEB can protect affixes from unfaithful mappings

One important prediction of the OI account of DEB is that the phonological process that's counterfed by affixation could be one that would have involved unfaithfulness to the underlying form of the affix rather than unfaithfulness to the surface form of the base. The existence of such cases is important because they cannot straightforwardly be analyzed using OO-faithfulness constraints (Benua 1997).

A straightforward example of affix-protecting DEB involves derived geminates in English. As was briefly discussed in Chapter 2, English disallows geminates in general, but does permit geminates on the surface if they arise through compounding or Level 2 affixation:

- (33)
- | | | |
|------------------|------------|---------------------------------|
| <i>carp pool</i> | [kɑp.puwt] | (cf. <i>car pool</i> [kɑ.puwt]) |
| <i>meanness</i> | [mijn.nəs] | (cf. <i>me-ness</i> [mij.nəs]) |
| <i>tailless</i> | [teɪl.ləs] | |

Geminates created at Level 1 junctures are, however, reduced:

- (34) /ɪn-neɪt/ → [ɪ.neɪt], *[ɪn.neɪt] innate

It's impossible to say on any theory-external basis whether it's the underlying /n/ of the affix or of the root that's deleted in words like *innate*. This doesn't actually matter, because what's important for our purposes is that in words with Level 2-derived geminates like *meanness*, neither the root nor the affix /n/ deletes: *both* survive, because we get a geminate on the surface.

In OI, the analysis of affix-protecting DEB looks exactly like the analysis of root-protecting DEB that we just saw for Northern Irish English. First, the degemination

found in non-Level 2 contexts follows from an unremarkable markedness-over-faithfulness ranking of *GEMINATE » MAX-C. To block degemination in contexts derived by Level 2 affixation, *GEMINATE will need to be dominated by PREC(MAX-C, L2). Crucially, this constraint will be violated if either of the /n/s in a word like *unnatural* is deleted:

(35)

	PREC (MAX-C, L2)	*GEMINATE	MAX-C
☞ ..., $\Lambda n_1.n_2\text{ætf}.j\text{ə}l$ >		1	
..., $\Lambda n_1.n_2\text{ætf}.j\text{ə}l$, $\Lambda n_2\text{ætf}.j\text{ə}l$ >	W_1	L	W_1
..., $\Lambda n_1.n_2\text{ætf}.j\text{ə}l$, $\Lambda.n_1\text{ætf}.j\text{ə}l$ >	W_1	L	W_1

By contrast, there is no straightforward way to model this fact using the familiar base-identity OO-faithfulness constraints proposed in Benua (1995, 1997) and Kenstowicz (1996). Base-identity constraints require that the output form of an affixed word $[[base] \text{ affix}]$ resemble the output form of $[base]$. In a word like *unnatural*, the first of the two [n]s making up the geminate are part of *affix* rather than *base*, so deleting the /n/ of the prefix does not disrupt base identity:

(36)

$/\Lambda n_1-n_2\text{ætf}.j\text{ə}l/$ Base of OO- correspondence: $[n\text{ætf}.j\text{ə}l]$	OO-MAX-V	*GEMINATE	IO-MAX-V
a. $\bullet^* [\Lambda.n_2\text{ætf}.j\text{ə}l]$			1
b. ☞ $[\Lambda n_1.n_2\text{ætf}.j\text{ə}l]$		W_1	L
c. $[\Lambda.n_1\text{ætf}.j\text{ə}l]$	W_1		1

Affix-protecting DEB thus cannot be modeled in a base-identity version of OO-faithfulness (Benua 1997: chapter 6). However, an analysis of these effects could be obtained in an alternative variety of OO-faithfulness where instances of the same affix in different words stood in correspondence (Burzio 1994, 2000). For example, we could suppose that *un-* kept its /n/ in *unnatural* because it was being faithful to the presence of that [n] in (say) *unusual*. Such an account would not be without further problems, though. Given that *un-* can occur with an open class of both underived (*unkind*) and derived (*unnatural*) adjectives, there seems little if any principled basis for saying which surface realization of *un-* would serve as the base to which the others had to be OO-faithful. Clearly some base will have to be chosen, since a paradigm uniformity model in which every instance of *un-* corresponded to every other would be unable to account for the underapplication which characterizes DEB effects (a general liability of paradigm uniformity theories: Sturgeon 2003, McCarthy 2005a, Albright 2007, Hall & Scott 2007).

As an alternative to both OI and OO-faithfulness, we could posit markedness constraints which penalized marked structures just in case they occurred within a single morphological domain (Martin 2007). In the case of English geminates, for example, we could simply posit a constraint like the following:

(37)

*TAUTOMORPHEMICGEMINATE

Assign a violation-mark for every sequence C_1C_2 where:

- a. C_1 and C_2 are identical
- b. C_1 and C_2 are exponents of the same morph

This account will work in cases of affix-protecting DEB in which the marked structure straddles a morph boundary. However, it won't work for the class of cases we'll see in

the next subsection, in which $\text{PREC}(P, M)$ constraints prevent marked structures fully internal to an affix from being modified.

Before moving on to those cases, it is worth emphasizing that the English geminates example is not unique as a case of affix-protecting DEB involving configurations straddling a boundary. English also supplies a second case which we saw earlier: coda nasals assimilate to the place of articulation of a following consonant if the nasal belongs to a ‘level 1’ prefix, but do so only optionally if it belongs to a ‘level 2’ prefix (Kiparsky 1985, Borowsky 1993, Coetzee & Pater to appear):

- (38) a. Level 1 nasal-final prefixes undergo place assimilation...:
 /ɪn/ + tolerable → intolerable
 /ɪn/ + possible → impossible, * impossible
 b. ...but Level 2 nasal-final prefixes don't:
 /ʌn/ + desirable → undesirable
 /ʌn/ + believable → unbelievable (~ u[m]believable)

Blumenfeld (2003b) cites a case of affix-protecting DEB from Ancient Greek (Smyth 1956). In general, this language forbids obstruent-obstruent clusters in which the second member is noncoronal. However, such clusters do appear if they're created through morph concatenation: /ek-bainō/ → [ekbainō] ‘walk out’. This is arguably a case of affix-protecting DEB given that it's the first consonant that belongs to the prefix, and it's the first consonant which is universally targeted in the reduction of clusters like these (Wilson 2000, 2001, McCarthy to appear a).

Perhaps the most widely discussed¹²⁴ example of affix-protecting DEB involves the German diminutive suffix /-çən/ (orthographic *-chen*). The initial palatal fricative [ç] of this suffix is in complementary distribution in German with the voiceless velar

¹²⁴ References include Bloomfield (1930), Hall (1989), Macfarland & Pierrehumbert (1991), Iverson & Salmons (1992), Borowsky (1993), Benua (1997) and Merchant (1997).

fricative [x]. In general, [x] is found only after back vowels, and [ç] is found elsewhere. The exceptions to this generalization occur in the diminutive. The diminutive marker *-chen* is umlauting, so most of the time, if the last vowel in the base is [+back], it will surface as [-back] in the diminutive. However, there are a few back-vowel-final roots which exceptionally fail to umlaut with *-chen*. With these roots, the initial segment of *-chen* remains [ç] on the surface, even though it's preceded by a back vowel:

(39)	frau-chen	[frauçən]	'little woman' / 'animal's mistress'
	tau-chen	[tauçən]	'little rope'
	kuhchen	[ku:çən]	'little cow'

Underlying /ç/ of the diminutive affix is thus protected from velarization following a back vowel of the preceding root. This is a blocking of the allophonic velarization process in a derived environment, but the process which fails to apply is one which would have affected a segment of the affix rather than a segment of the base.

5.3.3 Protection of affix-internal marked structure

In all of the DEB effects that we've seen so far, whether 'base-protecting' or 'affix-protecting' the marked structure was one which arose from the root-affix combination, e.g. Ancient Greek [Vk.bV] clusters created at the prefix-root boundary. DEB effects are not however limited to marked configurations that result from the combination of root and affix material. Addition of an affix also creates marked structures that are internal to the affix itself. Consequently, if a phonological process can be blocked following the addition of an affix, we expect to find, for example, languages in which a segment that's banned in roots does show up in a certain affix or class of affixes. Typically, it's assumed that roots support a greater range of contrasts

than affixes do (McCarthy & Prince 1995, Beckman 1998, cf. Bybee 2005), a generalization that can be captured in OT via the assumption that there are positional faithfulness constraints for roots but not for affixes (McCarthy & Prince 1995, Beckman 1998). However, several cases of affix-specific segments have been reported.

In the Papuan language Arammba (Parker to appear), with the exception of “a few” proper names, the segment [ǰ] occurs only in portmanteau prefixes that mark tense/aspect and agreement with a masculine subject or object:¹²⁵

<i>Tense/Aspect</i>	Masc. strong forms		Masc. weak forms		Feminine strong forms	Feminine weak forms
	w/ front V	w/ back V	w/ front V	w/ back V		
Imperfective	ǰε-	ǰΛ-	ǰə-	ǰɜ-	wε-	wə-
Past Completive	ǰəΦε-	ǰɜΦΛ-	ǰəΦ-	ǰɜΦ-	gyΦε-	gεΦ-
Future (1 st /3 rd pers. subject)	ǰrε-	ǰrΛ-	ǰrə-	ǰrɜ-	gyrε-	dε-
Future (2 nd pers. subject)	ǰε-	ǰΛ-	ǰə-	ǰɜ-	gwε-	gε-
Perfect	ǰε-	ǰΛ-	ǰə-	ǰɜ-	dwε-	dε-

Table 5.2. Arammba third person absolutive singular verbal prefixes

Under Richness of the Base (Prince & Smolensky 2004 [1993]), we must assume that it is possible for /ǰ/ to occur in the underlying form of any morph in Arammba (or any other language). In Arammba, underlying /ǰ/s are eliminated through some unfaithful mapping or other, except when found in the UR of a morph whose FS contains the feature [masculine]. In OI terms, we can understand this as an ordering requirement: the LUM that eliminates underlying /ǰ/s is barred from applying when it

¹²⁵ ‘Weak’ forms of the affixes in table 5.2 occur with singular and paucal patients; ‘strong’ forms with patients of higher number, as well as all those that occupy benefactive or recipient roles.

would be crucially preceded by the insertion of a [masculine] morph. The constraint ranking required for this would be:

$$(40) \text{PREC}(\text{F}, \text{insert-}[\text{masc}]\text{-affix}) \gg *ð \gg \text{F}$$

where F is the faithfulness constraint by whose violation underlying /ð/ is mapped to something else. In the absence of any particular evidence about what this might be, I'll arbitrarily assume that F is IDENT[continuant], and that underlying /ð/ in Arammba normally maps to [d].

To illustrate how this analysis works, let's consider a hypothetical Arammba root with underlying /ðisʌn/. After this morph is inserted, we expect its initial segment to fortite to [d]:

(41)

//ROOT//	PREC (ID[cont], insert-[masc]- affix)	MAX-M (root)	*ð	ID[cont]
a. ʌ <ROOT, ðisʌn, disun> rLUMSeq: <Insert-root, IDENT[contin]>				1
b. <ROOT, ðisʌn> rLUMSeq: :Insert-root			W ₁	L
c. <ROOT> rLUMSeq: <>		W ₁		L

Now let's consider what happens when /ðisʌn/ is inflected for masculine imperfective agreement. Here the relevant prefixal morph is underlyingly /ðɛ-/. The harmonically-improving chains (excluding those which fail to spell out all of the morphemes) will be as follows:

- (42) a. <AF-ROOT, AF-ðisʌn, AF-disʌn, ðɛ-disʌn>
LUMSeq: <insert-root, IDENT[contin]@3, insert-[masc]-affix>
- b. <AF-ROOT, AF-ðisʌn, ðɛ-ðisʌn, ðɛ-disʌn>
LUMSeq: <insert-root, insert-[masc]-affix, IDENT[contin]@3>

- c. <AF-ROOT, AF-ðisʌn, AF-disʌn, ðɛ-disʌn, dɛ-disʌn>
LUMSeq: <insert-root, IDENT[contin]@3, insert-[masc]-affix, IDENT[contin]@1>
- d. <AF-ROOT, AF-ðisʌn, ðɛ-ðisʌn, dɛ-ðisʌn, dɛ-disʌn >
LUMSeq: <insert-root, insert-[masc]-affix, IDENT[contin]@1, IDENT[contin]@3>
- e. <AF-ROOT, AF-ðisʌn, ðɛ-ðisʌn, dɛ-ðisʌn>
LUMSeq: <insert-root, insert-[masc]-affix, IDENT[contin]@1>
- f. <AF-ROOT, AF-ðisʌn, ðɛ-ðisʌn>
LUMSeq: <insert-root, insert-[masc]>

(The notation '@' is used to distinguish between violation of the same basic faithfulness constraint at different loci in the word. Here, '@1' means the initial segment of the prefix, and '@3' means the initial segment of the root.) Chains (42)a-b are convergent and will undergo chain merger; the same goes for (42)c-d. That leaves us with the following final candidate set:

- (43)
- a. [ðɛdisʌn]
rLUMSeq: {<insert-root, insert-[masc]-affix>, <insert-root, IDENT[contin]@3>}
 - b. [dɛdisʌn]
rLUMSeq: {<insert-root, insert-[masc]-affix, IDENT[contin]@1>, <insert-root, IDENT[contin]@3>}
 - c. [dɛðisʌn]
rLUMSeq: <insert-root, insert-[masc]-affix, IDENT[contin]@1>
 - d. [ðɛðisʌn]
rLUMSeq: <insert-root, insert-[masc]-affix>

In candidate (43)a, the root's underlying /ð/ fortites to [d], but the /ð/ of the prefix does not. The IDENT[contin]-violating LUM in the merged chain is ordered after the insertion of the root (obviously, because no unfaithful mappings can be performed

on the root's UR until after the root morph is inserted). However, the IDENT[contin]-violating LUM is not ordered with respect to the insertion of the [masculine] prefix, because (as can be seen in (43)a-b), it's harmonically improving to fortite the root's /ð/ both before and after the insertion of the prefix. In candidate (43)b, the underlying /ð/s of both the root and the prefix are fortified. As in the previous candidate, fortition of the root's /ð/ is unordered in the rLUMSeq with respect to the insertion of the affix. However, fortition of the affix's /ð/ follows the insertion of the affix, as is of necessity the case. Candidate (43)c fortites the /ð/ of the affix but not that of the root, so it likewise has an IDENT[contin]-violating LUM ordered after masculine affix insertion. Lastly, candidate (43)d is fully faithful, and fortites neither of the /ð/s.

If we submit these candidates to the same ranking adduced earlier, [ðɛdisʌn] will emerge as the winner:

(44)

//ROOT//	PREC (ID[cont], insert- [masc]- affix)	*ð	ID[cont]
a. [ðɛdisʌn] rLUMSeq: {<insert-root, insert-[masc]-affix>, <insert-root, IDENT[contin]@3>}		1	1
b. [dɛdisʌn] rLUMSeq: {<insert-root, insert-[masc]-affix, IDENT[contin]@1>, <insert-root, IDENT[contin]@3>}	W_1	L	W_2
c. [dɛðisʌn] rLUMSeq: <insert-root, insert-[masc]-affix, IDENT[contin]@1>	W_1	1	1
d. [ðɛðisʌn] rLUMSeq: <insert-root, insert-[masc]-affix>		W_2	L

Candidates (b)-(c) are eliminated because they fortite the underlying /ð/ of the affix, resulting in their rLUMSeqs containing an IDENT[contin] violation ordered after the insertion of a [masculine] morph. This results in violation of PREC(ID[cont], insert-[masc]-affix), the top-ranked constraint. This narrows the competition to [ðedisΛn], which has fortition in the root but not in the prefix, and [ðeðisΛn], with no fortition; the markedness constraint *ð is then able to choose the former candidate as the winner.

To summarize, then, the PREC-based theory of DEB effects predicts that any marked configuration can be protected from being repaired if the configuration arises through the insertion of a particular morph (or of one of a particular class of morphs). Such configurations can include not only those which straddle the root-affix boundary (e.g. /uç/ sequences in German, geminates in English), but also ones which are purely internal to the affix itself. Cases of the latter type include that of Arammba /ð/ as well as three others mentioned by Parker (to appear):

- In English, morph-initial [ð] is found in function words (*this, these, those, that, then, though, thou*) but not in roots (e.g. *thin* [θɪn], but *[ðɪn]).¹²⁶
- In Awara (Quigley 2003), [ʃ] is found only in the ‘specific’ noun-classifier suffix.
- In Guambiano (Branks & Branks 1973), [ʒ] is found only in the diminutive suffix.

A separate line of evidence that marked structures can be protected only in affix-internal contexts comes from ‘intonational’ languages like English. Such languages have no contrastive tone on lexical items. That means that if a root has tones in its UR (a possibility that ROTB forces us to consider), those tones must be deleted.

¹²⁶ The English example may be met by the objection that function words don’t simply exhibit initial [ð]; they also fail to exhibit initial [θ]. This may be merely accidental, however, owing to the function morphs being small in number; see Bybee (2005) for some related discussion.

However, intonational languages do still have a variety of meaningful intonational contours that mark such things as questions, focus, speaker commitment, etc. These tonal contours are arguably morphs whose URs consist of floating tones (Pierrehumbert & Hirschberg 1990, Potts 2005). Intonational languages thus normally expunge underlying tones, but allow tones to survive on the surface just in case they're introduced by tonal affixes.

Having completed our examination of OI's predictions about cyclic overapplication and about DEB, we can now move on to examine the merits of OI relative to competing theories of cyclic effects. We've already discussed the advantage which OI enjoys over OO-faithfulness theory in relation to affix-protecting DEB effects. In the next two sections, we will move on to critiques of Stratal OT and of the phase-based approach to phonological cyclicity.

5.4 Competing theories: Stratal OT

Stratal OT (see references in chapter 1, fn. 4) is a model which directly adapts the architecture of rule-based Lexical Phonology into OT. Whereas Lexical Phonology assumed that the phonology of each stratum was an *SPE* grammar with ordered rewrite rules, Stratal OT assumes that the phonology of each level is an OT grammar. A winning candidate is chosen at the end of each level. The output of the level n phonology, together with the underlying forms of all affixes added by the morphology of level $(n+1)$, then serves as the input to the phonology of level $(n+1)$.

Stratal OT might on the face of it appear to be ideally suited to analyzing the kind of phonology/morphology interleaving effects that were used to argue for Lexical

Phonology. As it turns out, though, Stratal OT (and rule-based LP along with it) suffers from several empirical failings *vis à vis* OI (and, more generally, OT-CC). We've already seen, in chapter 2, that OI does better than Stratal OT and Lexical Phonology in coping with local and variable orderings of epenthesis and allomorph selection in Tigrinya, and, in chapter 4 that OI is preferable with regard to NEDB. We'll now move on to consider some further problems with Stratal OT.

5.4.1 'Has a wider morphosyntactic domain' does not imply 'derivationally later'

In Lexical Phonology and Stratal OT, each lexical level of the grammar includes both a phonological and a morphological module. The morphology of each level adds successively more and more peripheral affixes, which means that phonological rules/processes assigned to later levels are able to affect larger morphological domains than phonological rules assigned to earlier levels. Rules of the last level, the postlexical one, have the broadest scope of application of all, since they can look at sequences of words in phrasal juncture, not just at individual words in isolation (as the lexical rules do). In such a system, if a phonological rule *B* is ordered after another phonological rule *A*, it could be the case that the two have the same morphosyntactic domain: *A* and *B* might belong to the same level. However, it's predicted to be impossible for *B* to have a *narrower* morphosyntactic domain than *A*. If *B* had a narrower domain, it would have to be assigned to an earlier stratum than the one that *A* was assigned to, which in turn would mean that it had to apply before (and not after) *A*. Therefore, any case in which a

later phonological process applies within narrower morphosyntactic domains than an earlier process constitutes evidence against LP and Stratal OT.

Several examples are attested of later rules having narrower scope. McCarthy (2007a) cites an example from Bedouin Arabic (Al-Mozainy 1981). Short high vowels syncopate in nonfinal open syllables, including syllables that are open because the consonant that would otherwise formed the syllable's coda has syllabified as an onset to the initial vowel of the following word:

(45) /ka:tib al-zuwa:b/ → [ka:t.bal.zu.wa:b]
'writing the letter'

Because it applies in environments created by junctural resyllabification, syncope in Stratal OT would have to belong to the postlexical stratum. The syncope process interacts opaquely with another process whereby short low vowels raise in nonfinal open syllables. We know that raising counterfeeds syncope, because find surface [i]s derived from underlying /a/ which occur in the environment for syncope. This would imply that raising is ordered after syncope, and so if syncope is postlexical, raising must also be postlexical. But raising is demonstrably *not* postlexical, because there is no raising in syllables that are open due to junctural resyllabification.

Phonological phrasing and phrase-level prominence also display evidence of paradoxical ordering between lexical and post-lexical processes. Hualde (1996) argues for an example in the Basque dialect of Ondarroa. Unlike other Basque varieties, the Ondarroa dialect deletes the second of two vowels in hiatus. The placement of word-level and of phrase-level accents are ordered differently with respect to the hiatus-resolving deletion process. Phrasal accents normally are assigned to the penultimate

syllable of the phrase. However, when the underlying phrase-final vowel has been deleted in hiatus, the final vowel of the phrase has the phrasal accent:

(46) /gure abare-a/ → [gure abarí] ‘our priest’
our priest-DETERMINER

This indicates that phrase-level accent placement applies before hiatus resolution (since the accented vowel in such cases is underlyingly phrase-penultimate.)

Word-level accent behaves differently, though. There is a distinction between accented and unaccented roots in Ondarroa Basque, and the accents of accented roots normally fall on the penult syllable of the word, with affixal vowels like the determiner /-a/ counting to define which is the penult:

(47)
/’indarr-a/ → [inddárra] ‘the bean’
bean-DETERMINER
(nb.: apostrophe in UR indicates lexically-accented root)

However, when the word-final vowel is deleted in hiatus, it’s the surface penult (underlying antepenult) vowel of accented words that gets the word accent:

(48)
/’eskola-a/ → [eskóli] ‘the school’
school-DETERMINER

This indicates that the placement of word accents is ordered after hiatus resolution, and hence by transitivity after the placement of phrasal accents. As Hualde (1996) notes, Lexical Phonology predicts that this should never happen, since word-level processes are assumed to occur on an earlier stratum than phrase-level processes. The examples discussed in this section show that Lexical Phonology’s (and by extension, Stratal OT’s) guiding hypothesis that the relative order of application of two processes

is predictable from the size of the morphosyntactic domains they apply in is simply incorrect.

5.4.2 Opacity within a stratum

One major problem with Stratal OT is that it is unable to analyze opaque interactions between a pair of processes which have to be assigned to the same stratum (McCarthy 2007a). Because the phonology of each stratum is a standard OT grammar with just markedness and faithfulness constraints, all interactions within a single stratum must be transparent. However, a number of examples exist of opaque interactions between pairs of processes which would have to be assigned to the same stratum.

McCarthy (2007a) cites an example of counterfeeding opacity in Russian, which is the subject of a rule-based Lexical Phonology analysis in Kiparsky (1985). Clusters of obstruents in Russian undergo regressive voicing assimilation. An exception to this generalization is that [v] fails to induce voicing of a preceding voiceless obstruent. A number of researchers have proposed, based on this and other facts, that Russian [v] derives from underlying /w/,¹²⁷ and that voicing assimilation precedes and therefore is counterfed by the obstruentization of /w/ to [v]:

(49)	UR	/ot wraga/	
	Assimilation	<i>doesn't apply</i>	
	Obstruentization	ot vraga	
	SR	[ot vraga]	'from the enemy'

¹²⁷ References include Jakobson (1948), Coats & Harshenin (1971), Lightner (1972), Halle (1973), Halle & Vergnaud (1981), Hayes (1984), and Kiparsky (1985). See McCarthy (2005b) on how to accommodate such assumptions in OT without sacrificing the Richness of the Base principle. For a different view of the Russian facts, see Padgett (to appear).

Voicing assimilation applies across word boundaries, so it must be assigned to the postlexical stratum. In rule-based Lexical Phonology, the counterfeeding order could then be obtained by placing /w/-obstruentization in the postlexical phonology and extrinsically ordering it after voicing assimilation. This is not an option in stratal OT, though, since each stratum is a classic OT grammar and hence lacks both rules and rule ordering. The only way to get processes to interact opaquely in Stratal OT is to assign the constraint rankings that give rise to each process to different strata; the observed order of the processes then follows from the order of the strata. The trouble that the Russian data pose is that there is standardly assumed to be just one postlexical stratum. Voicing assimilation needs to go on that stratum, but then there is no later stratum for /w/-obstruentization to be assigned to.

Another example of counterfeeding within the postlexical phonology was historically found in Aalst Dutch (Colinet 1896, Taeldeman 1980, 2002, van Oostendorp 2004). Nasals underwent place assimilation across word boundaries ((50)a), but did not assimilate if they became word-final via the deletion of the /-ə/ of the feminine suffix ((50)b):

- (50) a. *schoo/n/ ventje* → *schoo[m] ventje* 'handsome lad'
 b. *schoo/n/-/ə/ vrouw* → *schoo[n] vrouw* 'beautiful woman'

That is, schwa deletion counterfeeds place assimilation. In derivational terms, this means that schwa deletion is ordered after place assimilation. Because place assimilation occurs across word boundaries, it must be assigned to the postlexical stratum. But that leaves no later stratum for schwa deletion to be placed on.

A third example of postlexical counterfeeding is reported in Trukese by Dyen (1965: 10). The word /t^sək/ ‘just’ optionally loses its final /k/ when followed by another word. Trukese also has a process whereby word-initial /j/ deletes if it’s between two mid vowels. When /t^sək/ loses its /k/ before a word that begins with /j/ followed by a mid vowel, deletion of the /k/ places the /j/ in the environment for /j/-deletion. However, the /j/ does not delete in this context. Thus, /k/-deletion counterfeeds /j/-deletion:

(51)

UR	/ji:ji t ^s ək je sine:j/	
j → ∅ / V _{mid} _ V _{mid}	<i>doesn't apply</i>	
k → ∅ /] _σ ...] _{utt} (optional)	ji:ji t ^s ə je sine:j	
SR	[ji:ji t ^s ə je sine:j]	‘only he knew it’

In principle, Stratal OT could attempt to accommodate within-stratum counterfeeding by calling on locally-conjoined faithfulness constraints (Kirchner 1996, Moreton & Smolensky 2002). However, local conjunction is arguably quite dubious as a theory of counterfeeding opacity (McCarthy 2007a). Moreover, this solution to the within-stratum opacity problem does not generalize sufficiently. This is because local conjunction is no good for analyzing counterbleeding opacity, and counterbleeding interactions are also attested within the (supposedly single) postlexical stratum. An example: Idsardi (2006) reports that in his idiolect of Canadian English, flapping and Canadian Raising interact opaquely at the phrase level, as shown in examples like the following:¹²⁸

¹²⁸ If we assumed that *lie* was underlyingly [lɪ], then there would still be opacity here: flapping would counterfeed lowering instead of counterbleeding raising.

(52)		<i>'Don't lie to me'</i>
	URs	/dɒnt laɪ to mi/
	raising	dɒnt ɫaɪ to mi
	flapping	dɒnt ɫaɪ rɒ mi
	(other rules)	...
	SR	[dɒɫɫaɪrəmi]

Canadian Raising is the process that raises /aɪ, aʊ/ to [ɫɪ, ɫʊ] before voiceless consonants. As seen in the famous *writer* [ɫɫɪrəɫ]/*rider* [ɫaɪrəɫ] minimal pair, Canadian Raising is counterbled by flapping in some dialects, since the diphthongs raise before underlying /t/, even though the /t/ becomes a voiced [r] on the surface, destroying the environment for raising. The *don't lie to me* example shows that this opaque interaction must occur after words enter into postlexical juncture, since raising of the diphthong in *lie* is conditioned by the voiceless initial /t/ of the preposition *to*, which forms a constituent with the following pronoun *me*, and therefore is not plausibly part of the same morphosyntactic word as *lie*. Consequently, speakers who have raising in *don't lie to me* must have raising in the postlexical stratum. But since the postlexical stratum is the last stratum, there is no way for raising to be counterbled by the flapping of the /t/. Modeling counterbleeding interactions in Stratal OT requires that the later-ordered process (here, flapping) be assigned to a later stratum than the earlier-ordered process (here, raising). But with only one postlexical stratum, raising is already in the last stratum, and we have nowhere to put flapping.

Dutch dialects also supply an example of counterbleeding in the postlexical stratum. Taeldeman (1982: §4.3) reports such an interaction in eastern Flemish varieties. Dutch has final devoicing, as well as a process of progressive [-voice] assimilation from a stop to a following fricative (on which see van Rooy & Wissing 2001,

Wetzels & Mascaró 2001, Iverson & Salmons 2003). Additionally, many Flemish dialects have a morpho-phonological process whereby /d/-final attributive adjectives undergo deletion of their final consonant in the neuter singular. Except in ‘French Flanders and the larger part of western Flanders’ (Tældeman 1982), these rules apply in counterbleeding order:

(53) *Postlexical counterbleeding in Eastern Flemish*

	‘red sand’	‘good folks’
UR	ro/d z/and	goe/d v/olk
final devoicing	ro/t z/and	goe/t v/olk
assimilation	ro/t s/and	goe/t f/olk
/t/ deletion	ro /s/and	goe /f/olk
SR	ro [s]and	goe [f]olk

Deletion of final /t/ (erstwhile /d/) counterbleeds assimilatory fricative devoicing: deletion eliminates the voiceless stop that’s the source of the assimilation, but assimilation happens anyway. That means that assimilation must happen first. Assimilation applies across word boundaries and is therefore postlexical, so the later-ordered /t/-deletion process must also be postlexical. Since Stratal OT can’t model within-stratum counterbleeding, it’s unable to give an account of these facts, if there is only one postlexical stratum.

Obviously, if there were more than one postlexical stratum, then Stratal OT might be able to deal with the problematic cases discussed in this section. Positing a second postlexical stratum would be completely vacuous and stipulative, however, unless the assumption was accompanied by some theory regarding differences between the morphosyntactic scopes of the two strata and/or the kinds of phonological processes which could be assigned to each of them. Several researchers (Kaisse 1985, 1990, Kiparsky 1985, Clark 1990, McHugh 1990, Mutaka 1994, Pak 2005, Pak & Friesner

2006) have argued that there are two serially-ordered blocks of postlexical rules, along with various diagnostics to test which block a given rule should belong to; a sequence of two postlexical strata has also been suggested in Stratal OT (Koontz-Garboden 2003). I will follow the terminology in Kaisse (1985, 1990) in abbreviatorially referring to the two blocks of rules as P1 and P2.

For at least some of the cases of within-stratum opacity discussed in this section, it appears that the assignment of processes to P1 and P2 which is dictated by the rules' relative order will not match the assignment dictated by the diagnostics which have been claimed to distinguish P1 rules from P2 rules. For instance, in Aalst Dutch, schwa deletion is ordered later and therefore must be P2. However, Taeldeman (1982) reports that the schwa deletion rule shows lexical exceptionality: the schwa of the feminine marker is deleted less frequently in Adjective+Noun combinations which are stereotyped, fixed expressions. This is a problem because lexical exceptionality has been claimed to be diagnostic of a rule's belonging to P1 rather than P2 (Kaisse 1985, 1990); moreover it may be the case that Stratal OT intrinsically entails that postlexical rules can't have lexical exceptions as a result of predicting a version of bracket erasure (see the next section). Likewise, in eastern Flemish, the second-ordered /t/-deletion process seems to require reference to word-internal morphology (i.e., the adjective having gender morphology: Taeldeman 1982: §4.2). Again, assuming some sort of bracket erasure, this would suggest that /t/-deletion not only can't be P2, but must actually be *lexical*. In Canadian English, flapping must come second, implying P2 status. But flapping has been argued to show both cyclic application and lexical exceptions

(Withgott 1982, Steriade 2000a, though cf. Davis 2005), both properties which supposedly indicate P1 status. In Trukese, the process that deletes the final /k/ of /t^sək/ must come second, and therefore apply in P2, but this is a lexically-restricted process which affects just this morph, which would instead motivate placing /k/-deletion in P1.¹²⁹

Naturally, Stratal OT is not intrinsically bound by any proposal from rule-based phonology regarding the assignment of processes to P1 vs. P2. (Indeed certain properties claimed to be diagnostic of level assignment in rule-based Lexical Phonology, for instance structure preservation, cannot be translated into OT, as noted in such Stratal OT works as Bermúdez-Otero 2003). However, if Stratal OT were to adopt the hypothesis that two postlexical levels P1 and P2 exist while abandoning the distinctions which had been hypothesized to hold between the two classes (P1 and P2) of postlexical rules, it would mean that no motivation was left for positing distinct postlexical strata in the first place, other than the need to have multiple strata in order to explain postlexical opacity. Splitting the postlexical stratum in two would be an entirely vacuous move which would call into question Stratal OT's falsifiability as well as requiring an abandonment of Lexical Phonology's working hypothesis that the various strata possessed reliable phonological and morphosyntactic properties.

¹²⁹ Following Hudson (1974), Mascaró (2007), and Kager (to appear), we could treat this as listed allomorphy rather than a lexically-restricted process (a 'minor rule') affecting just one morph. But on that analysis there is still a problem for Stratal OT: the demonstrably postlexical /j/-deletion process must not apply in environments created by the /t^sə/ allomorph, and, as the next subsection discusses, Stratal OT might not allow for the postlexical stratum to show lexical exceptions.

5.4.3 Bracket erasure

In Stratal OT, the input to each stratum consists of the URs of any affixes added on that stratum, plus the phonological output of the previous stratum. Since the output of each stratum consists solely of phonological material, the subsequent stratum knows nothing about the internal morphological bracketing that was present in the input to the prior stratum (Bermúdez-Otero to appear: ch. 2). In particular, the postlexical stratum is expected to know nothing about the internal morphological structure of words (except perhaps indirectly, as that structure is reflected in phonological processes that have or have not occurred as a result of that structure). This result is an effective analogue of the principle of Bracket Erasure assumed in rule-based Lexical Phonology. The picture in OI is very different, insofar as the morphosyntactic tree being spelled out persists throughout the derivation and remains in principle accessible at all points.

The prediction of Bracket Erasure, or some analogue thereof, in Stratal OT is likely incorrect. This is because numerous arguably post-lexical processes have access to word-internal morphological information. First, postlexical processes can have lexical exceptions. Kaisse (1986) discusses a number of examples. In Turkish, coda devoicing is arguably postlexical for at least some speakers, specifically those for whom a stop can optionally remain voiced if it's resyllabified as the onset of a following vowel-initial word:

(54) [sarap aldi] ~ [sarab aldi] 'he brought wine'

However, coda devoicing famously has a number of lexical exceptions (Kaisse 1986, 1990, Inkelas 1995, Inkelas & Orgun 1995, Inkelas, Orgun & Zoll 1997, Becker 2008, Kager

to appear, Becker, Ketrez & Nevins under review). If brackets have been erased in the input to the postlexical stratum, then the postlexical phonology will have no access to information about the identity of morphs, which means that it has no way of knowing which morphs are exceptions to coda devoicing and which aren't.¹³⁰

Similarly, in English, certain words exceptionally resist shifting of stress by the Rhythm Rule (Lieberman & Prince 1977):

(55) *Stress shift:*
compléx ~ còmplex problème

No stress shift:
discréte ~ discrète pièces (*discrete pièces)

Kaisse (1986, 1990) also cites *august, grotesque, obese, exempt, superb, exact, benign, abstemious*, and *intense* as exceptions. Again, assuming that the output of each stratum of the phonology is a strictly phonological representation, any diacritic features of individual roots that would mark them as exempt to stress shift (e.g. being indexed to a lexically-specific faithfulness constraint) would presumably be lost postlexically. This leaves Stratal OT unable to explain how an undeniably postlexical process like the Rhythm Rule can have exceptions.

Morphophonological mutation processes in various languages supply examples of the same kind. In Mende (Cowper & Rice 1987) and in the Celtic languages (Pyatt 2003), the initial consonant mutations show evidence of being sensitive to prosodic phrasing, which motivates assigning them to the postlexical stratum. Nevertheless, they also have lexical exceptions (Innes 1967: 45-46, Hayes 1990: 99 on Mende; Green

¹³⁰ The generalization assumed in (and predicted by) Lexical Phonology that only cyclic rules can have lexical exceptions is due originally to Chung (1982).

2005 on Celtic). These rules are also, of course, arguably lexical for the reason that they realize morphology.

The second argument against the ‘bracket erasure’ prediction of Stratal OT is that postlexical processes can tell the difference between roots and affixes. Côté’s (1999, 2000) analysis of processes involving preconsonantal stops in Ondarroa Basque supplies a useful example. Preconsonantal stops and affricates belonging to function morphemes optionally delete in word-final, Intonational Phrase-medial position:

(56) /giʃon-ak topa dau/ → [giʃona topa rau] ~ [giʃonak topa rau], *[giʃonaka topa rau]
 man-ERGATIVE.SG. find.PERFECTIVE AUX.3SGS 3SGD
 ‘the man has found it/him/her’

/semat lapit^s/ → [semat lapit^s] ~ [sema lapit^s], *[semata lapit^s]
 how.many pencil.ABSOLUTE.INDEF.
 ‘how many pencils’

By contrast, preconsonantal stops and affricates belonging to roots do not delete, but an optional process of /a/-epenthesis (or simplification of an affricate to a fricative) can occur instead:

(57) /iru lapit^s topa dot/ → [iru lapit^s topa dot] ~ [iru lapit^sa topa dot] ~
 [iru lapis topa dot], *[iru lapi topa dot]
 three pencil.ABSOLUTE.INDEF. find.PERFECTIVE AUX.3SGS 3SGD
 ‘I have found three pencils’

These processes would have to be assigned to the postlexical stratum in a Stratal OT analysis for two reasons. First, the conditioning environment is created at junctures between different words (as in that between ‘man’ and ‘find’ in the first example). Second, whether the processes are allowed to apply depends on the consonants’ surface position in the Intonational Phrase, and this cannot be known until the postlexical stratum. However, the processes are clearly sensitive to whether the segments involved

belong to a root or to an affix, since this determines whether deletion, as opposed to epenthesis or fricativization, is available as an optional repair. If word-internal morphological bracketings are lost in the input to the postlexical level, then the observed generalizations about which processes are allowed to occur where cannot be accounted for.

Postlexical processes arguably can also target word-internal morph boundaries as well as referring to the morphological affiliation of segments. The most famous example of this is the fact that certain affixes in Japanese form a separate Minor Phrase from the root they attach to (Poser 1990). More broadly, if we identify gradient phonetic processes as being necessarily postlexical rather than lexical, an assumption which was made in rule-based Lexical Phonology (see e.g. Kiparsky 1985) and for which experimental support exists (Zsiga 1995), further examples can be added. A number of studies have found evidence for fine-grained, sub-contrastive phonetic differences between monomorphemic vs. polymorphemic environments (see, among others, Cho 1998, 1999, 2001, Schwarzlose & Bradlow 2001, Sugahara & Turk 2004a,b, Kuznetsova 2007, Pluymaekers *et al.* to appear).¹³¹ There is also evidence that phonetics can tell the difference between an instance of a word that occurs as part of an idiom from one that does not: Hay & Bresnan (2006) found that a historical sound change of /æ/-raising in New Zealand English affected the word *hand* more readily when it was used literally to mean a body part than when it occurred in idiomatic expressions like *lend a hand*.

¹³¹ As noted by Bermúdez-Otero (to appear), phonetic implementation can indirectly refer to morphological constituency if that constituency is reflected in prosodic constituency, e.g. if certain affixes induce recursive Pwd structure. It's unclear if an appeal to prosodic differences would help with all of the studies cited here, some of which involve affixes consisting of a single consonant: English plural /s/ in Schwarzlose & Bradlow 2001, English possessive and 3rd.sg. /s/ and past tense /t/ in Sugahara & Turk (2004a,b), and Russian /s-/ and /z-/ prefixes in Kuznetsova (2007).

The same cases will be problematic under an alternative view in which phonetic implementation is outside of the phonology and operates on phonology's ultimate output. If the output of the last, postlexical stratum has erased all word-internal brackets, then the phonetics will have no access to information about those brackets' locations. But because phonetic implementation arguably can be sensitive to morphological bracketing, the bracket-erasure prediction of Stratal OT is incorrect.

5.5 Competing theories: Cyclicity from phases

In recent years there has been an increasing amount of work in a particular rule-based model of cyclicity based on the notion of *phase* proposed by Chomsky (1999, 2001) and extended to word-formation by Marantz (1997, 2001) and Arad (2005). This theory holds that certain types of syntactic heads are privileged with the status of defining the edge of a 'phase', and that when the bottom-up syntactic derivation reaches a phase edge, the syntactic tree built so far is sent to the interpretive components of the grammar to be assigned a meaning and a pronunciation.

Marvin (2002) proposes that word-internal phonological cyclicity (inheritance by more-complex words of the phonological properties of less-complex words) is due to the phase-by-phase nature of spellout. Cyclic overapplication of phonology occurs because each phase undergoes a pass through the phonology; as such, phonological processes may apply on an earlier phase even if material destined to be introduced at a later phase would remove the motivation for doing the process. Structures derived on an earlier phase would be forced to persist on later phases as a result of Chomsky's (2001) Phase Impenetrability Condition. This states that operations triggered at a higher phase cannot affect the structure of a lower phase, except at the head of the

lower phase. As applied to phonology, this would prevent the result of applying a process on a lower phase (e.g., assigning stress) from being overwritten on a later phase (thus obliterating the evidence of, e.g., cyclic stress assignment). The PIC also presumably can be invoked as an account of DEB effects. Marked structures arising from the juncture of material belonging to different phases would be protected from being repaired if this would mean modifying the material derived on the earlier phase.

There has been a good deal of work arguing that phases play a role in both word-internal phonology (Marvin 2002, Henderson 2004, Oltra-Massuet & Arregi 2005, Piggott & Newell 2006, Michaels & Killimangalam 2007, Bachrach & Wagner to appear, Skinner to appear) and in phrasal phonology (Seidl 2001, Legate 2003, Kahnemuyipour 2004, Wagner 2005, Ishihara 2007, Kratzer & Selkirk 2007). Here I will concern myself only with the word-internal applications of phase theory.

Probably the biggest reason to be skeptical that cyclic effects can be reduced to the Phase Impenetrability Condition is that the PIC, if extended to phonology as stated, is far too strong. If, as proposed in Marantz (2001) and Arad (2005), every word contains a category-defining morpheme which attaches to the root to endow it with a syntactic category, it follows that every word contains a phase boundary above the root. This in turn means that a strict PIC would prevent phrase-level sandhi from ever affecting the phonological shape of the root. This is clearly incorrect, though, as Marvin (2002) in fact notes, citing as an example English Rhythm Rule alternations like those we considered earlier in connection with Stratal OT:

- (58) a. thirtéen
b. thirtèn mén

In isolation, the word *thirteen* has primary stress on the final syllable, but in a phrasal context like (58b), primary stress is retracted onto the initial syllable of *thirteen* so as to avoid clash with the primary stress on the following word *men*. The PIC seems to predict that this should be impossible, because it would mean that the phonology of the root *thirteen* would be being altered at a phase above the one where it is originally spelled out. Marvin (2002) suggests that this problem be solved by restricting the PIC to lines 0 and 1 of the metrical grid, but this is entirely stipulative. Legate (2003), in a phase-based analysis of English nuclear stress, also assumes that phonology of later phases must be allowed to modify the result of phonology that was done on a lower phase. Admitting exceptions to the PIC, however, obligates the phase-based analysis of cyclicity to explain why some properties of lower phases are protected from modification on higher phases, while other properties are not. Even if only phases can be cyclic domains, phase theory needs to adopt additional theoretical machinery (e.g. Stratal OT, OO-faithfulness, etc.) to determine which processes do and don't apply cyclically within those domains, and which structures are and aren't protected from over-writing on later domains. The PIC by itself is thus simply not a sufficient theory of cyclic effects.

It is also debatable whether the status of a constituent as being a cyclic domain or not is predictable from its phase-hood (or non-phase-hood). Reasonable minimal pairs can be found by looking at varieties that are in the process of leveling, i.e. transitioning from alternating paradigms to ones with overapplication. In Seoul Korean, for instance, conservative older speakers have alternating [kap]~[kap.s-i], while innovating younger speakers have nonalternating [kap]~[ka.p-i]. If cyclicity is a

function of morphosyntactic structure, this would seem to imply that younger speakers have a phase boundary between the root and the case marker (since there is a cycle that includes the root but not the suffix), but that older speakers have the root and the case suffix in the same phase:

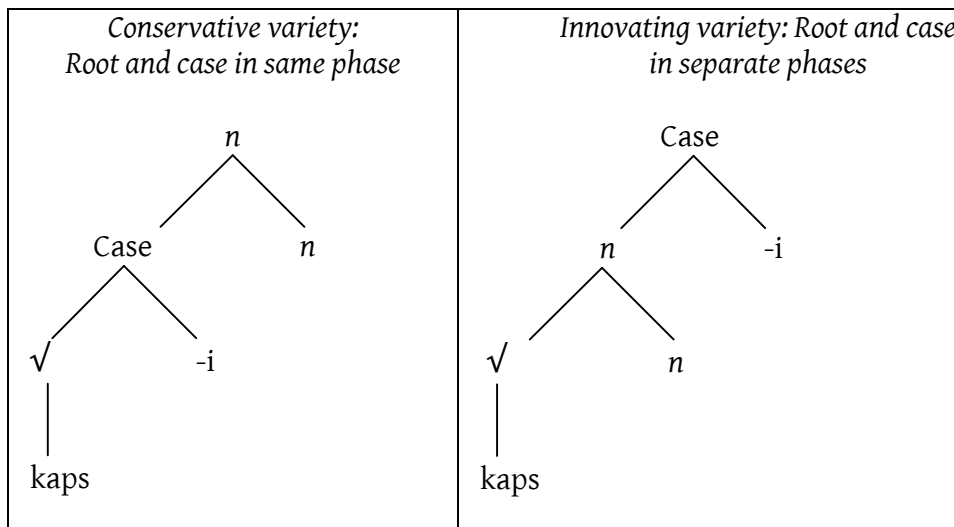


Table 5.3. Structures for Seoul Korean ‘price-NOMINATIVE’ in phase-based analysis of cyclicity

If cyclic domains are necessarily equated with phases, then there seems no way around the assumption that conservative and innovating Seoul Korean speakers have different morphosyntactic structures for the same words. In the absence of any syntactic motivation for assuming these different structures, we may wish to prefer a theory of phonological cyclicity which does not restrict cyclic process application to particular types of constituents, as phase theory does.

Finally, we may note that the phase-based approach to cyclicity shares a number of liabilities with Stratal OT. Indeed, if we assume that the mapping to phonological structure that occurs at the end of each phase of syntax is handled by an OT grammar, then phase theory simply *is* Stratal OT, coupled with a particular hypothesis about which stretches of morphological material go together on a single

stratum. For example, phase theory cannot account for cases like those from Bedouin Arabic or Ondarroa Basque accentuation, in which a process with a wide morphosyntactic domain must apply earlier than one with a narrower domain. In Bedouin Arabic, for instance, Syncope must apply within a high-level phase that includes multiple words in juncture. Raising will have to happen later, but because raising operates only within word-internal domains, it will be taking place entirely within the domain of lower, word-sized phases, and the PIC would seem to rule this out.

5.6 Doing without root-outwards spellout

In chapter 3, I suggested that attested examples of outwards-looking PCSA justified abandoning the assumption that morphemes are spelled out in a strictly root-outwards order. If we take this line, then we expect to find examples of cyclic overapplication in which a process overapplies to a string of morphs which don't form a morphosyntactic constituent. If no examples of this were to be found, it would constitute a strong empirical challenge to the claim that a universal requirement for strictly root-outward spellout could be dispensed with. However, there are at least two possible cases known; the examples are repeated from the discussion of bracketing paradoxes in chapter 3.

The first comes from Portuguese (Ranier 1995, Benua 1997). Consider the following two paradigms:

cão	'dog'	cães	'dog-PL'
cãozinho	'dog-DIMINUTIVE'	cãezinhos	'dog-DIM-PL'
flor	'flower'	flores	'flower-PL'
florzinha	'flower-DIMINUTIVE'	florezinhas	'flower-DIM-PL'

Table 5.4. Portuguese plural/diminutive paradigms

Suffixation of the plural /-(e)s/ causes the final vowel of ‘dog’ to assimilate to [e], and it remains [e] even in the diminutive plural [cãezinhos]. This suggests that the /o/ → [e] mapping conditioned by the plural takes place prior to the insertion of the diminutive morph. Similarly, the [e] induced by plural suffixation appears between the root and the diminutive marker in [florezinhas], even though, as [florzinha] shows, [rz] is an acceptable intervocalic cluster. There is thus evidence of vowel phonology taking place in the domain *root+plural*, even though the linear position of the diminutive marker hints that the structure of these words is [[[root]diminutive]plural].

Cibemba (Hyman 1994, 2002, Hyman & Orgun 2005, Benua 1997) supplies a second possible example. The causative suffix in this language is /-j/; the superclose vowel of the causative induces spirantization of root-final consonants. This spirantization occurs even when the applicative marker [-es]~[-is] intervenes between the root and the causative:

- | | | | |
|------|------------------|----------------------------------|---|
| (59) | /leep/ ‘be long’ | [leef- _j] ‘lengthen’ | [leef-es- _j] ‘lengthen for’ |
| | /fiit/ ‘be dark’ | [fiis- _j] ‘darken’ | [fiis-is- _j] ‘darken for’ |

This pattern suggests that the causative is added before the applicative. Crucially, the order *root-applicative-causative* always holds on the surface, regardless of the relative scope of the applicative and causative markers. In causativized applicatives, where the morphological structure would have to be [[[root] applicative] causative], we then have evidence that a phonological process (spirantization) applies within the domain *root+causative*, even though these morphemes that these morphs spell out do not form a constituent. However, the causativized applicative construction is apparently not productive. so the probative value of this case may be limited.

We can thus tentatively conclude that cyclic overapplication may occur within non-constituent strings of morphs, consistent with the suggestion from chapter 3 that root-outward spellout may have to be abandoned.

The data from Portuguese and Cibemba are useful for a second purpose: they represent evidence against the idea that a cyclic derivation can be dispensed with and cyclic effects accounted for by assuming that certain wellformedness conditions hold only within certain substrings of a word (Cole & Coleman 1992, and in a somewhat different sense McCarthy & Prince 1993b). For example, in the classic example of cyclic stress assignment in English, we could suppose that the second-syllable secondary stress in *imàginátion* (cf. initial secondary stress in *Tàtamaqóuche*) results from stress being assigned on the surface to both of the strings *imagine* and *imagination*, with an anti-clash constraint preventing both the initial and second syllables from surfacing with secondary stress. The problem for such an approach is that Portuguese diminutive plurals and Cibemba causativized applicatives show evidence of processes applying within domains which do not form contiguous substrings on the surface. Further evidence bearing on this point comes from cases of cyclic overapplication where a process applies within the base, and then the domain of the process is linearly interrupted by an infix. Sundanese nasal harmony (see discussion in chapter 6), the Sanskrit *ruki* rule (Kiparsky 1982a) and Abaza voicing assimilation (Allen 1956, Kenstowicz & Kisseberth 1977: §2.3) all furnish examples.

Placement of clitics at the clausal level can also interrupt the string within which a phonological process occurs. Kenstowicz & Kisseberth (1977: §2.3) identify an example from Pashto. Here, the perfective marker /wá/ and negative marker /ná/

appear in their underlying form before consonant-initial roots. However, with stems that begin with a low vowel (the only type of vowel-initial roots in the language), their vowels seem to coalesce with that of the root:

	<i>'I am keeping'</i>	<i>'I am buying'</i>
<i>plain</i>	sət-əm	áxl-əm
<i>negative</i>	nə́-sət-əm	nə́-ɣl-əm
<i>perfective</i>	wə́-sət-əm	wə́-ɣl-əm

Table 5.5. Vowel coalescence with Pashto negative and perfective markers

Strikingly, the negative and perfective markers still appear in their [nə́, wə́] forms with such roots, even if various clitics intervene between them and the root. Clitics appear after the first stressed constituent of a clause, so if the negative or perfective markers are the first morphs in the clause, any clitics in the clause will appear between them and the root. In this case, the vowel coalescence process still occurs:

	<i>'keep'</i>	<i>'buy'</i>
<i>'I am not Xing it'</i>	nə́ ye sət-əm	nə́ ye ɣl-əm
<i>'I will X it'</i>	wú ba ye sət-əm	wú ba ye ɣl-əm

Table 5.6. Overapplication of Pashto vowel coalescence with clitics

Similarly, when the perfective and negative markers appear together, the negative intervenes between the perfective and the root. However, the perfective appears in its [wə́] form, indicating that the perfective was added first: 'I did not buy it' is [wə́ nə ɣl-əm]. Attempting to explain this example in terms of vowel coalescence applying within a surface substring seems quite hopeless.

CHAPTER 6

CONCLUSIONS AND FUTURE DIRECTIONS

6.1 Overview of results

This dissertation has proposed a model of phonology-morphology interaction called Optimal Interleaving (OI), which combines McCarthy's (2007a) OT-CC architecture with the assumption that morphological spell-out takes place in the same OT grammar as the phonology. Along the way, we've seen that OI has a number of attractive empirical predictions.

In chapter 2 we saw several lines of evidence that phonological generalizations can interfere with morphological ones. Phonology can force the use of a morph other than the one which would be expected on morphological grounds alone (Spanish, Hebrew, Dyirbal); it can force the insertion of a morph which isn't needed for any morphological reason (Pitjantjatjara); it can force a morph expected on morphological grounds to be omitted outright (Hausa, Catalan); and it can force the presence of a morph which on morphological grounds we'd normally expect to be omitted (Tsuut'ina). The convergence of all of these cases strongly argues for a theory in which phonology and morphological spell-out occupy a single OT grammar, enabling phonological constraints to force violations of morphological ones. OI is exactly such a theory. Along the way, we also saw that OI, unlike competing theories of phonologically-conditioned suppletive allomorphy (PCSA), is able to derive without stipulation the fact that competing sets of allomorphs are normally mutually exclusive.

In chapter 3, we saw that, as a result of OT-CC's independently-needed Local Optimality assumption, OI is able to derive the typological generalization that PCSA is

always opaque with respect to phonological processes which would be triggered by any of the competing allomorphs. This result is obtained despite the fact that PCSA remains part of the phonology, with the distribution of allomorphs being driven by phonological constraints. This places OI at an advantage relative to subcategorization-only theories of PCSA, which are forced to remove PCSA from the phonology and place it in a separate morphology component. Such theories suffer from a version of the Duplication Problem, owing to the existence of languages like Kɔnni where the same phonological condition is enforced both in allomorph selection and in the language's phonotactics.

We also saw that OI gives us the means to make inside-out, cyclic morph-insertion a violable tendency rather than a stipulated universal. This makes it possible to accommodate attested languages (Italian, Southern Zaria Fulfulde) which show outwards-sensitive PCSA. Additionally, even if spell-out does proceed strictly inside-out, OI allows the choice to insert some morph vs. to use no morph to look outwards, which is attested in English and Italian. It was also shown in chapter 3 that OI, but not Lexical Phonology or Stratal OT, can straightforwardly handle both local pairwise ordering of a phonological process and a PCSA process, and between-utterance variation in such orderings, both phenomena that are attested in Tigrinya. We saw that OI's assumption that morph insertion is a single step in the phonology allows OT-CC's results about the nonexistence of synchronic long-distance metathesis to be reconciled with a faithfulness-based account of morph order (Horwood 2002). Lastly, chapter 3 also argued that OI's prediction that phonological constraints should be able to influence morph order is correct.

In chapter 4, we saw that OI makes possible a theory of non-derived environment blocking (NDEB) which results in five correct predictions: derived environment effects (DEEs) can occur in phonologically-derived environments; DEEs are not licensed in vacuously-derived environments; DEEs can be licensed in environments ‘derived’ by the removal of a blocking condition; a given DEE can occur in only one type of derived environment; and a process once NDEBed is always NDEBed. No previous theory of NDEB, either in OT or in rule-based phonology, makes all of these predictions, and existing theories also suffer from a range of empirical problems not suffered from by OI. These desirable results are achieved in OI without the need for any special assumptions specific to NDEB: the same formal machinery independently motivated in OT-CC for the analysis of counter-feeding and counter-bleeding opacity can also be applied to NDEB, with nothing new added. This is in stark contrast to *SPE*-style rule ordering, which works as a theory of counter-feeding and counter-bleeding, but which fails completely as a theory of NDEB (absent the introduction of some stipulation like the Strict Cycle Condition). OI’s results about NDEB thus furnish a strong recommendation for OT-CC generally as a better theory of opacity than rule ordering.

In chapter 5, we saw that OI also lends itself to the analysis of cyclic overapplication and derived environment blocking (DEB). It was argued that existing theories of such effects (Stratal OT, OO-faithfulness, phase-based cyclicity) suffer from a range of empirical drawbacks. We also saw that OI is capable of deriving a generalization (Cole 1990) that no winning candidate can contain more than one opaque cycle of overapplication, something no existing theory achieves without

stipulation. Finally, we also explored two ways that OI could avoid this prediction, should it prove wrong: positive $\text{PREC}(P, M)$ constraints, and insertion of lexically stored surface forms, both ideas for which independent motivation exists.

In sum, OI makes possible a unified account of the phonology/morphology interface which brings together phonologically-driven allomorphy with serial phonology/morphology interactions like DEEs, cyclic effects, and derived environment blocking. It does so while resulting in a wide range of restrictive and often novel typological predictions. Additionally, because it uses the derivational machinery of OT-CC with no additional assumptions besides that candidate chains include morph insertion, it is the case in OI that all types of opaque interactions, both between one phonological process and another, and between a phonological process and a morphological one, are accounted for in the exact same way.

These results are, however, only the beginning. There will be many more questions to be asked, and answered, in future work on OI. These include both new areas of the phonology/morphology interface to which OI could be extended, and outstanding questions about the OI model itself. In the remainder of this closing chapter, I will raise some of these questions, and offer some speculations about what the answers may turn out to be.

6.2 Process morphology

In OT-CC the candidate-generating function GEN can be regarded as consisting of a list of operations which can be attempted in chain construction. The core proposal in OI theory is that this list includes an operation ‘insert M’ for every morph M in a given

language's lexicon. Applying an operation 'insert M' does two things: it inserts M's feature structure, and it inserts M's phonological UR.

Since GEN must contain a separate operation for every morph of the language, we can actually assume that morphs only exist as operations in GEN's list.¹³² Thus, while I have in this dissertation been speaking of morphs as ordered pairs of *objects*—an FS and a UR—we can alternatively think of morphs as really being ordered pairs of *operations*: FS-insertion and UR-insertion.

If we pursue the second option, though, there is no reason why we would have to assume that the phonological half of these ordered pairs is always an operation which inserts some specified set of structure (i.e., a UR). We could just as well imagine a morph which consisted of (say) an operation of FS-insertion and an operation of *deleting* a segment. Such an operation would be useful for the analyses of languages like Koasati (Kimball 1991, Anderson 1992, Horwood 2001) which have truncative morphology, in Koasati's case for the plural: /tiwap-/ → [tiw-] 'open something.PL'. The same goes for languages with morphological metathesis and other types of 'process' morphology.

The operational morphs which in OI theory can be posited as part of GEN are essentially equivalent to the realization rules posited in rule-based realizational theories like A-Morphous Morphology (Anderson 1992). This has two consequences. First, the fact that both UR-insertion and things like truncation are equally eligible to serve as the phonological half of an operation in GEN means that the traditional

¹³² This situation to some extent parallels work in Lexical Phonology which explicitly viewed 'lexical items' as being morphological insertion rules rather than objects per se (e.g. Kiparsky's 1984 formulation that 'Every lexical item L is a lexical insertion rule of the form $\emptyset \rightarrow L$ '). The chief theoretical use which was made of this assumption was Kiparsky's (1982) proposal to derive the Strict Cycle Condition from the Elsewhere Condition (Kiparsky 1973b), as discussed in chapter 4.

distinction between item-and-arrangement and item-and-process theories of morphology (Hockett 1954) fades away. While OI allows all morphs, even of the ordinary segmental kind, to be reconceptualized as operations, OI's serial architecture allows it to retain the use of faithfulness constraints, and with them accounts of language typology which crucially rely on (positional) faithfulness as opposed to (positional) markedness alone. Second, the fact that OI can directly make use of the equivalent of morphophonological rules means that it has no need to posit constraints which directly call for alternations between morphologically-related words. This is the predominant existing OT approach to 'process' morphology, as exemplified by REALIZE-MORPHEME constraints (Kurusu 2001) and Transderivational Anti-Faithfulness theory (Alderete 1999, 2001).

There are several respects in which both of these theories suffer from empirical drawbacks *vis à vis* a theory like OI which is able to emulate morpholexical rules more directly. In the case of REALIZE-MORPHEME, the chief difficulty is this theory's inability to deal with cases of multiple exponence. Kurisu's (2001) formulation of the constraint REALIZE-MORPHEME (hereafter abbreviated RM) demands that the output phonological form of *base+affix* differ in some way from the output form of *base*. The problem is that RM should be satisfied by the presence of any single phonological difference between these two forms. RM therefore cannot explain how it should be possible for an affix to be realized by both overt segmental affixation and a morphological process, for instance umlaut in German plurals like /gast-e/ → [gäste] 'guests'.

Kurusu (2001) proposes an analysis of such double-exponence cases based on Sympathy theory (McCarthy 1999). In addition to the problems with Sympathy as an

account of opacity (see the references in fn. 36), this solution has a further empirical drawback: it allows for an affix to be realized by a segmental affix plus one unfaithful process, but it doesn't allow two 'processes' to co-occur in the realization of one affix. This prediction is arguably counter-exemplified by the suffix /-zu/ in Japanese (Kawahara & Wolf in prep.), which is marked by segmental suffixation, lengthening of the last stem vowel (if the stem is vowel-final), and pre-accentuation/accent shift:

- (1)
- | | | | |
|---------|----------|------------|--------------------------------|
| [usagi] | 'rabbit' | [úsagi:zu] | 'people interested in rabbits' |
| [gomí] | 'trash' | [gómi:zu] | 'people interested in trash' |

In OI, cases like these are not a problem, since the phonological half of a morph could be assumed to consist not of just a single phonological operation but of a set of phonological operations. This assumption would be the mirror image of the idea that the morphological part of a portmanteau morph is a set of FSES rather than a single FS.

Trans-derivational Anti-Faithfulness theory, or TAF (Alderete 1999, 2001) assumes that there are constraints which are wide-scope negations of OO-faithfulness constraints. For instance, truncation phenomena might be handled by a constraint like this:

- (2)
- OO-MAX-V
- It is not the case that:
- Every vowel in the base of affixation has a correspondent in the affixed form.

TAF theory does not suffer from RM's multiple exponence problem, because the OO-correspondence relation associated with a given affix might include multiple high-ranked anti-faithfulness constraints. TAF theory does, however, have some other

problems. One (first pointed out to me by Joe Pater) concerns the accidental satisfiability of TAF constraints. Imagine, for example, a hypothetical language which has the following two properties:

- (3) Rounding harmony on vowels: any [-round] vowel becomes [+round] if there is an adjacent [+round] vowel

Plural marked by a suffix /-tu/, plus labialization of rightmost noncoronal in stem (a type of mutation attested in Chaha and other Ethiopian Semitic languages—see e.g. McCarthy 1983a): [kon] ‘tree’ ~ [k^won-tu] ‘trees’

In TAF theory, the labializing mutation associated with /-tu/ could be analyzed by assuming that this affix is associated with a high-ranked anti-faithfulness constraint -OO-IDENT[round]:

(4)

/kon-tu/ Base of OO- correspondence: [kon]	-OO-IDENT [round]	OO-IDENT [round]	IO-IDENT [round]
a. $\text{[k}^w\text{on-tu]}$		1	1
b. [kon-tu]	W_1	L	L

The winning candidate (a) labializes the initial /k/ of the root. This is dispreferred by IO-IDENT[round], because the surface labialized consonant corresponds to an underlyingly nonlabialized one, and likewise by OO-IDENT[round], because the [k^w] in the plural disagrees with the [k] in the singular form which serves as the base of OO-correspondence. The candidate with labialization wins, however, because the candidate [kom-tu] where all of the segments of the plural form agree in roundness with their correspondents in the base [kom] violates -OO-IDENT[round].

Now let’s consider what will happen when we attach /-tu/ to a root which has an underlyingly [-round] vowel, e.g. /kin/. Here, we expect the language’s rounding

harmony system to kick in, so the root vowel will become [y]. The problem for TAF is that this results in labialization being suppressed, because the [i]~[y] alternation suffices to satisfy $\text{-OO-IDENT}[\text{round}]$'s demand for a roundness mismatch between some segment of the singular and its correspondent in the plural:

(5)

/kin-tu/ Base of OO- correspondence: [kin]	-OO-IDENT [round]	OO-IDENT [round]	IO-IDENT [round]
a. [kyn-tu]	1	1	1
b. $\text{[k}^{\text{w}}\text{yn-tu]}$	1	W_2	W_2

I am not aware of any language which works in this way, in which a morphophonological process (mutation, truncation, etc.) fails to apply because the affix it's associated with independently causes a phonological alternation which happens to violate the same faithfulness constraint.

Both RM's difficulty with multiple exponence and TAF's problem of accidental satisfaction result from the minimum violation property of OT constraints. In both cases, a measure of difference between the simplex and complex forms is demanded, but the change we want to see may fail to occur, because some other change happens independently and this suffices to satisfy the difference-demanding constraint. The process then fails to occur owing the need to satisfy faithfulness as fully as possible.

An alternative to problems like this would be to assume that mutation results from the realization of underlying structures. Analyses based the assumption that affixes can have floating, segmentally-unlinked features in their underlying forms are familiar (McCarthy 1983a,b, Lieber 1987, Zoll 1996, Gnanadesikan 1997, Wolf 2007a). Theories like these avoid the multiple exponence problem because a single affix might

have more than one floating feature in its UR. Likewise, accidental satisfaction is not a problem either. In our hypothetical language, the labializing mutation would result from a pressure to preserve underlyingly-floating features on the surface, and spreading of [+round] from the suffix vowel to the root vowel would not suffice to satisfy this pressure.

Floating-feature accounts of non-concatenative morphology suffer, however, from a major empirical hole: they can provide no account of morphological truncation, as in Koasati. There is no obvious way to explain morphology which is genuinely subtractive in terms of faithfulness to any sort of underlying structure, floating or otherwise.

The OI approach to ‘process’ morphology which I’m suggesting in this section would avoid the drawbacks of all of these theories. As mentioned earlier, OI does not suffer from RM’s problems with multiple exponence, because a single morph could include more than one phonological operation. By contrast with floating-feature models, subtractive morphology is no problem for OI, because the phonological operation of a morph could be one of deletion rather than insertion. Finally, OI can also avoid TAF theory’s accidental-satisfaction problem. In our hypothetical language which had both a labializing mutation and rounding harmony, the plural morph would look something like this:

(6) <Insert([+plural]), { Insert(/tu/), Change([-round] to [+round]) }>

Inserting this morph (spelling out the plural morpheme) would bring about two simultaneous changes, because the morph contains two phonological operations: the suffix string /tu/ will be inserted, and a root consonant will be labialized. So, for

example, /kin-PLURAL/ will become /k^wintu/. Due to the gradualness requirement, rounding harmony from the suffix vowel to the root vowel will then apply only on a subsequent LUM, yielding [k^wyntu]. Because the labializing mutation and the rounding harmony occur in separate steps, we avoid the problem of failing to labialize just in case rounding harmony is also destined to occur.

The OI approach to process morphology thus looks quite promising in terms of avoiding the problems faced by existing approaches to such morphology in OT. There is, however, at least one possibly problematic issue which bears addressing. This involves what might be termed ‘presupposition failure’ in process morphology, which arises in particular with regard to subtractive morphology. Suppose that we have an affix which induces deletion of accents from the base, such as Japanese /-kko/ ‘native of’ (Japanese examples from Alderete 1999):

(7) [kó:be] ‘Kobe’ [kobekko] ‘person from Kobe’

In OI the morph for this suffix will contain two phonological operations:

(8) <Insert(‘native-of’), {Insert(/kko/), Delete(accent)}>

Here’s the problem: if ‘inserting a morph’ means performing all of the phonological and morphological operations which the morph contains, then we will be unable to insert this morph with a root that has no accent. We can’t perform the ‘Delete(accent)’ operation if there is no accent to delete. And yet, in Japanese, dominant affixes like /-kko/ are entirely usable with accentless bases:

(9) [edo] ‘Tokyo’ [edokko] ‘person from Tokyo’

It would seem to be necessary to assume in OI that there are two accidentally-homophonous morphs which express ‘native of’:

- (10) <Insert(‘native-of’), {Insert(/kko/), Delete(accent)} >
<Insert(‘native-of’), Insert(/kko/)>

The first of these, which inserts /-kko/ and deletes a root accent, will be used with accented roots, and the second, which just inserts /-kko/, will be used with unaccented roots. The worry then is: why are they homophonous? Why do we not find a hypothetical language Japanese’, where the suffix strings inserted by the two morphs are totally different:

- (11) <Insert(‘native-of’), {Insert(/kko/), Delete(accent)} >
<Insert(‘native-of’), Insert(/ba/)>

In this hypothetical language, the morpheme ‘native of’ is marked on accented place-names by suffixing /-kko/ and deleting the accent, but on accentless place-names by suffixing /-ba/. The /-kko/ allomorph is blocked just in case its ‘presupposition’ that there is an accent around to be deleted fails. As far as I know, there is no attested system of subtractive morphology (involving deletion of either of accents or of segments) which works this way.

This is a legitimate worry for the OI approach to subtractive morphology, but it might not be entirely implausible to think that this is an accidental gap, since subtractive morphology is not especially common cross-linguistically. Also, while examples involving subtraction are not forthcoming, there may be cases of ‘presupposition failure’ involving mutation processes which change rather than delete segments of the base. A Sanskrit example is cited by Kiparsky (1972) from Wackernagel & Debrunner (1954). This involves the suffix /-a/ which marks several meanings

including authorship. This suffix is associated with a process called *vrddhi* ('growth') which involves, basically, causing the nucleus of the first syllable of the base to be long and include [a]:

- | | | | | |
|------|-------------|-------------|-------------|----------------|
| (12) | [patañjali] | 'Patañjali' | [pātañjala] | 'by Patañjali' |
| | [candra] | 'Candra' | [cāndra] | 'by Candra' |
| | [jinendra] | 'Jinendra' | [jainendra] | 'by Jinendra' |

However, if the the nucleus of the first syllable of the base is already /ā/, authorship is marked by /-īya/ instead of /-a/:

- | | | | | |
|------|----------|----------|-------------|-------------|
| (13) | [pāṇini] | 'Pāṇini' | [pāṇinīyam] | 'by Pāṇini' |
| | [vyādi] | 'Vyādi' | [vyādīya] | 'by Vyādi' |

That is, when the morphological process 'make the first syllable long and contain [a]' could not apply non-vacuously, a completely different allomorph emerges.

Similar effects can be found in chain-shifting mutations like Irish Eclipsis: voiceless stops are changed to voiced, but stops that are voiced to begin with are changed to nasals:

- | | | |
|------|-----------|-----------|
| (14) | /p/ → [b] | /b/ → [m] |
| | /t/ → [d] | /d/ → [n] |
| | /k/ → [g] | /g/ → [ŋ] |

Here, the morphological categories triggering Eclipsis are normally realized by voicing, but when voicing could only apply vacuously, a different feature-change (nasalization) happens instead. Cases like these, along with others from Grebo and Lena Bable Spanish, led me to propose (Wolf 2007a) a constraint *NOVACUOUSDOCKING*, which forbids floating-feature affixes from docking on segments which already have the same feature-value as the floating feature. (Becker 2008 also makes use of this constraint.)

Presumably this constraint could be dispensed with in OI via an appeal to the device of ‘presupposition failure’ in process morphology. Ideally, however, we would still like to find cases of presupposition failure involving morphological deletion or metathesis processes, rather than just feature-changing mutations.

6.3 Can phonology operate on morphs before they’re ‘inserted’?

Thusfar in this dissertation, I’ve assumed that the input to the phonology consists of just the abstract morphosyntactic structure of a word. Until morphs are inserted, no phonological material is present and therefore no phonological operations (besides perhaps epenthesis) can be performed. On the view adopted so far, ‘affixation’ means plucking a morph from the lexical storehouse and bringing it into the workspace of the phonological grammar.

One consequence of this, as we saw in chapter 5, is that a constraint $\text{PREC}(P, M)$, which forbids phonological process P from applying after the insertion of morph M , can prevent marked structures fully internal to M from being eliminated through process P . For instance, in Arammba, /ð/ can surface faithfully only in masculine suffixes, due to the effect of $\text{PREC}(P, \text{insert-masculine})$, where P is whatever phonological process normally eliminates underlying /ð/s in the rich base. Crucially, my analysis of Arammba assumed that the phonology could not delete or occlusivize or otherwise eliminate /ð/ in masculine suffixes before those suffixes are ‘inserted’. If that were possible, then /ð/ could be eliminated without violating $\text{PREC}(P, \text{insert-masculine})$.

However, there may be reasons to suspect that phonology can operate on morphs before they’re brought into contact with the base of affixation. This question

arises, first of all, in the context of an argument against Stratal OT advanced by Benua (1997). The argument concerns the cyclic overapplication of nasal harmony in Sundanese (Robins 1957, Anderson 1972, Stevens 1977, Hart 1981, van der Hulst & Smith 1982, Cohn 1990). Nasal consonants in Sundanese induce nasality to spread rightwards through vowels and laryngeals; nasal spreading stops once it reaches any other consonant:

(15)

[ɲĩār]		‘seek’
[nãʔãtkin]		‘dry’
[ŋũliat]		‘stretch’
[mãrios]		‘examine’

The nasality or orality of a vowel is predictable rather than contrastive in Sundanese: except for the the complicating cyclic cases that we’ll get to in a moment, vowels outside of nasal-harmony contexts are always oral.

Sundanese verbs take a plural affix which is realized as either /al/ or /ar/, depending on the quality of liquids in the root. The plural is prefixed with vowel-initial roots but infixes with consonant-initial roots:

(16)

[alus]	[ar-alus]	‘be pleasant’
[ala]	[ar-ala]	‘take’
[bawa]	[b-ar-awa]	‘carry’
[dahar]	[d-al-ahar]	‘eat’

Overapplication of nasal harmony occurs when the plural marker is infixes after a root-initial nasal. In such words, the liquid of the suffix is seemingly transparent to nasal harmony, in contravention of the normal status of liquids as blockers in Sundanese:

(17)		
[nĩār]	[ɲ-āl-ĩār]	‘seek’
[nãʔātkin]	[n-ār-ãʔātkin]	‘dry’

These facts straightforwardly lend themselves to a cyclic analysis, as proposed by Cohn (1990); the analysis based on locally-ordered rules in Anderson (1974) is similar:

(18)		
Stem cycle		
Morphology: root		ɲiar
Nasal harmony		nĩār
Affix cycle		
Morphology: plural infix		ɲ-al-ĩār
Nasal harmony		ɲ-āl-ĩār
Output		[ɲ-āl-ĩār]

Because liquids are blockers in Sundanese, there is no transparent motivation for the vowels to the right of the infix to be nasalized on the surface, because a liquid separates them from the root-initial nasal consonant. Because they fall outside of a transparent domain for nasal harmony, the /ia/ sequence to the right of the infix should be oral, but instead it's nasal. The cyclic analysis resolves this paradox: the /ia/ sequence undergoes nasal harmony transparently, albeit on an earlier cycle at which the infix /al/ and its harmony-blocking liquid is not yet present.

Now let's look at what happens when we try to implement this cyclic analysis in Stratal OT. We will need two strata: at level 1 nasal harmony applies transparently within the root, and at level 2, the plural infix is introduced. At level 1, vowel nasality is allophonic: nasal vowels are forbidden unless they fall within the domain for nasal

spreading. This means that faithfulness to underlying vowel nasality is outranked by a markedness constraint against nasal vowels:

(19) *No faithfulness to nasality at level 1*

/ãlus/	*NASALV	IDENT[nasal]
a. \rightarrow [alus]		1
b. [ãlus]	W ₁	L

Nasal vowels can however arise through nasal harmony. This means that the markedness constraint favoring nasal harmony dominates *NASALV. As the contentious issue of how to characterize harmony-triggering constraints is orthogonal to the issues at hand, I will simply call this constraint ‘HARMONIZE’:

(20) *Nasal harmony at level 1*

/ɲiar/	‘HARMONIZE’	*NASALV	IDENT[nasal]
a. \rightarrow [ɲiãr]		2	2
b. [ɲiar]	W ₁	L	L

Now we can examine the ranking conditions which will need to obtain at level 2. In a word like [ɲ-ãl-iãr], the distribution of nasality is non-transparent in that the vowels to the right of the infix are nasalized, thus bringing two extra violations of *NASALV, even though these violations are not necessary to satisfy ‘HARMONIZE’:

(21) *Wrong result if level 2 isn’t faithful to underlying nasality*

/ɲ-ãl-iãr/	‘HARMONIZE’	*NASALV	IDENT[nasal]
a. \bullet^* [ɲ-ãl-iar]		1	2
b. \rightarrow [ɲ-ãl-iãr]		W ₃	L ₁

The fact that the [ĩã] sequence remains nasal at Level 2 even though this is not needed to satisfy ‘HARMONIZE’ means that the ranking of *NASALV and IDENT[nasal] must be reversed at Level 2:

(22) *Level 2 must be faithful to underlying nasality*

/ɲ-al-ĩãr/	‘HARMONIZE’	IDENT[nasal]	*NASALV
a. ☞ [ɲ-ãl-ĩãr]		1	3
b. [ɲ-ãl-iar]		W_3	L_1

It is from this ranking that the problem identified by Benua (1997) arises: if IDENT[nasal] dominates *NASALV at Level 2, then affixes introduced at Level 2 should be able to contrast in vowel nasality:

(23)



/ãr-alus/	‘HARMONIZE’	IDENT[nasal]	*NASALV
a. ☛ [ãr-alus]			1
b. ☞ [ar-alus]		W_1	L

This prediction cannot be correct, because vowel nasality is never contrastive in Sundanese, regardless of whether the vowel belongs to a root or to an affix. The problem for Stratal OT thus is that overapplication of a process arises from faithfulness being high-ranked at a stratum after the one where the process applies transparently, which allows affixes of the later stratum to contain the same marked structure (here, nasal vowels) which arises from the overapplication. Stated less formally, nasal harmony is able to overapply because denasalization is not permitted after the plural infix has been introduced.

Putting in that way makes it clearer that OI potentially suffers from the same problem. In OI, too, the Sundanese ‘overapplication’ effect would be handled by barring

denasalization from occurring after the insertion of the infix. The only difference is that this is achieved by ranking $\text{PREC}(\text{IDENT}[\text{nasal}], \text{insert-plural})$ above $*\text{NASALV}$. The same problem now arises. If the plural suffix had an underlying nasal vowel, that vowel would be able to surface faithfully as [+nasal] all of the time. Denasalization of a segment belonging to the plural affix necessarily follows insertion of the plural affix, and therefore brings with it violation of the PREC constraint:

(24)

<PL-ROOT, PL-alus, ãr-alus, ar-alus>	‘HARMONIZE’	PREC (IDENT[nasal], insert-plural)	*NASV	Id[nas]
a.  <PL-ROOT, PL-alus, ãr-alus>			1	
b.  <PL-ROOT, PL-alus, ãr-alus, ar-alus>		W_1	L	W_1

In both Stratal OT and in OI, we potentially face a version of the same problem: a marked structure (here, nasal vowels) that can arise through overapplication is predicted also to be allowed internal to the affix(es) that render the overapplying process non-transparent (here, the plural infix). In Sundanese, this prediction is not correct.

At least for the present case, a way around this problem can be engineered for both theories. For OI, if we allow PREC constraints to refer to LUMs via positional (rather than just ‘basic’) faithfulness constraints that the LUMs violate, we could assume that the relevant PREC constraint for Sundanese is actually $\text{PREC}(\text{IDENT}[\text{nasal}]_{\text{root}}, \text{insert-plural})$. This constraint will bar denasalization of root segments after the insertion of the plural affix, but it will have no objection to denasalizing the vowel of the plural affix itself, because denasalizing an affix segment doesn’t violate $\text{IDENT}[\text{nasal}]_{\text{root}}$:

(25)

<PL-ROOT, PL-alus, ãr-alus, ar-alus>	'HARMONIZE'	PREC (IDENT[nas] _{root} , insert-plural)	*NASV	ID[nas]
a. <PL-ROOT, PL-alus, ãr-alus>			W ₁	L
b. [ãr-alus] <PL-ROOT, PL-alus, ãr-alus, ar-alus>				1

Similarly, in Stratal OT, we could assume that at Level 2, *NASALV is dominated not by general IDENT[nas] but by IDENT[nas]_{root}.¹³³

(26)

/ɲ-al-ĩãr/	'HARMONIZE'	IDENT[nasal] _{root}	*NASALV	IDENT[nasal]
a. [ɲ-ãl-ĩãr]			3	1
b. [ɲ-ãl-iar]		W ₂	L ₁	W ₃

(27)

/ãr-alus/	'HARMONIZE'	IDENT[nasal] _{root}	*NASALV	IDENT[nasal]
a. [ar-alus]				1
b. [ãr-alus]			W ₁	L

It thus may be possible to explain away the Sundanese case and other misapplication examples where OI would risk making wrong predictions about marked structures being allowed internal to the affixes which cause the misapplication. However, a trickier version of the same problem also arises with respect to DEEs. Recall from chapter 4 that in OI, DEEs result from the 'must be preceded by' clauses of PREC

¹³³ Given the bracket-erasure predictions of Stratal OT discussed in chapter 5, this constraint might be better defined not as faithfulness to roots, but as faithfulness to the output of the previous stratum (as opposed to faithfulness to the URs of affixes introduced on the current stratum).

constraints. A constraint $\text{PREC}(M, P)$ will be violated if phonological process P occurs in an environment that has not been crucially derived by the insertion of morph M . The problem is that an environment for process P can be derived by M -insertion in one of two ways: either the environment for P includes material from both M and its base, or the environment for P can be fully contained in M . However, there are attested DEEs in which the DEE process occurs only at junctures, but not internal to the affixes that create those same junctures.

Odden (1990: 98) cites an example from Hyman (1990). In Luganda, the final consonant of one morph spirantizes before a following /i/-initial morph. However, a consonant-plus-*i* sequence internal to a morph does not undergo spirantization. This can be seen in the example /lamuk-irir-i/ → [lamus-iriz-i], *[lamus-iriz-i] ‘greet without ceasing’. The spirantization of the root-final /k/ to [s] indicates that spirantization is allowed when it’s crucially preceded by suffixation of /irir/. But then why doesn’t the medial /r/ of /irir/ spirantize? Spirantization there *would* be preceded by /irir/-insertion, because (per our assumptions thusfar) no unfaithful mapping can be performed on the segments of an affix until the affix is inserted. If spirantization is restricted to affixation-derived environments by ranking $\text{PREC}(\text{insert-affix}, \text{IDENT}[\text{contin}])$ above the markedness constraint that favors assibilation, we cannot explain why the medial /r/ of /irir/ doesn’t spirantize, because $\text{PREC}(\text{insert-affix}, \text{IDENT}[\text{contin}])$ would not be violated by doing so.

What is to be done, then? The Luganda spirantization DEE could be handled in OI if we assumed that affix-insertion happened in two steps: first, the affix is inserted, and second, the affix is linearized with the base, in a separate LUM:

(28) <ROOT-A1-A2, lamuk-A1-A2, {lamuk, irir}-A2, lamukirir-A2>

Under these assumptions, consider what would happen if we tried spirantizing the medial /r/ of /irir/. Because it would be harmonically-improving to spirantize this /r/ both before and after the linearization of /irir/ with /lamuk/, that spirantization would not be crucially preceded by linearization. We could then analyze Luganda under the assumption that spirantization is allowed only in environments derived by linearization.

Splitting insertion and linearization of affixes into two separate steps would, however, come at a steep cost: specifically, we would completely forfeit any possible account of phonologically-conditioned suppletive allomorphy. Because, upon being inserted, an affix is not linearized with its base, there is no way for the determination of which allomorph of *affix* would be locally optimal in the environment *base+affix*. What seems to be necessary is a middle way in which the insertion and linearization of a given morph occurs in one step, but the phonology can also attempt unfaithful mappings on morphs before they're inserted.

Such a model might look something like this: the input to the phonology consists of both the morphosyntactic structure that's being spelled out and the set of all the morphs of the language:

(29) <AF2, /i/>

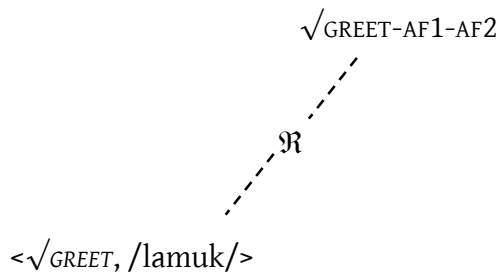
$\sqrt{\text{GREET-AF1-AF2}}$

< $\sqrt{\text{GREET}}$, /lamuk/>

<AF1, /irir/>

Because the morphs are all already present, the operation of ‘inserting a morph’ can be replaced with an operation of placing one morph into correspondence with a portion of the morphosyntactic structure:

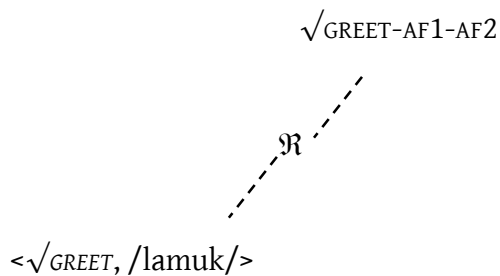
(30) <AF2, /i/>



<AF1, /irir/>

Lastly, because all morphs are visible to the phonology before being placed in correspondence with the morphosyntactic structure, an unfaithful mapping could be performed on a morph before it enters into morpheme/morph correspondence:

(31) <AF2, /i/>

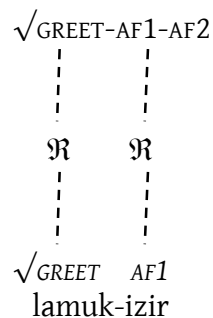


<AF1, /izir/>

A model like this would allow us to cope with the behavior of Luganda /-irir-/ and similar facts, while also maintaining an account of PCSA. All we need to assume is

that when a morph enters into correspondence with the morphosyntactic tree, it simultaneously acquires a linear order relationship with all of the other morphs spelling out that tree:

(32) <AF2, /i/ >



This same strategy also would provide an alternative means of coping with problems like the one raised by Sundanese. If the phonology were able to denasalize vowels in the underlying forms of affixes before those affixes are concatenated with a root, then underlying affix nasality can be filtered out of the rich base without violating $\text{PREC}(\text{IDENT}[\text{nasal}], \text{insert-aff})$.

Considerations of psychological plausibility would demand a few refinements to the idealized picture sketched so far. Specifically, if the input to the phonology for some given word includes literally *all* of the morphs of the language, then GEN is expected to be bogged down by trying out unfaithful mappings on the thousands of morphs of the language which are not destined to be used to spell out the tree. For instance, if an English speaker is computing the pronunciation for the word *build*, it's unlikely that in the course of doing so they waste time figuring out ways to assign stress to *knife*, *clean*, *tree*, *fast*, and all of the other roots of the language.

Performance concerns therefore suggest that the space of morphs that is available in the input consists not of all the morphs of the language but of some subset of them. One idea we could entertain is that only morphs whose level of activation meets some threshold become ‘visible’ in the input to the phonology. Following psycholinguistic models of lexical access which make a lemma/lexeme distinction (e.g. Levelt 1989) we could hypothesize that, when a given morphosyntactic tree is being assembled by the syntax, the morphemes of the tree (the lemmas) feed activation to the morphs in the lexicon (the lexemes) which have featurally-similar FSES. As a result, those morphs which stand some plausible chance of being the Locally Optimal spellout of some node of the tree thereby gain sufficient activation to be available to the grammar when it moves on from syntax to phonology.

6.4 The treatment of exceptions

One aspect of phonology/morphology interaction which has frequently cropped up in this thesis, despite never being the primary focus of analysis, is the issue of lexical exceptions in phonology and how best to analyze them. This question is important in that at least some cases of the phenomena treated in this thesis could alternatively be treated as cases of lexical exceptionality. In chapter 3, we saw one case of this: when a morph or closed class of morphs seems to undergo an alternation which otherwise doesn’t occur in the language, it is ambiguous (perhaps unresolvably so) whether we choose to say that the morph undergoes a ‘minor rule’ (perhaps driven in OT via lexically-indexed markedness constraints) or to say that it has multiple listed allomorphs.

This same ambiguity arises with at least some cases of DEEs. For example, Turkish and Hungarian have vowel harmony processes, but also have a certain number of roots which are internally disharmonic. Polgárdi (1998) and van Oostendorp (2007) treat these as cases of NDEB: the vowel harmony process is blocked from applying inside underived roots. An alternative way of talking about this would be to say that the disharmonic roots are exceptions to the harmony process. In OT, we could implement an account along those lines by assuming the disharmonic roots to be indexed to lexically-specific faithfulness constraints which were ranked above the markedness constraints which drive the harmony process.

A third place where the same kind of ambiguity arises concerns affix-protecting DEB. In Arammba, for instance, [ǰ] is allowed only in masculine suffixes. We can choose to talk about this, as we did in chapter 5, as a DEB effect: the unfaithful mapping which eliminates underlying /ǰ/ is barred from applying after the insertion of a masculine affix. Alternatively, we could talk about this as a case of exceptionality, and say that the masculine affixes of Arammba are indexed to a faithfulness constraint which is ranked above *ǰ.

Thus, an important question for OI as it goes forward is that of how to divide up explanatory labor between, on the one hand, allomorph selection and PREC constraints, and on the other hand, lexically-indexed markedness and faithfulness constraints. One radical programmatic hypothesis that we might choose to pursue would be to assume that there are no lexically-indexed constraints, and that all cases of ‘lexical exceptions’ in phonology result from allomorph selection, NDEB, or DEB. It’s not immediately clear that this would be possible or desirable, though, for reasons that we saw in chapter 4.

Specifically, OI seems to need an independent theory of exceptionality which incorporates a means for that exceptionality to be lost under morphological derivation. This is necessary in order to explain away the apparent cases of pseudo-DEEs which the OI/OT-CC account of NDEB cannot accommodate. Of course, it may turn out that closer empirical scrutiny of the apparent pseudo-DEEs will lead to alternative analytical possibilities.

In any case, we can hope that future refinement both of OI and of theories of exceptions will result from careful consideration of how individual cases of exceptionality are best accounted for. Albright (2008b) has recently argued that speakers sometimes, but not always, learn separate grammars for separate word classes when there are statistically significant phonological differences between the sets of words in the two classes. This hints that detailed psycholinguistic investigation will be required to help decide when accounts based on lexical exceptionality will and won't be appropriate.

6.5 Reduplication

One notable type of morphology which has not been addressed in this thesis is reduplication. Reduplication is a nontrivial challenge for OT-CC and related serial theories, as noted by McCarthy (2007a: ch. 3, fn. 18). The reason is that, if reduplication occurs gradually, 'copying' one segment at a time, the payoff in terms of harmonic improvement may not come until several segments have been copied. McCarthy's answer is that reduplicative 'copying' is outside the scope of the IO-correspondence relation and therefore without faithfulness cost (McCarthy & Prince 1994, 1995). This

means that reduplication is not a LUM and is therefore exempt from the gradualness requirement. In OI, however, this strategy will probably not work, given OI's basic premise that all other types of morphological operations are LUMs and subject to the gradualness requirement. The question of how best to understand the operation(s) involved in reduplication will therefore be an important research question for future work in OI.

6.6 Envoi

In this dissertation, I've tried to argue that the morphological spell-out and the linearization of morphs are part of the phonology and are subject to the influence of phonological constraints. As the discussion of further issues in this concluding chapter has hopefully made clear, there is a great deal of interesting future research to be done within OI. This includes more traditional generative-phonological research on issues like reduplication and how to handle them in OI, as well as more psycholinguistically oriented work on OI's connections issues like on-line lexical access and the proper place of exceptionality. As hinted at in the brief discussion of phrase-phonological effects in chapter 3, there is also a great deal of potential work to be done on how things like prosodic phrasing and syntactic linearization fit in with the theory. I hope that the proposals I've made here will have something to offer to linguists who work on these and all of the other issues that have been raised in the course of this dissertation, and that OI will serve as a step towards a unified understanding of how the phonological and morpho-syntactic parts of human language relate to one another.

REFERENCES

- Abdel Rahman, Rasha, and Werner Sommer (2003). Does phonological encoding in speech production always follow the retrieval of semantic knowledge? Electrophysiological evidence for parallel processing. *Cognitive Brain Research* 16, pp. 372-382.
- Abels, Klaus, and Peter Muriungi (2007). The focus marker in Kîtharaka: Syntax and semantics. Ms., Universitetet i Tromsø and University College London. [lingbuzz/000513]
- Abraham, Richard D. (1950). Fixed order of coordinates—a study in comparative lexicography. *Modern Language Journal* 34, pp. 276-287.
- Ackema, Peter, and Ad Neeleman (2004). *Beyond Morphology: Interface Conditions on Word Formation*. Oxford: Oxford University Press.
- Ackema, Peter, and Ad Neeleman (2005). Word-formation in Optimality Theory. In Pavol Štekauer and Rochelle Lieber (eds.), *Handbook of Word-Formation*. Dordrecht: Springer, pp. 285-313.
- Acquaviva, Paolo (2008). Roots and lexicality in Distributed Morphology. Ms., University College Dublin and Universität Konstanz. [lingBuzz/000654]
- Adam, Galit, and Outi Bat-El (to appear). Morphological knowledge without morphological structure: Morphology-prosody interface in the first Hebrew verbs. In Sharon Armon-Lotem, Gabi Danon and Susan Rothstein (eds.), *Generative Approaches to Hebrew Linguistics*. Amsterdam: John Benjamins.
- Akinlabi, Akinbiyi (1996). Featural affixation. *Journal of Linguistics* 32, pp. 239-289. [ROA-185]
- Al-Mozainy, Hamza Q. (1981). *Vowel Alternations in a Bedouin Hijazi Arabic Dialect: Abstractness and Stress*. Ph.D. dissertation, University of Texas, Austin.
- Albright, Adam (2003). A quantitative study of Spanish paradigm gaps. In Gina Garding and Mimuro Tsujimura (eds.), *WCCFL 22 Proceedings*. Somerville, MA: Cascadilla Press, pp. 1-14.
- Albright, Adam (2007). Cheap but not free: Commentary on Pfau 'Cheap repairs'. In Carson T. Schütze and Victor S. Ferreira (eds.), *MIT Working Papers in Linguistics 53: The State of the Art in Speech Error Research: Proceedings of the LSA Institute Workshop*. Cambridge, MA: MITWPL, pp. 35-51.
- Albright, Adam (2008a). Inflectional paradigms have bases too: Evidence from Yiddish. In Asaf Bachrach and Andrew Nevins (ed.), *Inflectional Identity*. Oxford: Oxford University Press.

- Albright, Adam (2008b). How many grammars am I holding up? Discovering phonological differences between word classes. In Charles B. Chang and Hannah J. Hanyie (eds.), *Proceedings of the 26th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 1-20. [lingref #1651]
- Albright, Adam (to appear). Lexical and morphological conditioning of paradigm gaps. In Curt Rice (ed.), *Modeling Ungrammaticality in Optimality Theory*. London: Equinox.
- Alderete, John D. (1999). *Morphologically Governed Accent in Optimality Theory*. Doctoral dissertation, University of Massachusetts, Amherst. [ROA-309]
- Alderete, John D. (2001). Dominance effects as trans-derivational anti-faithfulness. *Phonology* 18, pp. 201-253.
- Allen, Andrew (1976). Interfixes preserve syllables and word roots. In Henry Thompson, Kenneth Whistler, Vicki Edge, Jeri J. Jaeger, Ronya Javkin, Miriam Petruck, Christopher Smeall, and Robert D. Van Valin Jr. (eds.), *Proceedings of the Second Annual Meeting of the Berkeley Linguistics Society*. Berkeley: BLS, pp. 31-35.
- Allen, Margaret (1978). *Morphological Investigations*. Ph.D. dissertation, University of Connecticut, Storrs.
- Allen, W.S. (1956). Structure and system in the Abaza verbal complex. *Transactions of the Philological Society*, pp. 127-176.
- Álvarez de Miranda, Pedro (1993). El alomorfo de la y sus consecuencias. *Lengua español actual* 15, pp. 5-43.
- Anderson, Stephen R. (1969). An outline of the phonology of Modern Icelandic vowels. *Foundations of Language* 5, pp. 53-72.
- Anderson, Stephen R. (1972). On nasalization in Sundanese. *Linguistic Inquiry* 3, pp. 253-268.
- Anderson, Stephen R. (1974). *The Organization of Phonology*. San Diego: Academic Press.
- Anderson, Stephen R. (1977). On the formal description of inflection. In Woodford A. Beach, Samuel E. Fox, and Shulamith Philosoph (eds.), *Papers from the Thirteenth Regional Meeting, Chicago Linguistic Society*. Chicago: CLS, pp. 15-44.
- Anderson, Stephen R. (1981). Why phonology isn't "natural". *Linguistic Inquiry* 12, pp. 493-539.
- Anderson, Stephen R. (1982). Where's morphology? *Linguistic Inquiry* 13, pp. 571-612.
- Anderson, Stephen R. (1992). *A-Morphous Morphology*. Cambridge: Cambridge University Press.

- Anderson, Stephen R., and Wayles Browne (1973). On keeping exchange rules in Czech. *Papers in Linguistics* 6, pp. 445-482.
- Andrews, J.R. (1975). *Introduction to Classical Nahuatl*. Austin: University of Texas Press.
- Angluin, Dana (1980). Inductive inference of formal languages from positive data. *Information and Control* 45, pp. 117-135.
- Anttila, Arto (1997a). Deriving variation from grammar: A study of Finnish genitives. In Frans Hinskens, Roeland van Hout, and Leo Wetzels (eds.), *Variation, Change, and Phonological Theory*. Amsterdam: John Benjamins, pp. 35-68. [ROA-63]
- Anttila, Arto (1997b). *Variation in Finnish Phonology and Morphology*. Ph.D. dissertation, Stanford University.
- Anttila, Arto (2002). Morphologically conditioned phonological alternations. *Natural Language and Linguistic Theory* 20, pp. 1-24.
- Anttila, Arto (2006). Variation and opacity. *Natural Language and Linguistic Theory* 24, pp. 893-944.
- Anttila, Arto (2008). Phonological constraints on constituent ordering. In Charles B. Chang and Hannah J. Hanyie (eds.), *Proceedings of the 26th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 51-59.
- Anttila, Arto, and Young-mee Yu Cho (2000). Non-derived environment blocking as a faithfulness effect. Paper presented at 30th Annual Meeting of the North East Linguistic Society, Rutgers University, New Brunswick, NJ.
- Anttila, Arto, Vivienne Fong, Štefan Beňuš, and Jennifer Nycz (2004). Deriving consonant cluster phonotactics: Evidence from Singapore English. In Keir Moulton and Matthew Wolf (eds.), *Proceedings of the 34th Annual Meeting of the North East Linguistic Society*. Amherst: GLSA, pp. 89-103. [ROA-649]
- Anttila, Arto, Vivienne Fong, Štefan Beňuš, and Jennifer Nycz (to appear). Variation and opacity in Singapore English consonant clusters. *Phonology* 25.2. [ROA-981]
- Apoussidou, Diana (2006). On-line learning of underlying forms. Ms., Universiteit van Amsterdam. [ROA-835]
- Applegate, Richard B. (1972). *Ineseño Chumash Grammar*. Ph.D. dissertation, University of California, Berkeley.
- Arad, Maya (2005). *Roots and Patterns: Hebrew Morpho-Syntax*. Dordrecht: Springer.
- Aranovich, Raúl, Sharon Inkelas, Orhan Orgun, and Ronald Sprouse (2005). Opacity in phonologically conditioned suppletion. Talk presented at 13th Manchester Phonology Meeting.

- Aranovich, Raúl, and Orhan Orgun (2006). Opacity in *-ez/-eza* suffixation. In Timothy L. Face and Carol A. Klee (eds.), *Selected Proceedings of the 8th Hispanic Linguistics Colloquium*. Somerville, MA: Cascadilla Proceedings Project, pp. 116-122. [LingRef # 1259]
- Archangeli, Diana, and Douglas Pulleyblank (1994). *Grounded Phonology*. Cambridge, MA: MIT Press.
- Aronoff, Mark (1976). *Word Formation in Generative Grammar*. Cambridge, MA: MIT Press.
- Aronoff, Mark, Azhar Arsyad, Hassan Basri, and Ellen Broselow (1987). Tier conflation in Makassarese reduplication. In Anna Bosch, Barbara Need, and Eric Schiller (eds.), *Papers from the 23rd Annual Regional Meeting of the Chicago Linguistic Society: vol. 2: Parasession on Autosegmental and Metrical Phonology*. Chicago: CLS, pp. 1-15.
- Bachrach, Asaf, and Michael Wagner (2007). Syntactically driven cyclicity vs. output-output correspondence: The case of adjunction in diminutive morphology. Ms., MIT, Cambridge, MA, and Cornell University, Ithaca, NY.
- Badecker, W., M. Miozzo, and R. Zanuttini (1995). The two-stage model of lexical retrieval: Evidence from a case of anomia with selective preservation of grammatical gender. *Cognition* 57, pp. 193-216.
- Baker, C.L. (1979). Syntactic theory and the Projection Problem. *Linguistic Inquiry* 10, pp. 533-581.
- Baker, Mark C. (1985). The Mirror Principle and morphosyntactic explanation. *Linguistic Inquiry* 16, pp. 373-416.
- Baković, Eric (2000). *Harmony, Dominance, and Control*. Ph.D. dissertation, Rutgers University, New Brunswick. [ROA-360]
- Baković, Eric (2007). A revised typology of opaque generalizations. *Phonology* 24, pp. 217-259. [ROA-850]
- Baković, Eric, and Edward Keer (2001). Optionality and ineffability. In Géraldine Legendere, Jane Grimshaw, and Sten Vikner (eds.). *Optimality Theoretic Syntax*. Cambridge, MA: MIT Press, pp. 97-112.
- Baroni, Marco, and Laura Vanelli (2000). The relationship between vowel length and consonantal voicing in Friulian. In Lori Repetti (ed.), *Phonological Theory and the Dialects of Italy*. Amsterdam: John Benjamins, pp. 13-44.
- Barrie, Michael (2006). Tone circles and contrast preservation. *Linguistic Inquiry* 37, pp. 131-141.
- Bat-El, Outi (1993). Parasitic metrification in the Modern Hebrew stress system. *The Linguistic Review* 10, pp. 189-210.

- Bat-El, Outi (2003). Anti-faithfulness: An inherent morphological property. In Jacqueline Lecarme (ed.), *Research in Afroasiatic Grammar II*. Amsterdam: John Benjamins, pp. 21-34.
- Beard, Robert (1995). *Lexeme-Morpheme Base Morphology*. Albany: State University of New York Press.
- Becker, Michael (2003). Hebrew stress: Can't you hear those trochees? In Elsi Kaiser and Sudha Arunachalam (eds.), *University of Pennsylvania Working Papers in Linguistics 9.1: Proceedings of the 26th Annual Penn Linguistics Colloquium*. Philadelphia: PLC, pp. 45-57.
- Becker, Michael (2005). CCamelOT. [Web application available online at <http://www.oit.umass.edu/~linguist/CCamelOT/>]
- Becker, Michael (2008). *Phonological Trends in the Lexicon: The Role of Constraints*. Ph.D. dissertation, University of Massachusetts Amherst.
- Becker, Michael, Nihan Ketrez, and Andrew Nevins (under review). The surfeit of the stimulus: Grammatical biases filter lexical statistics in Turkish voicing deneutralization. Ms., University of Massachusetts Amherst, Yale University, and Harvard University. [lingbuzz/000544]
- Beckman, Jill N. (1998). *Positional Faithfulness*. Ph.D. dissertation, University of Massachusetts Amherst. [ROA-234]
- Behrens, Dietlinde (1975). Yakan phonemics and morphophonemics. *Papers in Philippine Linguistics 7* [=Pacific Linguistics A.44], pp. 13-28.
- Benua, Laura (1995). Identity effects in morphological truncation. In Jill N. Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.), *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*. Amherst: GLSA, pp. 77-136. [ROA-74]
- Benua, Laura (1997). *Transderivational Identity: Phonological Relations Between Words*. Ph.D. dissertation, University of Massachusetts, Amherst. [ROA-259]
- Beňuš, Štefan, Iris Smorodinsky, and Adamantios Gafos (2004). Gestural coordination and the distribution of English 'geminate'. In Sudha Arunachalam & Tatjana Scheffler (eds.), *Penn Working Papers in Linguistics 10.1: Proceedings of the 27th Annual Penn Linguistics Colloquium*. Philadelphia: PLC, pp. 33-46.
- Berent, Iris, Steven Pinker, and Joseph Shimron (1999). Default nominal inflection in Hebrew: Evidence for mental variables. *Cognition* 72, pp. 1-44.
- Berent, Iris, Steven Pinker, and Joseph Shimron (2002). The nature of regularity and irregularity: Evidence from Hebrew nominal inflection. *Journal of Psycholinguistic Research* 31, pp. 459-502.

- Bermúdez-Otero, Ricardo (1999). *Constraint Interaction in Language Change: Quantity in English and Germanic*. D.Phil. thesis, University of Manchester.
- Bermúdez-Otero, Ricardo (2003). The acquisition of phonological opacity. In Jennifer Spenader, Anders Eriksson, and Östen Dahl (eds.), *Proceedings of the Stockholm Workshop on 'Variation Within Optimality Theory'*. Stockholm: Department of Linguistics, University of Stockholm, pp. 25-36. [Expanded version available as ROA-593]
- Bermúdez-Otero, Ricardo (2006a). Phonological domains and opacity effects: A new look at voicing and continuancy in Catalan. Paper presented at 29th Generative Linguists of the Old World Colloquium, Barcelona. [Handout available at <http://www.bermudez-otero.com/GLOW2006.pdf>]
- Bermúdez-Otero, Ricardo (2006b). Phonological change in Optimality Theory. In Keith Brown (ed.), *Encyclopedia of Language and Linguistics*, 2nd ed., vol. 9. Oxford: Elsevier, pp. 497-505.
- Bermúdez-Otero, Ricardo (2007a). Marked phonemes vs. marked allophones: Segment evaluation in Stratal OT. Paper presented at 30th Generative Linguists of the Old World Colloquium, Tromsø. [Handout available at <http://www.bermudez-otero.com/GLOW2007.pdf>]
- Bermúdez-Otero, Ricardo (2007b). Diachronic phonology. In Paul de Lacy (ed.) *The Cambridge Handbook of Phonology*. Cambridge: Cambridge University Press, pp. 497-518.
- Bermúdez-Otero, Ricardo (2007c). On the nature of the cycle. Paper presented at 15th Manchester Phonology Meeting. [Handout available at <http://www.bermudez-otero.com/15mfm.pdf>]
- Bermúdez-Otero, Ricardo (2007d). Morphological structure and phonological domains in Spanish denominal derivation. In Fernando Martínez-Gill and Sonia Colina (eds.), *Optimality-Theoretic Studies in Spanish Phonology*. Amsterdam: John Benjamins, pp. 278-311.
- Bermúdez-Otero, Ricardo (to appear). *Stratal Optimality Theory*. Oxford: Oxford University Press.
- Bermúdez-Otero, Ricardo (in prep.) *The Life Cycle of Constraint Rankings: Studies in Early English Morphophonology*. Ms., University of Manchester. [Summary and chapter drafts available at <http://myweb.tiscali.co.uk/bermudez/lifecycle.htm>]
- Bermúdez-Otero, Ricardo, and Kersti Börjars (2003). Markedness in phonology and syntax: The problem of grounding. *Lingua* 116, pp. 710-756.

- Bermúdez-Otero, Ricardo, and Richard M. Hogg (2003). The actuation problem in Optimality Theory: Phonologization, rule inversion, and rule loss. In D. Eric Holt (ed.), *Optimality Theory and Language Change*. Dordrecht: Kluwer, pp. 91-119.
- Bermúdez-Otero, Ricardo, and April McMahon (2006). Markedness in phonology and syntax: The problem of grounding. *Lingua* 116, pp. 710-756.
- Bernhardt, Barbara H., and Joseph P. Stemberger (1998). *Handbook of Phonological Development from the Perspective of Constraint-Based Nonlinear Phonology*. San Diego: Academic Press.
- Berwick, Robert (1985). *The Acquisition of Syntactic Knowledge*. Cambridge, MA: MIT Press.
- Bing, Janet Mueller (1987). Phonologically conditioned agreement: Evidence from Krahn. In David Odden (ed.), *Current Approaches to African Linguistics*, vol. 4. Dordrecht: Foris, pp. 53-60.
- Biró, Tamás (2007). The benefits of errors: Learning an OT grammar with a structured candidate set. In *Proceedings of the Workshop on Cognitive Aspects of Computational Language Acquisition*, pp. 81-88. [ROA-929]
- Black, H. Andrew (1993). *Constraint-Ranked Derivation: A Serial Approach to Optimization*. Ph.D. dissertation, University of California, Santa Cruz.
- Blevins, Juliette (1995). The syllable in phonological theory. In John A. Goldsmith (ed.), *The Handbook of Phonological Theory*. Oxford: Blackwell, pp. 206-244.
- Bloomfield, Leonard (1930). German ç and x. *Le maître phonétique* 3.20, pp. 27-28.
- Bloomfield, Leonard (1933). *Language*. Chicago: Holt, Rinehart & Winston.
- Blumenfeld, Lev (2003a). Russian palatalization and stratal OT: Morphology and [back]. In Wayles Browne, Ji-yung Kim, Barbara H. Partee, and Robert A. Rothstein (eds.), *Annual Workshop on Formal Approaches to Slavic Linguistics: The Amherst Meeting 2002*. Ann Arbor: Michigan Slavic Publications, pp. 141-158.
- Blumenfeld, Lev (2003b). Counterfeeding, derived environment effects, and comparative markedness. *Theoretical Linguistics* 29, pp. 89-99.
- Blumenfeld, Lev (2006). *Constraints on Phonological Interactions*. Ph.D. dissertation, Stanford University. [ROA-877]
- Bobaljik, Jonathan David (2000). The ins and outs of contextual allomorphy. In Kleanthes K. Grohmann and Caro Struijke (eds.), *University of Maryland Working Papers in Linguistics 10: Proceedings of the Maryland Mayfest on Morphology 1999*. College Park: UMDWPL, pp. 35-71.

- Boersma, Paul (1997). How we learn variation, optionality, and probability. *IFA Proceedings* 21, pp. 43-58.
- Boersma, Paul (1998). *Functional Phonology: Formalizing the Interactions Between Articulatory and Perceptual Drives*. Ph.D. dissertation, Universiteit van Amsterdam.
- Boersma, Paul (2006). A programme for bidirectional phonology and phonetics and their acquisition and evolution. Ms., Universiteit van Amsterdam. [ROA-868]
- Boersma, Paul (2007). Some listener-oriented accounts of h-aspiré in French. *Lingua* 117, pp. 1989-2054. [ROA-730]
- Boersma, Paul, and Bruce Hayes (2001). Empirical tests of the Gradual Learning Algorithm. *Linguistic Inquiry* 32, pp. 45-86.
- Bolognesi, Roberto (1998). *The Phonology of Campidanian Sardinian: A Unitary Account of a Self-Organizing Structure*. Ph.D. dissertation, HiL.
- Bolozky, Shmuel, and Michael Becker (2008). Living lexicon of Hebrew nouns. Ms., University of Massachusetts, Amherst.
- Bonet i Alsina, M. Eulàlia (1991). *Morphology after Syntax: Pronominal Clitics in Romance*. Ph.D. dissertation, MIT, Cambridge, MA.
- Bonet, Eulàlia (1994). The Person-Case constraint: A morphological approach. In Heidi Harley and Colin Phillips (eds.), *MIT Working Papers in Linguistics 22: The Morphology-Syntax Connection*. Cambridge, MA: MITWPL, pp. 33-52.
- Bonet, Eulàlia (2004). Morph insertion and allomorphy in Optimality Theory. *International Journal of English Studies* 4.2, pp. 73-104. [Special issue on 'Advances in Optimality Theory', eds. Paul Boersma and Juan Antonio Cutillas.] [ROA-734]
- Bonet, Eulàlia, Maria-Rosa Lloret, and Joan Mascaró (2005). Lexical specification and ordering of allomorphs: two case studies. Ms., Universitat Autònoma de Barcelona and Universitat de Barcelona.
- Bonet, Eulàlia, María-Rosa Lloret, and Joan Mascaró (to appear). The prenominal allomorphy syndrome. In Bernard Tranel (ed.), *Understanding Allomorphy: Perspectives from OT*. London: Equinox.
- Booij, Geert (1996). Lexical Phonology and the derivational residue. In Jacques Durand and Bernard Laks (eds.), *Current Trends in Phonology: Models and Methods*. Salford: European Studies Research Institute, University of Salford, pp. 69-96.
- Booij, Geert (1997). Non-derivational phonology meets Lexical Phonology. In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: The Clarendon Press, pp. 261-288.

- Booij, Geert, and Jerzy Rubach (1984). Morphological and prosodic domains in Lexical Phonology. *Phonology Yearbook* 1, pp. 1-27.
- Borowsky, Toni (1986). *Topics in the Lexical Phonology of English*. Ph.D. dissertation, University of Massachusetts, Amherst.
- Borowsky, Toni (1993). On the Word level. In Sharon Hargus and Ellen M. Kaisse (eds.), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, pp. 199-234.
- Bradley, Travis (2007). Morphological derived-environment effects in gestural coordination: A case study of Norwegian clusters. *Lingua* 117, pp. 950-985. [ROA-834]
- Braine, Martin D.S. (1976). [Review of *The Acquisition of Phonology: A Case Study*]. *Language* 52, pp. 489-498.
- Brame, Michael K. (1974). The cycle in phonology: Stress in Palestinian, Maltese, and Spanish. *Linguistic Inquiry* 5, pp. 39-60.
- Branks, Thomas H., and Judith Branks (1973). Fonología de guambiano. In *Sistemas fonológicos de idiomas colombianos*, vol 2. Bogotá: Ministerio de Gobierno, pp. 39-56.
- Broadwell, George Aaron (2006). *A Choctaw Reference Grammar*. Lincoln: University of Nebraska Press.
- Broekhuis, Hans (2006). Derivations (MP) and Evaluations (OT). In Hans Broekhuis and Ralf Vogel (eds.), *Linguistics in Potsdam 25: Optimality Theory and Minimalism: A Possible Convergence?* Potsdam: Institut für Linguistik, Universität Potsdam, pp. 137-193.
- Broekhuis, Hans (to appear). *Derivations and Evaluations: Object Shift in the Germanic Languages*. Berlin: Mouton de Gruyter.
- Broekhuis, Hans, and Joost Dekkers (2000). The Minimalist Program and Optimality Theory: Derivations and Evaluations. In Joost Dekkers, Frank van der Leeuw, and Jeroen van de Weijer (eds.), *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford: Oxford University Press, pp. 386-422.
- Broekhuis, Hans, and Ralf Vogel (2006). *Linguistics in Potsdam 25: Optimality Theory and Minimalism: A Possible Convergence?* Potsdam: Institut für Linguistik, Universität Potsdam.
- Broselow, Ellen (1999). Stress, epenthesis, and segment transformation in Selayarese loans. In Steve S. Chang, Lily Liaw, and Josef Ruppenhofer (eds.), *Proceedings of the Twenty-Fifth Annual Meeting of the Berkeley Linguistics Society*. Berkeley: BLS, pp. 211-225.

- Brown, Augustus Foss (1958). *The Derivation of English Adjectives Ending -ful*. Ph.D. dissertation, University of Pennsylvania, Philadelphia.
- Browman, Catherine P., and Louis M. Goldstein (1986). Towards an articulatory phonology. *Phonology Yearbook* 3, pp. 219-252.
- Burzio, Luigi (1994). *Principles of English Stress*. Cambridge: Cambridge University Press.
- Burzio, Luigi (2000). Cycles, non-derived-environment-blocking, and correspondence. In Joost Dekkers, Frank van der Leeuw, and Jeroen van de Weijer (eds.), *Optimality Theory: Phonology, Syntax, and Acquisition*. Cambridge: Cambridge University Press.
- Burzio, Luigi (2002a). Surface-to-surface morphology: When your representations turn into constraints. In Paul Boucher (ed.), *Many Morphologies*. Somerville, MA: Cascadilla Press, pp. 142-177.
- Burzio, Luigi (2002b). Missing players: Phonology and the past-tense debate. *Lingua* 112, 157-199.
- Burzio, Luigi (2003). Output-to-output faithfulness: The Italian connection. *Lingue e Linguaggio* 1, pp. 69-104.
- Burzio, Luigi (2005a). Sources of paradigm uniformity. In Laura J. Downing, T.A. Hall, and Renate Raffelsiefen (eds.), *Paradigms in Phonological Theory*. Oxford: Oxford University Press, pp. 65-106.
- Burzio, Luigi (2005b). Lexicon and grammar: Unequal but inseparable. Ms., The Johns Hopkins University, Baltimore.
- Burzio, Luigi (2006). Lexicon versus grammar in English morphophonology: Modularity revisited. *Korean Journal of English Language and Linguistics* 6, pp. 437-464.
- Burzio, Luigi (2007). Phonologically conditioned syncretism. In Fabio Montermini, Gilles Boyé, and Nabil Hathout (eds.), *Selected Proceedings of the 5th Décembrettes: Morphology in Toulouse*. Somerville, MA: Cascadilla Proceedings Project, pp. 1-19. [Lingref #1611]
- Burzio, Luigi, and Niki Tantalou (2007). Modern Greek accent and faithfulness constraints in OT. *Lingua* 117, pp. 1080-1124.
- Bybee, Joan (2005). Restrictions on phonemes in affixes: A crosslinguistic test of a popular hypothesis. *Linguistic Typology* 9, pp. 165-222.
- Bye, Patrik (2001). *Virtual Phonology: Rule Sandwiching and Multiple Opacity in North Saami*. Doctoral dissertation, Universitetet i Tromsø. [ROA-498]

- Bye, Patrik (2006). Allomorphy: Selection, not optimization. To appear in Sylvia Blaho, Patrik Bye, and Martin Kraemer (eds.), *Freedom of Analysis*. Berlin: Mouton de Gruyter.
- Cable, Seth (2000). Constraint rankings that map outputs only onto themselves. Ms., Rutgers University, New Brunswick, NJ.
- Cable, Seth (2004). Phonological noun-verb dissimilarities in Optimal Paradigms. Ms., MIT, Cambridge, MA.
- Cable, Seth (2006). *Syncope in the Verbal Prefixes of Tlingit: Meter and Surface Phonotactics*. München: Lincom Europa.
- Caha, Pavel (2007). The shape of paradigms. Paper presented at 30th Generative Linguists of the Old World Colloquium, Tromsø. [Abstract available at <http://www.hum.uit.no/glow/abstracts/Caha.pdf>]
- Cahill, Michael C. (2007). *Aspects of the Morphology and Phonology of Kǝnni*. Dallas: Summer Institute of Linguistics.
- Campbell, Mary Ann, and Lloyd Anderson (1976). Hocus pocus nursery rhymes. In Salikoko S. Mufwene, Carol A. Walker, and Sanford B. Steever (eds.), *Papers from the 12th Regional Meeting, Chicago Linguistic Society*. Chicago: CLS, pp. 72-95.
- Caramazza, A., and M. Miozzo (1997). The relation between syntactic and phonological knowledge in lexical access: Evidence from the 'tip-of-the-tongue' phenomenon. *Cognition* 64, pp. 309-343.
- Cardona, George (1988). *Pāṇini, His Work and Traditions, vol. 1: Background and Introduction*. Delhi: Motilal Banarsidass.
- Carpenter, Angela (2002). Noncontiguous metathesis and adjacency. In Angela Carpenter, Andries Coetzee, and Paul de Lacy (eds.), *University of Massachusetts Occasional Papers in Linguistics 26: Papers on Optimality Theory II*. Amherst: GLSA, pp. 1-26. [ROA-489]
- Carstairs, Andrew (1987). *Allomorphy in Inflexion*. London: Croon Helm.
- Carstairs, Andrew (1988). Some implications of phonologically-conditioned suppletion. In Geert Booij and Jaap van Marle (eds.), *Yearbook of Morphology 1988*. Dordrecht: Foris, pp. 67-94.
- Carstairs, Andrew (1990). Phonologically conditioned suppletion. In Wolfgang U. Dressler, Hans C. Luschütsky, Oskar E. Pfeiffer, and John R. Rennison (eds.), *Contemporary Morphology*. Berlin: Mouton de Gruyter, pp. 17-23.
- Catford, J.C. (1977). *Fundamental Problems in Phonetics*. Bloomington: Indiana University Press.

- Causley, Trisha (1997). Identity and featural correspondence: The Athapaskan case. In Kiyomi Kusumoto (ed.), *Proceedings of NELS 27*. Amherst: GLSA, pp. 93-105.
- Ćavar, Damir and Chris Wilder (1994). Long head movement? Verb-movement and cliticization in Croatian. *Lingua* 93, pp. 1-58.
- Čavar, Małgorzata (2004). *Palatalization in Polish: An Interaction of Articulatory and Perceptual Factors*. Doctoral dissertation, Universität Potsdam.
- Čavar, Małgorzata (2005). Alternating environment in the analysis of derived environment effects. *IULC Working Papers Online* 5. [Available online at <https://www.indiana.edu/~iulcwp/pdfs/05-cavar.pdf>]
- Chapin, Paul G. (1970). On affixation in English. In Manfred Bierwisch and Karl Erich Heidolph (eds.), *Progress in Linguistics: A Collection of Papers*. The Hague: Mouton, pp. 51-63.
- Chelliah, Shobhana L. (1992). Bracketing paradoxes in Manipuri. In Mark Aronoff (ed.), *Morphology Now*. Albany: State University of New York Press, pp. 33-47.
- Chen, Matthew (1999). Directionality constraints on derivations? In Ben Hermans and Marc van Oostendorp (eds.), *The Derivational Residue in Phonological Optimality Theory*. Amsterdam: John Benjamins, pp. 105-127. [ROA-453]
- Chen-Main, Joan (2007). Rules, constraints, and overlapping violations: The case of Acoma accent loss. In Tatjana Scheffler, Joshua Tauberer, Aviad Eilam, and Laia Mayol (eds.), *Penn Working Papers in Linguistics* 13.1: *Proceedings of the 30th Annual Penn Linguistics Colloquium*. Philadelphia: PLC, pp. 29-42.
- Cho, Mi-Hui, and Shinsook Lee (2000). Ordering problems in phonological acquisition. *Studies in Phonetics, Phonology, and Morphology* 6, pp 137-157.
- Cho, Taehong (1998). Intergestural timing and overlap in Korean palatalization: An Optimality-Theoretic approach. In David Silva (ed.), *Japanese/Korean Linguistics* 8. Stanford: CSLI, pp. 261-276.
- Cho, Taehong (1999). *Specification of Intergestural Timing and Gestural Overlap: EMA and EPG Studies*. MA thesis, University of California, Los Angeles.
- Cho, Taehong (2001). Effects of morpheme boundaries on intergestural timing: Evidence from Korean. *Phonetica* 58, pp. 129-162.
- Cho, Young-mee Yu (to appear). A historical perspective on non-derived environment blocking: The case of Korean palatalization. In Kristin Hanson and Sharon Inkelas (eds.), *The Nature of the Word: Essays in Honor of Paul Kiparsky*. Cambridge, MA: MIT Press.
- Chomsky, Noam (1965). *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press.

- Chomsky, Noam (1973). Conditions on transformations. In Stephen R. Anderson and Paul Kiparsky (eds.), *A Festschrift for Morris Halle*. New York: Holt, Rinehart and Winston, pp. 232-286.
- Chomsky, Noam (1986). *Knowledge of Language: Its Nature, Origin, and Use*. New York: Praeger.
- Chomsky, Noam (1995). *The Minimalist Program*. Cambridge, MA: MIT Press.
- Chomsky, Noam (1999). *Derivation by Phase*. [MIT Occasional Papers in Linguistics 18]. Cambridge, MA: MITWPL.
- Chomsky, Noam (2001). Beyond Explanatory Adequacy. [MIT Occasional Papers in Linguistics 20]. Cambridge, MA: MITWPL.
- Chomsky, Noam, and Morris Halle (1968). *The Sound Pattern of English*. New York: Harper and Row.
- Chomsky, Noam, Morris Halle, and Fred Lukoff (1956). On accent and juncture in English. In Morris Halle, Horace Lunt, Hugh McLean and Cornelius van Schooneveld (eds.), *For Roman Jakobson: Essays on the Occasion of his Sixtieth Birthday*. The Hague: Mouton, pp. 65-80.
- Christensen, Kirsti Koch (1985). Subject clitics and A-bound traces. *Nordic Journal of Linguistics* 8, pp. 1-23.
- Chung, Sandra (1983). Transderivational relationships in Chamorro phonology. *Language* 59, pp. 35-66.
- Clark, Mary (1990). *The Tonal System of Igbo*. Dordrecht: Foris.
- Clayton, Mary L. (1976). The redundancy of underlying morpheme structure conditions. *Language* 52, pp. 295-313.
- Clements, G.N. (1986). Syllabification and epenthesis in the Barra dialect of Gaelic. In Koen Bogers, Harry van der Hulst, and Maarten Mous (eds.), *The Phonological Representation of Suprasegmentals*. Dordrecht: Foris, pp. 317-336.
- Clements, G.N. (1997). Berber syllabification: Derivations or constraints? In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: The Clarendon Press, pp. 289-330.
- Coates, Richard (1987). On a class of solutions to a phonological dilemma. Cognitive Science Research Reports, University of Sussex.
- Coats, Herbert S., and Alex P. Harshenin (1971). On the phonological properties of Russian v. *Slavic and East European Journal* 15, pp. 466-478.

- Coetzee, Andries (2006). Variation as accessing “non-optimal” candidates. *Phonology* 23, pp. 337-385.
- Coetzee, Andries, and Joe Pater (to appear). The place of variation in phonological theory. In John Goldsmith, Jason Riggle, and Alan Yu (eds.), *The Handbook of Phonological Theory, 2nd ed.* Oxford: Blackwell.
- Cohn, Abigail (1989). Stress in Indonesian and bracketing paradoxes. *Natural Language and Linguistic Theory* 7, pp. 167-216.
- Cohn, Abigail (1990). *Phonetic and Phonological Rules of Nasalization*. Ph.D. dissertation, University of California, Los Angeles.
- Cohn, Abigail, and John J. McCarthy (1998). Alignment and parallelism in Indonesian phonology. *Working Papers of the Cornell Phonetics Laboratory* 12, pp. 53-137. [ROA-25]
- Cole, Jennifer S. (1990). Arguing for the phonological cycle: A critical review. In *Proceedings of the First Meeting of the Formal Linguistics Society of Mid-America*. Madison: Department of Linguistics, University of Wisconsin, pp. 101-114.
- Cole, Jennifer S., and John Coleman (1992). No need for cyclicity in generative phonology. In Jeannette Marshall Denton, Grace P. Chan, and Costas P. Canakis (eds.), *Papers from the 28th Regional Meeting of the Chicago Linguistic Society 1992: Volume 2: The Parasession on the Cycle in Linguistic Theory*. Chicago: CLS, pp. 36-50.
- Colina, Sonia (2006). Voicing assimilation in Ecuadoran Spanish: Evidence for Stratal OT. Paper presented at 36th Linguistic Symposium on Romance Languages, New Brunswick, NJ.
- Colinet, Ph. (1896). Het dialect van Aalst. Eene Phonetisch-historische Studie. *Leuvense Bijdragen*, pp. 1-59, 99-206, 223-309.
- Collie, Sarah (2007). *English Stress-Preservation and Stratal Optimality Theory*. Ph.D. thesis, University of Edinburgh. [ROA-965]
- Compton, A.J., and M. Streeter (1977). Child phonology: Data collection and preliminary analyses. *Papers and Reports on Child Language Development* 7. Stanford: Stanford University.
- Cook, Eung-Do (1971). Phonological constraint and syntactic rule. *Linguistic Inquiry* 2, pp. 465-478.
- Cook, Eung-Do (1984). *A Sarcee Grammar*. Vancouver: University of British Columbia Press.

- Cooper, William E., and John Robert Ross (1975). World order. In Robin E. Grossman, L. James San, and Timothy J. Vance (eds.), *Papers from the Parasession on Functionalism*. Chicago: CLS, pp. 63-111.
- Côté, Marie-Hélène (1999). Edge effects in the prosodic hierarchy: Evidence from stops and affricates in Basque. In Pius Tamanji, Masako Hirotsu, and Nancy Hall (eds.), *Proceedings of NELS 29*. Amherst: GLSA, pp. 51-65.
- Côté, Marie-Hélène (2000). *Consonant Cluster Phonotactics: A Perceptual Approach*. Ph.D. dissertation, MIT, Cambridge, MA.
- Côté, Marie-Hélène (2006). Segmental constraints on prosodic phrasing. Paper presented at GLOW Workshop on Prosodic Phrasing, Universitat Autònoma de Barcelona. [Abstract available online at <http://seneca.uab.es/ggt/glow2006/abstracts-phrasing/Helene%20Cote.pdf>]
- Crosswhite, Katherine (1998). Segmental vs. prosodic correspondence in Chamorro. *Phonology* 15, pp. 281-316.
- Cowper, Elizabeth A., and Keren D. Rice (1987). Are phonosyntactic rules necessary? *Phonology Yearbook* 4, pp. 185-194.
- Curnow, Timothy Jowan (1999). Maung verbal agreement revisited: A response to Donohue (1998). *Australian Journal of Linguistics* 19, pp. 141-159.
- Cutillas, Juan Antonio (2003). *Teoría lingüística de la optimidad. Fonología, morfología, y aprendizaje*. Murcia: Servicio de Publicaciones de la Universidad de Murcia.
- Cutler, Anne, and William E. Cooper (1978). Phoneme-monitoring in the context of different phonetic sequences. *Journal of Phonetics* 6, pp. 221-225.
- Darden, Bill (1977). A global rule in Lithuanian phonology. In Woodford A. Beach, Samuel E. Fox, and Shulamith Philosoph (eds.), *Papers from the 13th Regional Meeting, Chicago Linguistic Society*. Chicago: CLS, pp. 116-124.
- Darden, Bill (1979). On the nature of morphophonemic rules. In Paul R. Clyne, William F. Hanks, and Carol L. Hofbauer (eds.), *Papers from the Fifteenth Regional Meeting, Chicago Linguistic Society*. Chicago: CLS, pp. 79-89.
- Davis, Stuart (1999). On the representation of initial geminates. *Phonology* 16, pp. 93-104.
- Davis, Stuart (2005). Capitalistic v. militaristic: The paradigm uniformity effect reconsidered. In Laura J. Downing, T. Alan Hall, and Renate Raffelsiefen (eds.), *Paradigms in Phonological Theory*. Oxford: Oxford University Press, pp. 107-121.
- Deguchi, Masanori (2001). Affrication in Wichita: An Optimality account. *IULC Working Papers Online* 1. [Available online at <https://www.indiana.edu/~iulcwp/pdfs/01-deguchi02.pdf>]

- de Lacy, Paul (2000). Haplology and correspondence. In Paul de Lacy and Anita Nowak (eds.), *University of Massachusetts Occasional Papers in Linguistics 24: Papers from the 25th Anniversary*. Amherst: GLSA, pp. 51-88 [ROA-298]
- de Lacy, Paul (2002). *The Formal Expression of Markedness*. Ph.D. dissertation, University of Massachusetts Amherst. [ROA-542]
- Demuth, Katherine (1995). Markedness and the development of prosodic structure. In Jill N. Beckman (ed.), *Proceedings of NELS 25*. Amherst: GLSA, pp. 13-25. [ROA- 50]
- Di Fabio, Elvira (1990). *The Morphology of the Verbal Infix -isc in Italian and Romance*. Ph.D. dissertation, Harvard University, Cambridge, MA.
- Dinnsen, Daniel A. (1993). Underspecification and phonological disorders. In Mushira Eid and Gregory K. Iverson (eds.), *Principles and Prediction: The Analysis of Natural Language*. Amsterdam: John Benjamins, pp. 287-304.
- Dinnsen, Daniel A. (1998). On the organization and specification of manner features. *Journal of Linguistics* 34, pp. 1-25.
- Dinnsen, Daniel A. (2002). A reconsideration of children's phonological representations. In Barbora Skarabela, Sarah Fish, and Anna H.-J. Do (eds.), *Proceedings of the 26th Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press, pp. 1-23.
- Dinnsen, Daniel A., and Jessica A. Barlow (1998). On the characterization of a chain shift in normal and delayed phonological acquisition. *Journal of Child Language* 25, pp. 61-94.
- Dinnsen, Daniel A., Jessica A. Barlow and Michele L. Morrisette (1997). Long-distance place assimilation with an interacting error pattern in phonological acquisition. *Clinical Linguistics & Phonetics* 11, pp. 319-338.
- Dinnsen, Daniel A., and Laura W. McGarrity (1999). Variation and emerging faithfulness in phonological acquisition. In Annabel Greenhill, Heather Littlefield, and Cheryl Tano (eds.), *BUCLD 23: Proceedings of the 23rd Annual Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press, pp. 172-183.
- Dinnsen, Daniel A., and Laura W. McGarrity (2004). On the nature of alternations in phonological acquisition. *Studies in Phonetics, Phonology, and Morphology* 10, pp. 23-41.
- Dinnsen, Daniel A. and Kathleen M. O'Connor (2001). Typological predictions in developmental phonology. *Journal of Child Language* 28, pp. 597-628.
- Dinnsen, Daniel A., Kathleen M. O'Connor and Judith A. Gierut (2001). The puzzle-puddle-pickle problem and the Duke-of-York gambit in acquisition. *Journal of Linguistics* 37, pp. 503-525.

- Dixon, R.M.W. (1972). *The Dyirbal Language of North Queensland*. Cambridge: Cambridge University Press.
- Dixon, R.M.W. (1977). Semantic neutralization for phonological reasons. *Linguistic Inquiry* 8, pp. 599-602.
- Dolbey, Andrew (1997). Output optimization and cyclic allomorph selection. In Brian Agbayani and Sze-wing Tang (eds.), *Proceedings of the 15th West Coast Conference on Formal Linguistics*. Stanford: CLSI, pp. 97-112.
- Donohue, Mark (1998). A note on verbal agreement in Maung. *Australian Journal of Linguistics* 19, pp. 73-89.
- Drachman, Gaberell, René Kager, and Angeliki Malikouti-Drachman (1996). Greek allomorphy: An Optimality Theory account. *OTS Working Papers* 10, pp. 1-12.
- Drachman, Gaberell, and Angeliki Malikouti-Drachman (1973). Studies in the acquisition of Greek as a native language: I. Some preliminary findings on phonology. *Ohio State University Working Papers in Linguistics* 15, pp. 99-114.
- Duanmu, San (1997). Recursive constraint evaluation in Optimality Theory: Evidence from cyclic compounds in Shanghai. *Natural Language and Linguistic Theory* 15, pp. 465-507.
- Dyen, Isidore (1965). *A Sketch of Trukese Grammar*. New Haven: American Oriental Society.
- Eckman, Fred R., Abdullah Elreyes, and Gregory K. Iverson (2001). Allophonic splits in L2 phonology: The question of learnability. *International Journal of English Studies* 1, pp. 21-51.
- Eckman, Fred R., Abdullah Elreyes, and Gregory K. Iverson (2003). Some principles of second language phonology. *Second Language Research* 19, pp. 169-208.
- Eckman, Fred R., and Gregory K. Iverson (1997). Structure preservation in interlanguage phonology. In S.J. Hannahs & Martha Young-Scholten (eds.), *Focus on Phonological Acquisition*. Amsterdam: John Benjamins, pp. 183-207.
- Eckman, Fred R., and Gregory K. Iverson (2000). Contrast and hypercontrast in interlanguage. *Studies in Phonetics, Phonology and Morphology* 6, pp. 213-247.
- Eddington, David, and José Ignacio Hualde (to appear). *El abundante agua fría: Spanish hermaphroditic nouns*. *Studies in Hispanic and Lusophone Linguistics*.
- Elenbaas, Nine (1999). *A Unified Account of Binary and Ternary Stress: Considerations from Sentani and Finnish*. Ph.D. dissertation, Utrecht University.

- Elenbaas, Nine, and René Kager (1999). Ternary rhythm and the lapse constraint. *Phonology* 16, pp. 273-329.
- Elfner, Emily (2006). Contrastive syllabification in Blackfoot. In Donald Baumer, David Montero, and Michael Scanlon (eds.), *Proceedings of the 25th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project. [lingref # 1442]
- Elfner, Emily (2008). The interaction of linearization and prosody: Evidence from pronoun postposing. Ms., University of Massachusetts, Amherst.
- Embick, David (2000). Features, syntax, and categories in the Latin perfect. *Linguistic Inquiry* 31, pp. 185-230.
- Embick, David, and Alec Marantz (2008). Architecture and blocking. *Linguistic Inquiry* 39, pp. 1-53. [LingBuzz/000262]
- Emonds, Joseph E. (2000). *Lexicon and Grammar: The English Syntacticon*. Berlin: Mouton de Gruyter.
- Emonds, Joseph E. (2002). A common basis for syntax and morphology: Tri-level lexical insertion. In Paul Boucher (ed.), *Many Morphologies*. Somerville, MA: Cascadilla Press, pp. 235-262.
- Escudero, Paola (2005). *The Attainment of Optimal Perception in Second-Language Acquisition*. Doctoral dissertation, Universiteit Utrecht.
- Ettliger, Marc (to appear). Phonological chain shifts during acquisition. In Muhammad Abdurrahman, Anisa Schardl, and Martin Walkow (eds.), *Proceedings of the 38th Annual Meeting of the North East Linguistic Society*. Amherst: GLSA.
- Fabra, Pompeu (1912). *Gramática de la lengua catalana*. Barcelona: L'Avenç.
- Fabra, Pompeu (1956). *Gramàtica catalana*. Barcelona: Teide.
- Fábregas, Antonio (2007). Ordered separationism: The morphophonology of *ir*. In Fabio Montermini, Gilles Boyé, and Nabil Hathout (eds.), *Selected Proceedings of the 5th Décembrettes: Morphology in Toulouse*. Somerville, MA: Cascadilla Proceedings Project, pp. 59-67. [Lingref #1615]
- Farris, Ashley W. (2007). Doubly-derived environment blocking. Paper presented at 81st Linguistic Society of America Annual Meeting, Anaheim.
- Fitzgerald, Colleen (1994). Prosody drives the syntax. In S. Gahl, A. Dolbey, and C. Johnson (eds.), *Proceedings of the Twentieth Annual Meeting of the Berkeley Linguistic Society*. Berkeley: BLS, pp. 173-183. [ROA-27]

- Fitzgerald, Colleen (1996). Degenerate feet and morphology in Tohono O'odham. In Brian Agbayani and Sze-Wing Tang (eds.), *Proceedings of WCCFL 15*. Stanford: CSLI, pp. 129-143.
- Fitzgerald, Colleen (1997). *O'odham Rhythms*. Ph.D. dissertation, University of Arizona, Tucson. [ROA-190]
- Fitzgerald, Colleen (2001). The Morpheme-to-Stress Principle in Tohono O'odham. *Linguistics* 39, pp. 941-972.
- Fitzpatrick, Justin (to appear). A concatenative theory of possible affix types. In Andrés Pablo Salanova (ed.), *Papers from EVELIN 1*. Cambridge, MA: MITWPL.
- Flack, Kathryn (2007a). *The Sources of Phonological Markedness*. Ph.D. dissertation, University of Massachusetts Amherst.
- Flack, Kathryn (2007b). Ambiguity avoidance as contrast preservation: Case and word order freezing in Japanese. In Leah Bateman, Michael O'Keefe, Ehren Reilly, and Adam Werle (eds.), *University of Massachusetts Occasional Papers in Linguistics 32: Papers in Optimality Theory III*. Amherst: GLSA, pp. 57-88. [Longer version available as ROA-748]
- Flemming, Edward (2004). Contrast and perceptual distinctiveness. In Bruce Hayes, Robert Kirchner, and Donca Steriade (eds.), *Phonetically-Based Phonology*. Cambridge: Cambridge University Press, pp. 232-276.
- Flemming, Edward (2005). Deriving natural classes in phonology. *Lingua* 115, pp. 287-309.
- Forster, Kenneth, and Susan Chambers (1973). Lexical access and naming time. *Journal of Verbal Learning and Verbal Behavior* 12, pp. 627-635.
- Fraser, Bruce (1998). A phonological constraint on the alternate to-dative form. Ms., Boston University.
- Fretheim, Thorstein (1988). Den kontraherte negativpartikkelen: 'ke eller 'kke. *Norsk Lingvistik Tidsskrift* 6, pp. 73-88.
- Friedmann, Naama, and Michal Biran (2003). When is gender accessed? A study of paraphrasias in Hebrew anomia. *Cortex* 39, pp. 441-463.
- Fukazawa, Haruka, and Viola Miglio (1998). Restriction conjunction to constraint families. In *Proceedings of the Twenty-Sixth Western Conference on Linguistics*. Santa Cruz: University of California, Santa Cruz, pp. 102-117.
- Fukazawa, Haruka (1999) *Theoretical Implications of OCP Effects on Features in Optimality Theory*. Ph.D. dissertation, University of Maryland, College Park. [ROA-307]

- Fulmer, S. Lee (1991). Dual-position affixes in Afar: An argument for phonologically-driven morphology. In Aaron L. Halpern (ed.), *Proceedings of the Ninth West Coast Conference on Formal Linguistics*. Stanford: CSLI, pp. 189-203.
- Gibson, Masayuki (2008). Opaque allomorph selection: The need for intermediate forms. Paper presented at 82nd Linguistic Society of America Annual Meeting, Chicago.
- Gick, Bryan (1999). A gesture-based account of intrusive consonants in English. *Phonology* 16, pp. 29-54.
- Giegerich, Heinz J. (1988). Strict cyclicity and elsewhere. *Lingua* 75, pp. 125-134.
- Giegerich, Heinz J. (2001). Synonymy blocking and the Elsewhere Condition: Lexical morphology and the speaker. *Transactions of the Philological Society* 99, pp. 65-98.
- Gierut, Judith A. and Annette Hust Champion (1999). Interacting error patterns and their resistance to treatment. *Clinical Linguistics and Phonetics* 13, pp. 421-431.
- Gnanadesikan, Amalia (1997). *Phonology with Ternary Scales*. Ph.D. dissertation, University of Massachusetts, Amherst. [ROA-195]
- Gnanadesikan, Amalia (2004). Markedness and faithfulness constraints in child phonology. In René Kager, Joe Pater, and Wim Zonneveld (eds.), *Fixing Priorities: Constraints in Phonological Acquisition*. Cambridge: Cambridge University Press, pp. 73-108. [ROA-67]
- Gold, E. Mark (1967). Language identification in the limit. *Information and Control* 10, pp. 447-474.
- Goldrick, Matthew (2000). Turbid output representations and the unity of opacity. In Masako Hirotani, Andries Coetzee, Nancy Hall, and Ji-yung Kim (eds.), *Proceedings of the North East Linguistic Society* 30. Amherst: GLSA, pp. 231-246.
- Goldrick, Matthew, and Paul Smolensky (1998). Opacity = turbidity + myopia? Ms., The Johns Hopkins University, Baltimore.
- Goldsmith, John (1976). *Autosegmental Phonology*. Ph.D. dissertation, MIT, Cambridge,
- Goldsmith, John (1993). Harmonic Phonology. In John Goldsmith (ed.), *The Last Phonological Rule: Reflections on Constraints and Derivations*. Chicago: University of Chicago Press, pp. 21-60.
- Goldsmith, John (2008). Generative phonology in the late 1940s. *Phonology* 25, pp. 37-59.
- Golston, Chris (1995). Syntax outranks phonology. *Phonology* 12, pp. 343-368.
- Golston, Chris (1996). Direct Optimality Theory: Representation as pure markedness. *Language* 72, pp. 713-748.

- Gouskova, Maria (2003). *Deriving Economy: Syncope in Optimality Theory*. Ph.D. dissertation, University of Massachusetts, Amherst. [ROA-610]
- Gouskova, Maria, and Nancy Hall (to appear). Acoustics of unstressable vowels in Lebanese Arabic. In Steve Parker (ed.), *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox.
- Green, Antony D. (2005). *Phonology Limited*. Habilitationsschrift, Universität Potsdam. [ROA-745]
- Grimshaw, Jane (1997a). Projection, heads, and optimality. *Linguistic Inquiry* 28, pp. 373-422.
- Grimshaw, Jane (1997b). The best clitic: Constraint conflict in morphosyntax. In Liliane Haegeman (ed.), *Elements of Grammar*. Dordrecht: Kluwer, pp. 169-196.
- Grimshaw, Jane (2003). Economy of structure in OT. In Angela C. Carpenter, Paul de Lacy, and Andries W. Coetzee (eds.), *University of Massachusetts Occasional Papers in Linguistics 26: Papers in Optimality Theory II*. Amherst: GLSA, pp. 81-120. [ROA-434].
- Grimshaw, Jane (2005). *Words and Structure*. Stanford: CSLI.
- Grimshaw, Jane, and Alan Prince (1986). A prosodic account of the to-dative alternation. Ms., Brandeis University, Waltham, MA.
- Grunwell, Pamela (1987). *Clinical Phonology* (2nd ed.). Baltimore: Williams & Wilkins.
- Guo, Taomei, and Danling Peng (2007). Speaking words in the second language: From semantics to phonology in 170 ms. *Neuroscience Research* 57, pp. 387-392.
- Gussenhoven, Carlos (2007). A vowel height split explained: Compensatory listening and speaker control. In Jennifer Cole and José Ignacio Hualde (eds.), *Laboratory Phonology 9*. Berlin: Mouton de Gruyter, pp. 145-172.
- Hahn, Reinhard F. (1991). *Spoken Uyghur*. Seattle: University of Washington Press.
- Hale, Kenneth (1973). Deep-surface canonical disparities in relation to analysis and change: An Australian example. In Thomas Sebeok (ed.), *Current Trends in Linguistics*, vol. 11. The Hague: Mouton, pp. 401-458.
- Hale, Kenneth, and Abanel Lacayo Blanco (1989). *Vocabulario Preliminar del Ulwa (Sumu Meridional)*. Managua: Centro de Investigaciones y Documentación de la Costa Atlántica.

- Hale, Mark, and Madelyn Kisson (1998). The phonology-syntax interface in Rotuman. In Matthew Pearson (ed.), *UCLA Occasional Papers in Linguistics 21: Recent Papers in Austronesian Linguistics: Proceedings of the Third and Fourth Meetings of the Austronesian Formal Linguistics Society*. Los Angeles: UCLA WPL, pp. 115-128.
- Hale, Mark, Madelyn Kisson, and Charles Reiss (1998). Output-output correspondence in Optimality Theory. In Emily Curtis, James Lyle, and Gabriel Webster (eds.), *Proceedings of the West Coast Conference on Formal Linguistics 16*. Stanford: CSLI, pp. 223-236. [ROA-202]
- Hall, Tracy Alan (1989). Lexical phonology and the distribution of German [ç] and [x]. *Phonology* 6, pp. 1-18.
- Hall, T.A. (2006). Derived environment blocking effects in Optimality Theory. *Natural Language and Linguistic Theory* 24, pp. 803-856.
- Hall, T.A., and Silke Hamann (2006). Towards a typology of stop assimilation. *Linguistics* 44, pp. 1195-1236.
- Hall, T.A., Silke Hamann, and Marzena Zygis (2006). The phonetic motivation for phonological stop assimilation. *Journal of the International Phonetic Association* 36, pp. 59-81.
- Hall, T.A., and John G. Scott (2007). Inflectional paradigms have a base: Evidence from s-dissimilation in southern German dialects. *Morphology* 17, pp. 151-178.
- Halle, Morris (1973). The accentuation of Russian words. *Language* 49, pp. 312-348.
- Halle, Morris (1990). An approach to morphology. In Juli Carter, Rose-Marie Déchaine, William Philip, and Tim D. Sherer (eds.), *Proceedings of NELS 20*. Amherst: GLSA, pp. 150-184.
- Halle, Morris (1997). Distributed Morphology: Impoverishment and Fission. In Benjamin Bruening, Yoonjung Kang, and Martha McGinnis (eds.), *MIT Working Papers in Linguistics 30: PF: Papers at the Interface*. Cambridge, MA: MITWPL, pp. 425-449.
- Halle, Morris (2003). Phonological features. In William J. Frawley (ed.), *International Encyclopedia of Linguistics*. Oxford: Oxford University Press, pp. 314-320.
- Halle, Morris, James Harris, and Jean-Roger Vergnaud (1991). A reexamination of the stress erasure convention and Spanish stress. *Linguistic Inquiry* 22, pp. 141-159.
- Halle, Morris, and William Idsardi (1997). r, hypercorrection, and the Elsewhere Condition. In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: The Clarendon Press, pp. 331-348.

- Halle, Morris, and Michael Kenstowicz (1989). On cyclic and noncyclic stress. Ms., MIT, Cambridge, MA.
- Halle, Morris, and Paul Kiparsky (1981). [Review of *Histoire de l'accentuation slave*.] *Language* 57, pp. 150-181.
- Halle, Morris, and Alec Marantz (1993). Distributed Morphology and the pieces of inflection. In Kenneth Hale and Samuel Jay Keyser (eds.), *The View From Building 20: Essays in Linguistics in Honor of Sylvain Bromberger*. Cambridge, MA: MIT Press, pp. 111-176.
- Halle, Morris and Alec Marantz (1994). Some key features of Distributed Morphology. In Andrew Carnie, Heidi Harley, and Tony Bures (eds.), *MIT Working Papers in Linguistics 21: Papers on Phonology and Morphology*. Cambridge, MA: MITWPL, pp. 275-288.
- Halle, Morris, and Ora Matushansky (2002). [α back] assimilation in Russian: An overview. In Anikó Csirmaz, Zhiqiang Li, Andrew Nevins, Olga Vaysman and Michael Wagner (eds.), *MIT Working Papers in Linguistics 42: Phonological Answers (and their Corresponding Questions)*. Cambridge, MA: MITWPL, pp. 69-79.
- Halle, Morris, and K.P. Mohanan (1985). Segmental phonology of modern English. *Linguistic Inquiry* 16, pp. 57-116.
- Halle, Morris and Bert Vaux (1998). Theoretical aspects of Indo-European nominal morphology: The nominal declensions of Latin and Armenian. In Jay Jasanoff, H. Craig Melchert, and Lisi Olivier (eds.), *Mír Curad: Studies in Honor of Calvert Watkins*. Innsbruck: Institut für Sprachwissenschaft der Universität Innsbruck, pp. 223-240.
- Halle, Morris, Bert Vaux, and Andrew Wolfe (2000). On feature spreading and the representation of place of articulation. *Linguistic Inquiry* 31, pp. 387-444.
- Halle, Morris, and Jean-Roger Vergnaud (1981). Harmony processes. In Wolfgang Klein and Willem Levelt (eds.), *Crossing the Boundaries in Linguistics: Studies Presented to Manfred Bierwisch*. Dordrecht: Reidel, pp. 1-22.
- Halle, Morris, and Jean-Roger Vergnaud (1987a). *An Essay on Stress*. Cambridge, MA: MIT Press.
- Halle, Morris, and Jean-Roger Vergnaud (1987b). Stress and the cycle. *Linguistic Inquiry* 18, pp. 45-84.
- Halpern, Aaron (1992). *On the Placement and Morphology of Clitics*. Ph.D. dissertation, Stanford University. [Published 1995, Stanford: CSLI.]
- Hammond, Michael (1989). Cyclic secondary stress and accent in English. In E. Jane Fee and Katherine Hunt (eds.), *Proceedings of the Eighth West Coast Conference on Formal Linguistics*. Stanford: Stanford Linguistics Association, pp. 139-153.

- Hammond, Michael (1992). Deriving the Strict Cycle Condition. In Jeannette Marshall Denton, Grace P. Chan, and Costas P. Canakis (eds.), *Papers from the 28th Regional Meeting of the Chicago Linguistic Society: Volume 2: The Parasession: The Cycle in Linguistic Theory*. Chicago: CLS, pp. 126-140.
- Hammond, Michael (2000). There is no lexicon! *Coyote Papers* 10, pp. 55-77. [ROA-43]
- Hammond, Michael (2003). Frequency, cyclicity, and optimality. Paper presented at Seoul International Korean Phonology Conference, Seoul National University, June 13-14. [Slides available online at <http://www.u.arizona.edu/~hammond/kslides.pdf>]
- Hannahs, S.J., and Maggie Tallerman (2006). At the interface: Selection of the Welsh definite article. *Linguistics* 44, pp. 781-816.
- Hargus, Sharon (1988). *The Lexical Phonology of Sekani*. New York: Garland.
- Hargus, Sharon (1989). Underspecification and derived-only rules in Sekani phonology. In Donna B. Gerds and Karin Michelson (eds.), *Theoretical Perspectives on Native American Languages*. Albany: SUNY Press, pp. 70-103.
- Hargus, Sharon, and Siri G. Tuttle (1997). Augmentation as affixation in Athabaskan languages. *Phonology* 14, pp. 177-220.
- Harley, Heidi (1994). Hug a tree: Deriving the morphosyntactic feature hierarchy. In Andrew Carnie, Heidi Harley, and Tony Bures (eds.), *MIT Working Papers in Linguistics 21: Papers on Phonology and Morphology*. Cambridge, MA: MITWPL, pp. 289-320.
- Harley, Heidi, and Elizabeth Ritter (2002). Person and number in pronouns: A feature-geometric analysis. *Language* 78, pp. 482-526.
- Harrell, Richard S. (1962). *A Grammar of Moroccan Arabic: With an Appendix of Texts in Urban Moroccan Arabic by Louis Brunot*. Washington: Georgetown University Press.
- Harris, James (1983). *Syllable Structure and Stress in Spanish: A Nonlinear Analysis*. Cambridge, MA: MIT Press.
- Harris, James (1987). Disagreement rules, referral rules, and the Spanish feminine article *el*. *Journal of Linguistics* 23, pp. 177-183.
- Harris, James (1989). The stress erasure convention and cliticization in Spanish. *Linguistic Inquiry* 20, pp. 339-363.
- Harris, James (1991). The exponence of gender in Spanish. *Linguistic Inquiry* 22, 27-62.

- Harris, John (1990). Derived phonological contrasts. In Susan Ramsaran (ed.), *Studies in the Pronunciation of English: A Commemorative Volume in Honour of A.C. Gimson*. London: Routledge, pp. 87-105.
- Hart, George (1981). *Nasality and the Organization of Autosegmental Phonology*. Bloomington: IULC.
- Hawkins, John A., and Garry Gilligan (1988). Prefixing and suffixing universals in relation to basic word order. *Lingua* 74, pp. 219-259.
- Hay, Jennifer, and Joan Bresnan (2006). Spoken syntax: The phonetics of *giving a hand* in New Zealand English. *The Linguistic Review* 23, pp. 321-349.
- Hayes, Bruce (1984). The phonetics and phonology of Russian voicing assimilation. In Mark Aronoff and Richard T. Oehrle (eds.), *Language Sound Structure: Studies in Phonology Presented to Morris Halle by his Teacher and Students*. Cambridge, MA: MIT Press, pp. 318-328.
- Hayes, Bruce (1986). Inalterability in CV phonology. *Language* 62, pp. 321-351.
- Hayes, Bruce (1989a). Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20, pp. 253-306.
- Hayes, Bruce (1989b). The prosodic hierarchy in meter. In Paul Kiparsky and Gilbert Youmans (eds.), *Rhythm and Meter*. Orlando: Academic Press, pp. 201-260.
- Hayes, Bruce (1990). Precompiled phrasal phonology. In Sharon Inkelas and Draga Zec (eds.), *The Phonology-Syntax Connection*. Stanford: CLSI, pp. 85-108.
- Hayes, Bruce (1995). *Metrical Stress Theory: Principles and Case Studies*. Chicago: University of Chicago Press.
- Hayes, Bruce (2004). Phonological acquisition in Optimality Theory: The early stages. In René Kager, Joe Pater, and Wim Zonneveld (eds.), *Fixing Priorities: Constraints in Phonological Acquisition*. Cambridge: Cambridge University Press, pp. 158- 203.
- Hayes, Bruce, Bruce Tesar, and Kie Zuraw (2003). OTSoft 2.1. [Software available online at <http://www.linguistics.ucla.edu/people/hayes/otsoft/>]
- Heath, Jeffery (1984). *Functional Grammar of Nunggubuyu*. Canberra: Australian Institute of Aboriginal Studies.
- Henaff Gonon, M.A., R. Bruckert, and F. Michel (1989). Lexicalization in an anomic patient. *Neuropsychologia* 27, pp. 391-407.
- Henderson, Brent Mykel (2004). PF evidence for phases and Distributed Morphology. In Keir Moulton and Matthew Wolf (eds.), *Proceedings of the Thirty-Fourth Annual Meeting of the North East Linguistic Society*. Amherst: GLSA, pp. 255-265.

- Hetzron, Robert (1972). Phonology in syntax. *Journal of Linguistics* 8, pp. 251-262.
- Hewitt, Mark S., and Megan J. Crowhurst (1996). Conjunctive constraints and templates in Optimality Theory. In Kiyomi Kusumoto (ed.), *Proceedings of the North East Linguistic Society* 26. Amherst: GLSA, pp. 101-116.
- Hittmair-Delazer, M., C. Semenza, R. De Bleser, and T. Benke (1994). Naming by German compounds. *Journal of Neurolinguistics* 8, pp. 27-41.
- Hockett, Charles F. (1954). Two models of grammatical description. *Word* 10, pp. 210-231.
- Hojjer, Harry (1971). Athapaskan morphology. In J. Sawyer (ed.), *Studies in American Indian Languages*. Berkeley: University of California Press, pp. 113-147.
- Horwood, Graham (2001). Anti-faithfulness and subtractive morphology. Ms., Rutgers University, New Brunswick. [ROA-466]
- Horwood, Graham (2002). Precedence faithfulness governs morpheme position. In Line Mikkelsen and Christopher Potts (eds.), *Proceedings of the Twenty-First West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Press, pp. 166-179. [ROA-527]
- Howard, Philip G. (1990). *A Dictionary of the Verbs of South Slavey*. Yellowknife: Department of Culture and Communication, Government of the Northwest Territories.
- Howe, Darin (2004). Vocalic dorsality in Revised Articulator Theory. Ms., University of Calgary.
- Hualde, José Ignacio (1989). The Strict Cycle Condition and noncyclic rules. *Linguistic Inquiry* 20, pp. 675-680.
- Hualde, José Ignacio (1990). Compensatory lengthening in Friulian. *Probus* 2, pp. 31-46.
- Hualde, José Ignacio (1996). Accentuation and empty vowels in Ondarroa Basque: Against the concept of phonological derivation. *Lingua* 99, pp. 197-206.
- Hudson, Grover (1974). The representation of non-productive alternation. In John M. Anderson and Charles C. Jones (eds.), *Historical Linguistics II: Theory and Description in Phonology*. Amsterdam: North-Holland, pp. 203-229.
- van der Hulst, Harry, and Norval Smith (1984). Prosodic domains and opaque segments in autosegmental theory. In Harry van der Hulst and Norval Smith (eds.), *The Structure of Phonological Representations, vol. 2*. Dordrecht: Foris, pp. 311-336.

- Hume, Elizabeth (1990). Front vowels, palatal consonants, and the rule of umlaut in Korean. In Juli Carter, Rose-Marie Déchaine, William Philip, and Tim D. Sherer (eds.), *Proceedings of NELS 20*. Amherst: GLSA, pp. 230-243.
- Hume, Elizabeth (2001). Metathesis: Formal and functional considerations. In Elizabeth Hume, Norval Smith, and Jeroen van de Weijer (eds.), *Surface Syllable Structure and Segment Sequencing*. Leiden: HiL, pp. 1-25.
- Hurch, Bernhard (1994). Morphoprosody: Some reflections on accent and morphology. In Rajendra Singh and Richard Desroches (eds.), *Trubetzkoy's Orphan: Proceedings of the Montréal Roundtable "Morphology: Contemporary Responses"*. Amsterdam: John Benjamins, pp. 189-221.
- Hyman, Larry (1985). *A Theory of Phonological Weight*. Dordrecht: Foris.
- Hyman, Larry (1990). Conceptual issues in the comparative study of the Bantu verb stem. Paper presented at 21st Conference of African Linguistics, University of Georgia.
- Hyman, Larry (1993). Problems for rule ordering in phonology: Two Bantu test cases. In John Goldsmith (ed.), *The Last Phonological Rule: Reflections on Constraints and Derivations*. Chicago: University of Chicago Press, pp. 195-222.
- Hyman, Larry (1994). Cyclic phonology and morphology in Cibemba. In Jennifer Cole and Charles Kisseberth (eds.), *Perspectives in Phonology*. Stanford: CLSI, pp. 81-112.
- Hyman, Larry (2002). Cyclicity and base non-identity. In David Restle and Dietmar Zaefferer (eds.), *Sounds and Systems: Studies in Structure and Change: A Festschrift for Theo Venneman*. Berlin: Mouton de Gruyter, pp. 223-239.
- Hyman, Larry, and Cemil Orhan Orgun (2005). Endocyclicity and paradigm non-uniformity. In Cemil Orhan Orgun and Peter Sells (eds.), *Morphology and the Web of Grammar: Essays in Memory of Steven G. Lapointe*. Stanford: CSLI, pp. 7-23.
- Idsardi, William J. (1997). Sympathy creates chaos. Ms., University of Delaware, Newark.
- Idsardi, William J. (1998). Tiberian Hebrew spirantization and phonological derivations. *Linguistic Inquiry* 29, pp. 37-73.
- Idsardi, William J. (2006). Canadian Raising, opacity, and rephonemicization. *Canadian Journal of Linguistics/Revue canadienne de linguistique* 51, pp. 119-126.
- Inkelas, Sharon (1988). Prosodic effects on syntax: Hausa *fa*. In Hagit Borer (ed.), *Proceedings of the Seventh West Coast Conference on Formal Linguistics*. Stanford: Stanford Linguistics Association, pp. 375-388.

- Inkelas, Sharon (1995). The consequences of optimization for underspecification. In Jill N. Beckman (ed.), *Proceedings of the North East Linguistic Society 25*. Amherst: GLSA, pp. 287-302. [ROA-40]
- Inkelas, Sharon (2000). Phonotactic blocking through structural immunity. In Barbara Stiebels and Dieter Wunderlich (eds.), *Lexicon in Focus*. Berlin: Akademie Verlag, pp. 7-40. [ROA-366]
- Inkelas, Sharon, and Young-mee Yu Cho (1993). Inalterability as prespecification. *Language* 69, pp. 569-574.
- Inkelas, Sharon, and Cemil Orhan Orgun (1995). Level ordering and economy in the lexical phonology of Turkish. *Language* 71, pp. 763-793.
- Inkelas, Sharon, Cemil Orhan Orgun, and Cheryl Zoll (1997). Implications of lexical exceptions for the nature of grammar. In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: Clarendon Press, pp. 393-418.
- Innes, Gordon (1967). *A Practical Introduction to Mende*. London: SOAS.
- Ishihara, Shiniciro (2007). Major Phrase, focus intonation, multiple spell-out (MaP, FI, MSO). *The Linguistic Review* 24, pp. 137-167.
- Ishii, Toru (1996). An Optimality Theoretic approach to ternary stress systems. In B. Agbayani and N. Harada (eds.), *UCI Working Papers in Linguistics 2: Proceedings of the South Western Optimality Theory Workshop (SWOT II)*. Irvine: Irvine WPL, pp. 95-111.
- Itô, Junko (1989). A prosodic theory of epenthesis. *Natural Language and Linguistic Theory* 7, pp. 217-259.
- Itô, Junko (1990). *Prosodic Minimality in Japanese*. Technical report SRC-90-04, Syntax Research Center, University of California, Santa Cruz.
- Itô, Junko, and Armin Mester (1996). Structural economy and OCP interactions in local domains. Talk presented at Western Conference on Linguistics, University of California, Santa Cruz.
- Itô, Junko, and Armin Mester (1998). Markedness and word structure: OCP effects in Japanese. Ms., University of California, Santa Cruz. [ROA-255]
- Itô, Junko, and Armin Mester (1999). The phonological lexicon. In Natsuko Tsujimura (ed.), *The Handbook of Japanese Linguistics*. Oxford: Blackwell, pp. 62-100.
- Itô, Junko, and Armin Mester (2001a) Covert generalizations in Optimality Theory: the role of stratal faithfulness constraints. *Studies in Phonetics, Phonology, and Morphology* 7, pp. 273-299.

- Itô, Junko, and Armin Mester (2001b). Structure preservation and stratal opacity in German. In Linda Lombardi (ed.), *Segmental Phonology in Optimality Theory: Constraints and Representations*. Cambridge: Cambridge University Press, pp. 261-295.
- Itô, Junko, and Armin Mester (2003a). Lexical and postlexical phonology in Optimality Theory: Evidence from Japanese. *Linguistische Berichte Sonderheft 11: Resolving conflicts in grammars*, pp. 183-207.
- Itô, Junko, and Armin Mester (2003b). On the sources of opacity in OT: Coda processes in German. In Caroline Féry and Ruben van de Vijver (eds.), *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press, pp. 271-303. [ROA-347]
- Iverson, Gregory K. (1987). The Revised Alternation Condition in Lexical Phonology. *Nordic Journal of Linguistics* 10, pp. 151-164.
- Iverson, Gregory K. (1992). Lexical vs. postlexical rule application in Catalan. In Mushira Eid and Gregory K. Iverson (eds.), *Principles and Prediction: The Analysis of Natural Language*. Amsterdam: John Benjamins, pp. 339-350.
- Iverson, Gregory K. (1993). (Post)lexical rule application. In Ellen Kaisse and Sharon Hargus (eds.), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, pp. 255-275.
- Iverson, Gregory K. (2004). Deriving the Derived Environment Constraint in nonderivational phonology. *Studies in Phonetics, Phonology, and Morphology* 11, pp. 1-23.
- Iverson, Gregory K., and Joe Salmons (1992). The place of Structure Preservation in German diminutive formation. *Phonology* 9, pp. 137-143.
- Iverson, Gregory K., and Joseph C. Salmons (2003). Legacy specification in the laryngeal phonology of Dutch. *Journal of Germanic Linguistics* 15, pp. 1-26.
- Iverson, Gregory K., and Deirdre W. Wheeler (1988). Blocking and the Elsewhere Condition. In Michael Hammond and Michael Noonan (eds.), *Theoretical Morphology: Approaches in Modern Linguistics*. San Diego: Academic Press, pp. 325-338.
- Jackendoff, Ray (1997). Twistin' the night away. *Language* 73, pp. 534-559.
- Jaeggli, Osvaldo (1980). Spanish diminutives. In F.H. Neussel (ed.), *Contemporary Studies in Romance Languages*. Bloomington: IULC.
- Jakobson, Roman (1948). Russian conjugation. *Word* 4, pp. 155-167.

- Jakobson, Roman (1968). *Child Language, Aphasia, and Phonological Universals*. The Hague: Mouton.
- Janda, Richard D. (1983). "Morphemes" aren't something that grows on trees: Morphology as more the phonology than the syntax of words. In John F. Richardson, Mitchell Marks, and Amy Chukerman (eds.), *Papers from the Parasession on the Interplay of Phonology, Morphology and Syntax*. Chicago: CLS, pp. 79-95.
- Janda, Richard D. (1998). Comments on the paper by Perlmutter. In Steven G. Lapointe, Diane K. Brentari, and Patrick M. Farrell (eds.), *Morphology and its Relation to Phonology and Syntax*. Stanford: CLSI Publications, pp. 339-359.
- Janda, Richard D., and Fabiola Varela-García (1991). On lateral hermaphroditism and other variation in Spanish "feminine" *el*. In Lise M. Dobrin, Lynn Nichols, and Rosa M. Rodríguez (eds.), *Papers from the 27th Regional Meeting of the Chicago Linguistic Society: Part One: The General Session*. Chicago: CLS, pp. 276-290.
- Jaeger, T. Florian (to appear). Phonological optimization and syntactic variation: The case of optional *that*. *Proceedings of BLS 32*.
- Jensen, John (1995). Constraints and opaque interactions. *Cahiers Linguistiques d'Ottawa* 23, pp. 1-9.
- Jescheniak, Jörg D., Anja Hahne, and Herbert Schriefers (2003). Information flow in the mental lexicon during speech planning: Evidence from event-related brain potentials. *Cognitive Brain Research* 15, pp. 261-276.
- Jescheniak, J.D., and H. Schriefers (1999). Strictly discrete serial stages and contextual appropriateness. *The Behavioral and Brain Sciences* 22, pp. 47-48.
- Jesney, Karen (2005). *Chain Shift in Phonological Acquisition*. MA thesis, University of Calgary.
- Jesney, Karen (2007). Child chain shifts as faithfulness to input prominence. In Alyona Belikova, Luisa Meroni & Mari Umeda (eds.), *Proceedings of the 2nd Conference on Generative Approaches to Language Acquisition - North America (GALANA 2)*. Somerville, MA: Cascadilla Proceedings Project, pp. 188-199. [lingref # 1560]
- Jun, Jongho (1999). Generalized sympathy. In Pius N. Tamanji, Masako Hirotsu, and Nancy Hall (eds.), *Proceedings of the North East Linguistic Society 29*. Amherst: GLSA, pp. 121-135.
- Kabak, Barış, and Anthi Revithiadou (2007). An interface approach to prosodic recursivity. Paper presented at 15th Manchester Phonology Meeting.
- Kager, René (1995). English stress: Re-inventing the paradigm. *Glott International* 9/10, pp. 19-21.

- Kager, René (1996). On affix allomorphy and syllable counting. In Ursula Kienhenz (ed.), *Interfaces in Phonology*. Berlin: Akademie Verlag, pp. 155-71. [ROA-88]
- Kager, René (1997). Rhythmic vowel deletion in Optimality Theory. In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: The Clarendon Press, pp. 463-499.
- Kager, René (to appear). Lexical irregularity and the typology of contrast. In Kristin Hanson and Sharon Inkelas (eds.), *The Nature of the Word: Essays in Honor of Paul Kiparsky*. Cambridge, MA: MIT Press.
- Kahnemuyipour, Arsalan (2004). *The Syntax of Sentential Stress*. Ph.D. dissertation, University of Toronto.
- Kaisse, Ellen M. (1985). *Connected Speech: The Interaction of Syntax and Phonology*. Orlando: Academic Press.
- Kaisse, Ellen M. (1986). Locating Turkish devoicing. In Mary Dalrymple, Jeffrey Goldberg, Kristin Hanson, Michael Inman, Chris Piñon, and Stephen Wechsler (eds.), *Proceedings of the West Coast Conference on Formal Linguistics, vol. 5*. Stanford: SLA, pp. 119-128.
- Kaisse, Ellen M. (1990). Toward a typology of postlexical rules. In Sharon Inkelas and Draga Zec (eds.), *The Phonology-Syntax Connection*. Chicago: University of Chicago Press, pp. 127-143.
- Kaisse, Ellen M., and Sharon Hargus (1993). Introduction. In Sharon Hargus and Ellen M. Kaisse (eds.), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, pp. 1-19.
- Kaisse, Ellen M., and Patricia A. Shaw (1985). On the theory of Lexical Phonology. *Phonology Yearbook 2*, pp. 1-30.
- Karlsson, Fred (1982). *Suomen kielen äänne- ja muotorakenne*. Helsinki: Werner Söderström Osakeyhtiö.
- Karlsson, Fred (2008). *Finnish: An Essential Grammar* (2nd ed.). London: Routledge.
- Kawahara, Shigeto (2004). Locality in echo epenthesis: Comparison with reduplication. In Keir Moulton and Matthew Wolf (eds.), *Proceedings of the Thirty-Fourth Annual Meeting of the North East Linguistic Society*. Amherst: GLSA, pp. 295-309.
- Kawahara, Shigeto (2006). A faithfulness ranking projected from a perceptibility scale: The case of [+voice] in Japanese. *Language* 82, pp. 536-574.
- Kawahara, Shigeto (2007). Sonorancy and geminacy. In Leah Bateman, Michael O'Keefe, Ehren Reilly, and Adam Werle (eds.), *University of Massachusetts Occasional Papers in Linguistics 32: Papers in Optimality Theory III*. Amherst: GLSA, pp. 145-186.

- Kawahara, Shigeto, and Matthew Wolf (in prep.). A root-initial-accenting suffix in Japanese: -zu. Ms., University of Georgia/Rutgers University and University of Massachusetts Amherst/Georgetown University.
- Kaye, Alan S. (2005). Gemination in English. *English Today* 21, pp. 43-55.
- Kaye, Jonathan D. (1981). La sélection des formes pronominales en vata. *Revue québécoise de linguistique* 11, pp. 117-135.
- Kean, Mary-Louise (1974). The strict cycle in phonology. *Linguistic Inquiry* 5, pp. 179-203.
- Keating, Patricia A. (1985). Universal phonetics and the organization of grammars. In Victoria A. Fromkin (ed.), *Phonetic Linguistics: Essays in Honor of Peter Ladefoged*. Orlando: Academic Press, pp. 115-132.
- Kenstowicz, Michael (1982). Gemination and spirantization in Tigrinya. *Studies in the Linguistic Sciences* 12, pp. 103-122.
- Kenstowicz, Michael (1995). Cyclic vs. non-cyclic constraint evaluation. *Phonology* 12, pp. 397-436.
- Kenstowicz, Michael (1996). Base identity and uniform exponence: Alternatives to cyclicity. In Jacques Durand and Bernard Laks (eds.), *Current Trends in Phonology: Models and Methods*. Salford, Manchester: European Studies Research Institute, University of Salford, pp. 363-394. [ROA-103]
- Kenstowicz, Michael (2005). Paradigmatic uniformity and contrast. In Laura J. Downing, T. Allen Hall, and Renate Raffelsiefen (eds.), *Paradigms in Phonological Theory*. Oxford: Oxford University Press, pp. 145-169.
- Kenstowicz, Michael, and Charles Kisseberth (1970). Rule ordering and the asymmetry hypothesis. In *Papers from the 6th Regional Meeting of the Chicago Linguistic Society*. Chicago: CLS, pp. 504-519.
- Kenstowicz, Michael, and Charles W. Kisseberth (1977). *Topics in Phonological Theory*. New York: Academic Press.
- Keyser, S.J., and Paul Kiparsky (1984). Syllable structure in Finnish phonology. In Mark Aronoff and Richard T. Oehrle (eds.), *Language Sound Structure: Studies in Phonology Presented to Morris Halle by his Teacher and Students*. Cambridge, MA: MIT Press, pp. 7-31.
- Kibre, Nicholas J. (1997). *A Model of Mutation in Welsh*. Bloomington: IULC.
- Kikuchi, Seiichiro (2001). Spanish definite article allomorphy: A correspondence approach. *Phonological Studies* 4, pp. 49-56.

- Kikuchi, Seiichiro (2006). On Galician definite article allomorphy. *On'in Kenkyu [Phonological Studies]* 9, pp. 41-48.
- Kim, Gyung-Ran (2002). Korean palatalization in Optimality Theory: Against the strict parallelism. *Studies in Phonetics, Phonology, and Morphology* 8, pp. 1-15.
- Kim, Jieun (to appear). Focus realization: Not by focus-to-accent but by prosodic structure. In Muhammad Abdurrahman, Anisa Schardl, and Martin Walkow (eds.), *Proceedings of the Thirty-Eighth Annual Meeting of the North East Linguistic Society*. Amherst: GLSA.
- Kim, Jin-hyung (2005). A reconsideration of phonological leveling: A case of noun inflection in Korean. *Studies in Phonetics, Phonology, and Morphology* 11, pp. 83-98.
- Kimball, Geoffrey D. (1991). *Koasati Grammar*. Lincoln: University of Nebraska Press.
- Kiparsky, Paul (1966). Über den deutschen Akzent. *Studia Grammatica* 7, pp. 69-97.
- Kiparsky, Paul (1968). Linguistic universals and language change. In Emmon Bach and Robert T. Harms (eds.), *Universals in Linguistic Theory*. New York: Holt, Rinehart and Winston, pp. 171-202.
- Kiparsky, Paul (1972). Explanation in phonology. In Stanley Peters (ed.), *Goals of Linguistic Theory*. Englewood Cliffs, NJ: Prentice-Hall, pp. 189-227.
- Kiparsky, Paul (1973a). Phonological representations. In Osamu Fujimura (ed.), *Three Dimensions of Linguistic Theory*. Tokyo: TEC, pp. 1-135.
- Kiparsky, Paul (1973b). "Elsewhere" in phonology. In Stephen R. Anderson and Paul Kiparsky (eds.), *A Festschrift for Morris Halle*. New York: Holt, Rinehart and Winston, pp. 93-106.
- Kiparsky, Paul (1982a). From cyclic phonology to lexical phonology. In Harry van der Hulst and Norval Smith (eds.), *The Structure of Phonological Representations*, vol. 1. Dordrecht: Foris, pp. 131-175.
- Kiparsky, Paul (1982b). Lexical phonology and morphology. In I.S. Yang (ed.), *Linguistics in the Morning Calm*. Seoul: Hanshin, pp. 3-91.
- Kiparsky, Paul (1983). Word formation and the lexicon. In F. Ingeman (ed.), *Proceedings of the 1982 Mid-America Linguistics Conference*. Lawrence: University of Kansas, pp. 3-29.
- Kiparsky, Paul (1984). On the lexical phonology of Icelandic. In Claes-Christian Elert, Iréne Johansson, and Eva Strangert (eds.), *Nordic Prosody III*. Umeå: University of Umeå, pp. 135-164.

- Kiparsky, Paul (1985). Some consequences of Lexical Phonology. *Phonology Yearbook* 2, pp. 85-138.
- Kiparsky, Paul (1993a). Blocking in nonderived environments. In Ellen Kaisse and Sharon Hargus (eds.), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, pp. 277-313.
- Kiparsky, Paul (1993b). Variable rules. Talk presented at Rutgers Optimality Workshop I, October, Rutgers University, New Brunswick, NJ.
- Kiparsky, Paul (1994). Allomorphy or morphophonology? In Rajendra Singh and Richard Desroches (eds.), *Trubetzkoy's Orphan: Proceedings of the Montréal Roundtable "Morphonology: Contemporary Responses"*. Amsterdam: John Benjamins, pp. 13-31.
- Kiparsky, Paul (1997). LP and OT. Course handout from LSA Summer Institute, Cornell University, Ithaca, NY.
- Kiparsky, Paul (2000). Opacity and cyclicity. *The Linguistic Review* 17, pp. 351-367.
- Kiparsky, Paul (2002). Syllables and moras in Arabic. In Caroline Féry and Ruben van de Vijver (eds.), *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press, pp. 147-182.
- Kiparsky, Paul (2005). Blocking and periphrasis in inflectional paradigms. In Geert Booij and Jaap van Marle (eds.), *Yearbook of Morphology 2004*. Dordrecht: Springer, pp. 113-136.
- Kiparsky, Paul (2007a). Reduplication in Stratal OT. To appear in Linda Uyechi and L.-H. Wee (eds.), *Reality, Exploration, and Discovery: Pattern Interaction in Language and Life*. Stanford: CSLI.
- Kiparsky, Paul (2007b). Description and explanation: English revisited. Paper presented at 81st Linguistic Society of America Annual Meeting, Anaheim. [Slides available online at <http://www.stanford.edu/~kiparsky/Papers/lisa2007.1.pdf>]
- Kiparsky, Paul (2008). Fenno-Swedish quantity: Contrast in Stratal OT. In Bert Vaux and Andrew Nevins (eds.), *Rules, Constraints, and Phonological Phenomena*. Oxford: Oxford University Press.
- Kiparsky, Paul (to appear). *Paradigmatic Effects*. Stanford: CSLI.
- Kiparsky, Paul, and Lise Menn (1977). On the acquisition of phonology. In John Macnamara (ed.), *Language Learning and Thought*. New York: Academic Press, pp. 47-78.
- Kirchner, Robert (1996) Synchronic chain shifts in Optimality Theory. *Linguistic Inquiry* 27, pp. 341-350.

- Kirchner, Robert (1998). *An Effort-Based Approach to Consonant Lenition*. Ph.D. dissertation, University of California, Los Angeles.
- Kisseberth, Charles (1970). On the functional unity of phonological rules. *Linguistic Inquiry* 1, pp. 291-306.
- Kisseberth, Charles (1973). Is rule ordering necessary in phonology? In Braj B. Kachru, Robert B. Lees, Yakov Malkiel, Angelina Pietrangeli, and Sol Saporta (eds.), *Issues in Linguistics: Papers in Honor of Henry and Renée Kahane*. Urbana: University of Illinois Press, pp. 418-441.
- Kisseberth, Charles, and Mohammed Imam Abasheikh (1975). The perfect stem in Chi-Mwi:ni and global rules. *Studies in African Linguistics* 6, pp. 249-266.
- Koontz-Garboden, Andrew J. (2003). Tiberian Hebrew spirantization and related phenomena in Stratal OT. Ms., Stanford University. [ROA-607]
- Kornfilt, Jaklin (1984). The Stuttering Prohibition and morpheme deletion in Turkish. In Ayhan Aksu Koç and Eser Erguvanli Taylan (eds.), *Proceedings of the Turkish Linguistics Conference*. Istanbul: Bogaziçi University Publications, pp. 59-83.
- Kraska-Szlenk, Iwona (1995). *The Phonology of Stress in Polish*. Ph.D. dissertation, University of Illinois, Urbana-Champaign.
- Kraska-Szlenk, Iwona (1997) Exceptions in phonological theory. *Proceedings of the 16th International Congress of Linguists*. Paper No. 0173. Oxford: Pergamon.
- Kraska-Szlenk, Iwona (1999) Syllable structure constraints in exceptions. In John R. Rennison and Klaus Kühnhammer (eds.), *Phonologica 1996: Syllables!?*. The Hague: Thesus, pp. 113--131.
- Kraska-Szlenk, Iwona (2007). *Analogy: The Relation between Lexicon and Grammar*. München: Lincom Europa.
- Kratzer, Angelika, and Elisabeth Selkirk (2007). Phase theory and prosodic spellout: The case of verbs. *The Linguistic Review* 24, pp. 93-135.
- Kristoffersen, Gjert (2000). *The Phonology of Norwegian*. Oxford: Oxford University Press.
- Kurisu, Kazutaka (2001). *The Phonology of Morpheme Realization*. Ph.D. dissertation, University of California, Santa Cruz. [ROA-490]
- Kurisu, Kazutaka (2007). Weak derived environment effects. In Emily Elfner and Martin Walkow (eds.), *Proceedings of the 37th Annual Meeting of the North East Linguistic Society*, vol. 2. Amherst: GLSA, pp. 29-42.
- Kuznetsova, Julia (2007). Morphologically-driven C-center effect in Russian. Paper presented at 81st Linguistic Society of America Annual Meeting, Anaheim.

- Labov, William (1994). *Principles of Linguistic Change, vol. 1: Internal Factors*. Oxford: Blackwell.
- Labov, William (2008). Defining the site of linguistic variation. Talk presented at the Workshop on Locating Variability, Amherst, April 25. [Slides available online at <http://www.ling.upenn.edu/~wlabov/PowerPoints/LocVar.ppt>]
- Lahiri, Aditi, and Paula Fikkert (1999). Trisyllabic shortening in English: Past and present. *English Language and Linguistics* 3, pp. 229-267.
- Lahne, Antje (2006). When features are not deleted: Contextual allomorphy in Sanskrit noun declension. In Gereon Müller and Jochen Trommer (eds.), *Subanalysis of Argument Encoding in Distributed Morphology* [*Linguistische Arbeits Berichte* 84]. Leipzig: Universität Leipzig, pp. 143-160. [LingBuzz/000374]
- Lamarque, Jacques (1996). Gender agreement and suppletion in French. In Karen Zagana (ed.), *Grammatical Theory and Romance Languages*. Amsterdam: John Benjamins, pp. 145-157.
- Lapointe, Steven (1999). Stem selection and OT. In Geet Booij and Jaap van Marle (eds.), *Yearbook of Morphology 1999*. Dordrecht: Kluwer, pp. 263-297.
- Lapointe, Steven G., and Peter Sells (1996). Separating syntax and phonology in Optimality Theory: The case of suppletive segment/∅ allomorphy. Ms., University of California, Davis and Stanford University.
- Lee, Ming-Wei, and Julie Gibbons (2007). Rhythmic alternation and the optional complementizer in English: New evidence of phonological influence on grammatical encoding. *Cognition* 105, pp. 446-456.
- Legate, Julie Anne (1999). The morphosyntax of Irish agreement. In Karlos Arregi, Benjamin Bruening, Cornella Krause, and Vivian Lin (eds.), *MIT Working Papers in Linguistics 32: Papers on Morphology and Syntax, Cycle One*. Cambridge, MA: MITWPL.
- Legate, Julie Anne (2003). Some interface properties of the phase. *Linguistic Inquiry* 34, pp. 506-516.
- Legendre, Géraldine (2000a). For an OT conception of a parallel interface: Evidence from Basque V2. In Masako Hirotani, Andries Coetzee, Nancy Hall, and Ji-yung Kim (eds.), *Proceedings of NELS 30*. Amherst: GLSA.
- Legendre, Géraldine (2000b). Positioning Romanian verbal clitics at PF: An Optimality-Theoretic analysis. In Birgit Gerlach and Janet Grijzenhout (eds.), *Clitics from Different Perspectives*. Amsterdam: John Benjamins, pp. 219-254.

- Legendre, Géraldine (2000c). Morphological and prosodic alignment of Bulgarian clitics. In Joost Dekkers, Frank van der Leeuw, and Jeroen van de Weijer (eds.), *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford: Oxford University Press, pp. 423-462.
- Lehiste, Ilse (1970). *Suprasegmentals*. Cambridge, MA: MIT Press.
- Leslau, Wolf (1941). *Documents tigrigna (éthiopien septentrional): Grammaire et textes*. Paris: Klincksieck.
- Lesley-Neuman, Diane (2007). *ATR Harmony in Karimojong: Justification for a Stratal Optimality Theory*. MA thesis, University of Colorado, Boulder. [ROA-930]
- Levelt, Willem J.M. (1989). *Speaking: From Intention to Articulation*. Cambridge, MA: MIT Press.
- Levelt, Willem J.M. (1993). Lexical selection, or how to bridge the major rift in language processing. In F. Beckmann and G. Heyer (eds.), *Theorie und Praxis des Lexicons*. Berlin: Walter de Gruyter.
- Levelt, Willem J.M., Ardi Roelofs, and Antje S. Meyer (1999). A theory of lexical access in speech production. *The Behavioral and Brain Sciences* 22, pp. 1-38.
- Levy, Yonata (1983). The acquisition of Hebrew plurals: The case of the missing gender category. *Journal of Child Language* 10, pp. 107-121.
- Lewis, Geoffrey L. (1967). *Turkish Grammar*. Oxford: Clarendon Press.
- Lieber, Rochelle (1980). *On the Organization of the Lexicon*. Ph.D. dissertation, MIT, Cambridge, MA.
- Lieber, Rochelle (1987). *An Integrated Theory of Autosegmental Processes*. Albany: SUNY Press.
- Liberman, Mark, and Alan Prince (1977). On stress and linguistic rhythm. *Linguistic Inquiry* 8, pp. 249-336.
- Lightner, Theodore (1972). *Problems in the Theory of Phonology: I. Russian Phonology and Turkish Phonology*. Edmonton: Linguistic Research, Inc.
- Löfstedt, Ingvar (to appear). Perceptually driven allomorphy: The Swedish non-neuter singular definite article. In Muhammad Abdurrahman, Anisa Schardl, and Martin Walkow (eds.), *Proceedings of the Thirty-Eighth Annual Meeting of the North East Linguistic Society*. Amherst: GLSA.
- Lombardi, Linda (1998). Evidence for MaxFeature constraints from Japanese. In Haruka Fukazawa, Frida Morelli, Caro Struijke, and Yi-Ching Su (eds.), *University of Maryland Working Papers in Linguistics* 7. College Park: UMDWPL, pp. 41-62.

- Lombardi, Linda (1999). Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language and Linguistic Theory* 17, pp. 267-302.
- Lombardi, Linda (2001). Why place and voice are different. In Linda Lombardi (ed.), *Segmental Phonology in Optimality Theory: Constraints and Representations*. Cambridge: Cambridge University Press, pp. 13-45. [ROA-105]
- López, Luis (to appear). Ranking the LCA. *Linguistic Inquiry*. [lingbuzz/000670]
- Łubowicz, Anna (2002). Derived environment effects in Optimality Theory. *Lingua* 112, pp. 243-280.
- Łubowicz, Anna (2003a). *Contrast Preservation in Phonological Mappings*. Ph.D. dissertation, University of Massachusetts Amherst. [ROA-554]
- Łubowicz, Anna (2003b). Local conjunction and comparative markedness. *Theoretical Linguistics* 29, pp. 101-112.
- Łubowicz, Anna (2005). Locality of conjunction. In John Alderete, Chung-hye Han, and Alexei Kochetov (eds.), *Proceedings of the 24th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 254-263. [lingref #1230]
- Łubowicz, Anna (2006). Opaque allomorphy in OT. In Donald Baumer, David Montero, and Michael Scanlon (eds.), *Proceedings of the 25th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 261-269.
- Łubowicz, Anna (in press). Paradigmatic contrast in Polish. *Journal of Slavic Linguistics*.
- MacBride, Alexander (2004). *A Constraint-Based Approach to Morphology*. Ph.D. dissertation, University of California, Los Angeles.
- Macfarland, Talke, and Janet Pierrehumbert (1992). On ich-laut, ach-laut, and Structure Preservation. *Phonology* 9, pp. 171-180.
- Macken, Marlys A. (1980). The child's lexical representation: the 'puzzle-puddle-pickle' evidence. *Journal of Linguistics* 16, pp. 1-17.
- Malkiel, Yakov (1959). Studies in irreversible binomials. *Lingua* 8, pp. 113-160.
- Malkiel, Yakov (1968). *Essays on Linguistic Themes*. Oxford: Basil Blackwell.
- Marantz, Alec (1995a). A late note on Late Insertion. In Y.-S. Kim, K.-J. Lee, B.-C. Lee, H.-K. Yang, and J.-Y. Yoon (eds.), *Explorations in Generative Grammar: A Festschrift for Dong-Whee Yang*. Seoul: Hankuk, pp. 396-413.
- Marantz, Alec (1995b). "Cat" as a phrasal idiom: Consequences of Late Insertion in Distributed Morphology. Ms., MIT, Cambridge, MA.

- Marantz, Alec (1997). No escape from syntax: Don't try morphological analysis in the privacy of your own lexicon. In Alexis Dimitriadis, Laura Siegel, Clarissa Surek-Clark, and Alexander Williams (eds.), *University of Pennsylvania Working Papers in Linguistics 4.2: Proceedings of the 21st Annual Penn Linguistics Colloquium*. Philadelphia: Penn Linguistics Club, pp. 201-225.
- Marantz, Alec (2001). *Words*. Ms., MIT, Cambridge, MA.
- Martin, Andrew (2005). *The Effects of Distance on Lexical Bias: Sibilant Harmony in Navajo*. MA Thesis, University of California, Los Angeles.
- Martin, Andrew (2007). *The Evolving Lexicon*. Ph.D. dissertation, University of California, Los Angeles.
- Marušič, Franc (2003). **Aff-STEM-ix: On discontinuous morphology*. Ms., Stony Brook University.
- Marvin, Tatjana (2002). *Topics in the Stress and Syntax of Words*. Ph.D. dissertation, MIT, Cambridge, MA.
- Mascaró, Joan (1976). *Catalan Phonology and the Phonological Cycle*. Ph.D. dissertation, MIT, Cambridge, MA.
- Mascaró, Joan (1996a). External allomorphy and contractions in Romance. *Probus* 8, pp. 181-205.
- Mascaró, Joan (1996b). External allomorphy as emergence of the unmarked. In Jacques Durand and Bernard Laks (eds.), *Current Trends in Phonology: Models and Methods*. Salford, Manchester: European Studies Research Institute, University of Salford, pp. 473-83.
- Mascaró, Joan (2007). External allomorphy and lexical representation. To appear in *Linguistic Inquiry* 38.4.
- Matthei, Edward (1989). Crossing boundaries: More evidence for phonological constraints on early multi-word utterances. *Journal of Child Language* 16, pp. 41-54.
- Matthews, Peter H. (1965). The inflectional component of a Word-and-Paradigm grammar. *Journal of Linguistics* 1, pp. 139-171.
- Matthews, Peter H. (1967). The main features of Modern Greek verb inflection. *Foundations of Language* 3, pp. 262-284.
- Matthews, Peter H. (1972a). *Inflectional Morphology: A Theoretical Study Based on Aspects of Latin Verb Conjugation*. Cambridge: Cambridge University Press.

- Matthews, Peter H. (1972b). Huave verb morphology: Some comments from a non-tagmemic standpoint. *International Journal of American Linguistics* 38, pp. 96-118.
- Matthews, Peter H. (1974). *Morphology: An Introduction to the Theory of Word Structure*. Cambridge: Cambridge University Press.
- McCarthy, John J. (1979). *Formal Problems in Semitic Phonology and Morphology*. Ph.D. dissertation, MIT, Cambridge, MA.
- McCarthy, John J. (1981). A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry* 12, pp. 373-418.
- McCarthy, John J. (1983a). Consonantal morphology in the Chaha verb. In Michael Barlow, Daniel P. Flickinger, and Michael T. Westcoat (eds.), *Proceedings of the Second West Coast Conference on Formal Linguistics*. Stanford: Stanford Linguistics Association, pp. 176-188.
- McCarthy, John J. (1983b). Phonological features and morphological structure. In John F. Richardson, Mitchell Marks, and Amy Chukerman (eds.), *Papers from the Parasession on the Interplay of Phonology, Morphology and Syntax*. Chicago: CLS, pp. 135-161.
- McCarthy, John J. (1998). Morpheme structure constraints and paradigm occultation. In M. Catherine Gruber, Derrick Higgins, Kenneth Olson, and Tamra Wysocki (eds.), *CLS 32, vol. 2: Papers from the Panels*. Chicago: CLS, pp. 123-150.
- McCarthy, John J. (1999). Sympathy and phonological opacity. *Phonology* 16, pp. 331-399.
- McCarthy, John J. (2000). Harmonic serialism and parallelism. In Masako Hirovani, Andries Coetzee, Nancy Hall, and Ji-yung Kim (eds.), *Proceedings of the North East Linguistic Society 30*. Amherst: GLSA, pp. 501-524. [ROA-357]
- McCarthy, John J. (2003a). Sympathy, cumulativity, and the Duke-of-York gambit. In Caroline Féry and Ruben van de Vijver (eds.), *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press, pp. 23-76.
- McCarthy, John J. (2003b). Comparative Markedness. *Theoretical Linguistics* 29, pp. 1-51.
- McCarthy, John J. (2003c). What does Comparative Markedness explain, what should it explain, and how? *Theoretical Linguistics* 29, pp. 141-155.
- McCarthy, John J. (2003d). OT constraints are categorical. *Phonology* 20, pp. 75-138.
- McCarthy, John J. (2004). Headed spans and autosegmental spreading. Ms., University of Massachusetts Amherst. [ROA-685]

- McCarthy, John J. (2005a). Optimal Paradigms. In Laura J. Downing, T.A. Hall, and Renate Raffelsiefen (eds.), *Paradigms in Phonological Theory*. Oxford: Oxford University Press, pp. 170-210.
- McCarthy, John J. (2005b) Taking a free ride in morphophonemic learning. *Catalan Journal of Linguistics* 4, pp. 19-55.
- McCarthy, John J. (2007a). *Hidden Generalizations: Phonological Opacity in Optimality Theory*. London: Equinox.
- McCarthy, John J. (2007b). Restraint of Analysis. In Sylvia Blaho, Patrik Bye, and Martin Kraemer (eds.), *Freedom of Analysis*. Berlin: Mouton de Gruyter.
- McCarthy, John J. (2007c). Consonant harmony via correspondence: Evidence from Chumash. In Leah Bateman, Michael O'Keefe, Ehren Reilly, and Adam Werle (eds.), *University of Massachusetts Occasional Papers in Linguistics 32: Papers in Optimality Theory III*. Amherst: GLSA, pp. 223-237. [ROA-879]
- McCarthy, John J. (2007d). Slouching towards optimality: Coda reduction in OT-CC. *On'in Kenkyu [Phonological Studies]*. [ROA-878]
- McCarthy, John J. (to appear a). The gradual path to cluster simplification. *Phonology*.
- McCarthy, John J. (to appear b). The serial interaction of stress and syncope. *Natural Language and Linguistic Theory*.
- McCarthy, John J., and Alan S. Prince (1990). Foot and word in Prosodic Morphology: The Arabic broken plurals. *Natural Language and Linguistic Theory* 8, pp. 209-282.
- McCarthy, John J., and Alan Prince (1993a). *Prosodic Morphology I: Constraint Interaction and Satisfaction*. Ms., University of Massachusetts Amherst and Rutgers University, New Brunswick, NJ. [ROA-482]
- McCarthy, John J., and Alan Prince (1993b). Generalized Alignment. In Geert Booij and Jaap van Marle (eds.), *Yearbook of Morphology 1993*. Dordrecht: Kluwer, pp. 79-153. [ROA-7]
- McCarthy, John J., and Alan Prince (1994). The Emergence of the Unmarked: Optimality in Prosodic Morphology. In Mercè González (ed.), *Proceedings of the North East Linguistic Society 24*. Amherst: GLSA, pp. 333-379. [ROA-13]
- McCarthy, John J., and Alan Prince (1995). Faithfulness and reduplicative identity. In Jill N. Beckman, Suzanne Urbanczyk, and Laura Walsh Dickey (eds.), *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*. Amherst: GLSA, pp. 249-384. [ROA-60]

- McCarthy, John J., and Alan Prince (1999). Faithfulness and identity in Prosodic Morphology. In René Kager, Harry van der Hulst, and Wim Zonneveld (eds.), *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press, pp. 218-309. [ROA-216]
- McCawley, James D. (1974). [Review of *The Sound Pattern of English*]. *International Journal of American Linguistics* 40, pp. 50-88.
- McDonald, Janet L., Kathryn Bock, and Michael H. Kelly (1993). Word and world order: Semantic, phonological, and metrical determinants of serial position. *Cognitive Psychology* 25, pp. 188-230.
- McDonough, Joyce (1990). *Topics in the Phonology and Morphology of Navajo Verbs*. Ph.D. dissertation, University of Massachusetts, Amherst.
- McHugh, Brian D. (1986). Cyclicity in phrasal phonology: Evidence from Chaga. In Mary Dalrymple, Jeffrey Goldberg, Kristin Hanson, Michael Inman, Chris Piñon, and Stephen Wechsler (eds.), *Proceedings of the West Coast Conference on Formal Linguistics, Volume 5*. Stanford: SLA, pp. 154-164.
- McHugh, Brian D. (1990). The phrasal cycle in Kivunjo Chaga tonology. In Sharon Inkelas and Draga Zec (eds.), *The Phonology-Syntax Connection*. Chicago: University of Chicago Press, pp. 217-242.
- McKay, Graham (1984). Stop alternations in Ndjébbana (Kunibidji). *Papers in Australian Linguistics* 16, pp. 107-117.
- McKay, Graham (2000). Ndjébbana. In R.M.W. Dixon and Barry Blake (eds.), *The Handbook of Australian Languages*, vol. 5. Oxford: Oxford University Press, pp. 155-353.
- McMahon, April (2000). *Chance, Change, and Optimality*. Oxford: Oxford University Press.
- Meir, Irit (2006). Morphological levels and diachronic change in Modern Hebrew plural formation. *Studies in Language* 30, pp. 777-806.
- Menn, Lise, and Brian MacWhinney (1984). The repeated morph constraint: Toward an explanation. *Language* 60, pp. 519-541.
- Merchant, Jason (1997). Alignment and fricative assimilation in German. *Linguistic Inquiry* 27, pp. 709-719.
- Mester, Armin (1994). The quantitative trochee in Latin. *Natural Language and Linguistic Theory* 12, pp. 1-61.

- Michaels, Jennifer, and Ashtamurthy Killimangalam (2007). Syntactically-conditioned phonology: Agentive suffixes in Malayalam. Paper presented at 81st Linguistic Society of America Annual Meeting, Anaheim, CA.
- Michelson, Karin (1988). *A Comparative Study of Lake-Iroquoian Accent*. Dordrecht: Reidel.
- Michelson, Karin (1989). Invisibility: Vowels without a timing slot in Mohawk. In Donna B. Gerdts and Karin Michelson (eds.), *Theoretical Perspectives on Native American Languages*. Albany: State University of New York Press, pp. 38-69.
- Miller, D. Gary (1972). A case for derivational history in Greek. *Papers in Linguistics* 5, pp. 46-72.
- Miller, D. Gary (1975). On constraining global rules in phonology. *Language* 51, pp. 128-132.
- Miller, Philip, Geoffrey K. Pullum, and Arnold M. Zwicky (1992). Le principe d'inaccessibilité de la phonologie par la syntaxe: trois contre-exemples apparents en français. *Linguisticæ Investigationes* 16, pp. 317-343.
- Miller, Philip, Geoffrey K. Pullum, and Arnold M. Zwicky (1997). The Principle of Phonology-Free Syntax: Four apparent counter-examples in French. *Journal of Linguistics* 33, pp. 67-90.
- Mohanan, Karuvannur Puthanveetil (1982). *Lexical Phonology*. Ph.D. dissertation, MIT, Cambridge, MA.
- Mohanan, K.P., and Tara Mohanan (1984). Lexical Phonology of the consonant system in Malayalam. *Linguistic Inquiry* 15, pp. 575-602.
- Montler, Timothy R., and Heather K. Hardy (1991). The phonology of negation in Alabama. *International Journal of American Linguistics* 57, pp. 1-23.
- Morén, Bruce, and Elizabeth C. Zsiga (2006). The lexical and post-lexical phonology of Thai tones. *Natural Language and Linguistic Theory* 24, pp. 113-178.
- Moreton, Elliott (1999). Non-computable functions in Optimality Theory. Ms., University of Massachusetts Amherst. [ROA-364]
- Moreton, Elliott (2000). Faithfulness and potential. Ms., University of Massachusetts, Amherst.
- Moreton, Elliott, and Paul Smolensky (2002). Typological consequences of local constraint conjunction. In Line Mikkelsen and Christopher Potts (eds.), *Proceedings of the Twenty-First West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Press, pp. 306-319. [ROA-525]

- Mortensen, David (2004). Abstract scales in phonology. Ms., University of California, Berkeley [ROA-667]
- Murane, Elizabeth (1974). *Daga Grammar: From Morpheme to Discourse*. Norman: Summer Institute of Linguistics.
- Mutaka, Ngessimo M. (1994). *The Lexical Tonology of Kinande*. München: Lincom Europa.
- Myers, James, and Jane Tsay (2002). Neutralization in Taiwanese tone sandhi. Ms., National Chung Cheng University, Min-Hsiung, Chia-Yi, Taiwan.
- Myers, Scott (1987). Vowel shortening in English. *Natural Language and Linguistic Theory* 5, pp. 485-518.
- Myers, Scott (1991). Structure preservation and the Strong Domain Hypothesis. *Linguistic Inquiry* 22, pp. 379-385.
- Nagy, Naomi, and Bill Reynolds (1997). Optimality Theory and word-final deletion in Faetar. *Language Variation and Change* 9, pp. 37-55.
- Nathan, Geoffrey S. (1981). What's these facts about? *Linguistic Inquiry* 12, pp. 151-153.
- Nespor, Marina, and Irene Vogel (1986). *Prosodic Phonology*. Dordrecht: Foris.
- Norton, Russell J. (2003). *Derivational Phonology and Optimality Phonology: Formal Comparison and Synthesis*. D.Phil. thesis, University of Essex, Colchester. [ROA-613]
- Noyer, Robert Rolf (1992). *Features, Positions, and Affixes in Autonomous Morphological Structure*. Ph.D. dissertation, MIT, Cambridge, MA. [Published 1997, New York: Garland.]
- Noyer, Rolf (1993). Optimal Words: Towards a declarative theory of word-formation. Paper presented at ROW-1, New Brunswick, NJ.
- Noyer, Rolf (1994). Mobile affixes in Huave: Optimality and morphological wellformedness. In Erin Duncan, Donka Farkas, and Philip Spaelti (eds.), *Proceedings of the Twelfth West Coast Conference on Formal Linguistics*. Stanford: CLSI, pp. 67-82.
- Oakeshott-Taylor, John (1984). Phonetic factors in word order. *Phonetica* 41, pp. 226-237.
- Oden, Gregg C., and Lola L. Lopes (1981). Preference for order in freezes. *Linguistic Inquiry* 12, pp. 673-679.
- Odden, David (1981). *Problems in Tone Assignment in Shona*. Ph.D. dissertation, University of Illinois, Urbana-Champaign.

- Odden, David (1990). Phonology and its interaction with syntax and morphology. *Studies in the Linguistic Sciences* 20.2, pp. 69-108.
- Odden, David (1993). Interaction between modules in Lexical Phonology. In Sharon Hargus and Ellen M. Kaisse (eds.), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, p.. 111-144.
- Oldfield, R.C., and A. Wingfield (1965). Response latencies in naming objects. *Quarterly Journal of Experimental Psychology* 17, pp. 273-281.
- Oltra Massuet, Isabel, and Karlos Arregi (2005). Stress-by-structure in Spanish. *Linguistic Inquiry* 36, pp. 43-84.
- van Oostendorp, Marc (1998). Non-derivational opacity in allomorph selection. Talk presented at GLOW Workshop on Opacity in Phonology, Tilburg University. [Handout available online at <http://www.vanoostendorp.nl/pdf/opacity.pdf>]
- van Oostendorp, Marc (2000). *Phonological Projection: A Theory of Feature Content and Prosodic Structure*. Berlin: Mouton de Gruyter. [Revision of 1995 doctoral thesis, Tilburg University, available as ROA-84]
- van Oostendorp, Marc (2004). Phonological recoverability in dialects of Dutch. Ms., Meertens Institute, Amsterdam. [Available online at <http://meertens.knaw.nl/medewerkers/marc.van.oostendorp/recoverable.pdf>]
- van Oostendorp, Marc (2007). Derived environment effects and consistency of exponence. In Sylvia Blaho, Patrik Bye, and Martin Kraemer (eds.), *Freedom of Analysis*. Berlin: Mouton de Gruyter.
- van Oostendorp, Marc (to appear). Dutch diminutives and the question mark. In Curt Rice (ed.), *Modeling Ungrammaticality in Optimality Theory*. London: Equinox.
- Orešnik, Janez (1977). Modern Icelandic u-umlaut from the descriptive point of view. *Gripla* 2, pp. 151-182.
- Orgun, Cemil Orhan (1994). Monotonic cyclicity and Optimality Theory. In Mercè González (ed.), *Proceedings of the North East Linguistic Society 24*. Amherst: GLSA, pp. 461-474.
- Orgun, Cemil Orhan (1996a). Correspondence and identity constraints in two-level Optimality Theory. In José Camacho, Lina Choueiri, and Maki Watanabe (eds.), *Proceedings of the West Coast Conference on Formal Linguistics 14*. Stanford: CSLI, pp. 399-413. [ROA-62]
- Orgun, Cemil Orhan (1996b). *Sign-Based Morphology and Phonology: With Special Attention to Optimality Theory*. Ph.D. dissertation, University of California, Berkeley. [ROA-171]

- Orgun, Cemil Orhan (1999). Sign-Based Morphology: A declarative theory of phonology-morphology interleaving. In Ben Hermans and Marc van Oostendorp (eds.), *The Derivational Residue in Phonological Optimality Theory*. Amsterdam: John Benjamins, pp. 247-267.
- Orgun, Cemil Orhan, and Andrew Dolbey (2007). Phonology-morphology interaction in a constraint-based framework. In Gillian Ramchand and Charles Reiss (eds.), *The Oxford Handbook of Linguistic Interfaces*. Oxford: Oxford University Press.
- Ota, Mitsuhiro (2004) The learnability of the stratified phonological lexicon. *Journal of Japanese Linguistics* 20, pp. 19-40. [ROA-668]
- Padgett, Jaye (1991). *Stricture in Feature Geometry*. Ph.D. dissertation, University of Massachusetts, Amherst.
- Padgett, Jaye (to appear). Russian voicing assimilation, final devoicing, and the problem of [v]. *Natural Language and Linguistic Theory*.
- Pak, Marjorie (2005). Explaining branchingness effects in phrasal phonology. In John Alderete, Chung-hye Han, and Alexei Kochetov (eds.), *Proceedings of the 24th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 308-316. [lingref #1236]
- Pak, Marjorie, and Michael Friesner (2006). French phrasal phonology in a derivational model of PF. In Christopher M. Davis, Amy Rose Deal, and Youri Zabbal (eds.), *Proceedings of the 36th Annual Meeting of the North East Linguistic Society*. Amherst: GLSA.
- Pam, Martin David (1973). *Tigrinya Phonology*. Ph.D. dissertation, City University of New York.
- Paradis, Carole (1997). Non-transparent constraint effects in Gere: From cycles to derivations. In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: The Clarendon Press, pp. 529-550.
- Parker, Stephen G. (2002). *Quantifying the Sonority Hierarchy*. Ph.D. dissertation, University of Massachusetts Amherst.
- Parker, Steve (to appear). An affix-specific phoneme in Arammba. In Steve Parker (ed.), *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox.
- Paster, Mary (2005a). Subcategorization vs. output optimization in syllable-counting allomorphy. In John Alderete, Chung-hye Han, and Alexei Kochetov (eds.), *Proceedings of the Twenty-Fourth West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 326-333. [Lingref # 1238]

- Paster, Mary (2005b). Pulaar verbal extensions and phonologically conditioned affix order. In Geert Booij and Jaap van Marle (eds.), *Yearbook of Morphology 2005*. Dordrecht: Springer, pp. 155-199.
- Paster, Mary (2006). *Phonological Conditions on Affixation*. Ph.D. dissertation, University of California, Berkeley.
- Paster, Mary (to appear). Phonologically conditioned suppletive allomorphy: Cross-linguistic results and theoretical consequences. In Bernard Tranel (ed.), *Understanding Allomorphy: Perspectives from Optimality Theory*. London: Equinox.
- Pater, Joe (1997). Minimal violation and phonological development. *Language Acquisition* 6, pp. 201-253.
- Pater, Joe (1999). Austronesian nasal substitution and other *NÇ effects. In René Kager, Harry van der Hulst, and Wim Zonneveld (eds.), *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press, pp. 310-43.
- Pater, Joe (2000). Nonuniformity in English secondary stress: The role of ranked and lexically-specific constraints. *Phonology* 17, pp. 237-274.
- Pater, Joe (2001). Austronesian nasal substitution revisited. In Linda Lombardi (ed.) *Segmental Phonology in Optimality Theory: Constraints and Representations*. Cambridge: Cambridge University Press, pp. 159-182.
- Pater, Joe (2005) Learning a stratified grammar. In Alejna Brugos, Manuella R. Clark-Cotton, and Seungwan Ha (eds.) *Proceedings of the 29th Boston University Conference on Language Development*. Somerville, MA: Cascadilla Press, pp. 482-492. ROA-739.
- Pater, Joe (to appear). Morpheme-specific phonology: Constraint indexation and inconsistency resolution. In Steve Parker (ed.), *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox.
- Pater, Joe, Rajesh Bhatt, and Christopher Potts (2007). Linguistic optimization. Ms., University of Massachusetts Amherst. [ROA-924]
- Payne, David (1981). *The Phonology and Morphology of Axininca Campa*. Arlington, TX: Summer Institute of Linguistics.
- Payne, David (1990). Accent in Aguaruna. In Doris L. Payne (ed.), *Amazonian Linguistics: Studies in Lowland South American Languages*. Austin: University of Texas Press, pp. 161-184.
- Perlmutter, David M. (1998). Interfaces: Explanation of allomorphy and the architecture of grammars. In In Steven G. Lapointe, Diane K. Brentari, and Patrick M. Farrell (eds.), *Morphology and its Relation to Phonology and Syntax*. Stanford: CSLI Publications, pp. 307-338.

- Pesetsky, David (1979). Russian morphology and lexical theory. Ms., MIT, Cambridge, MA.
- Pesetsky, David (1985). Morphology and logical form. *Linguistic Inquiry* 16, pp. 193-246.
- Pfau, Roland (2000). *Features and Categories in Language Production*. Doctoral dissertation, Johan-Wolfgang-Goethe-Universität, Frankfurt am Main.
- Picanço, Gessiane (2002) Tonal polarity as phonologically conditioned allomorphy in Mundurukú. In Julie Larson & Mary Paster (eds.), *Proceedings of the 28th Annual Meeting of the Berkeley Linguistics Society*. pp. 237-48. Berkeley, CA: Berkeley Linguistics Society, pp. 237-248.
- Pierrehumbert, Janet (2006). The statistical basis of an unnatural alternation. In Louis Goldstein, D.H. Whalen, and Catherine T. Best (eds.), *Laboratory Phonology VIII: Varieties of Phonological Competence*. Berlin: Mouton de Gruyter, pp. 81-107.
- Pierrehumbert, Janet, and Julia Hirschberg (1990). The meaning of intonation in the interpretation of discourse. In Philip R. Cohen, Jerry Morgan, and Martha E. Pollack (eds.), *Intentions in Communication*. Cambridge, MA: MIT Press, pp. 271-311.
- Piggott, Glyne, and Heather Newell (2006). Syllabification, stress, and derivation by phase in Ojibwa. Ms., McGill University, Montréal.
- Pinker, Steven (1999). *Words and Rules: The Ingredients of Language*. New York: Basic Books.
- Pinker, Steven, and David Birdsong (1979). Speakers' sensitivity to rules of frozen word order. *Journal of Verbal Learning and Verbal Behavior* 18, pp. 497-508.
- Pinker, Steven, and Alan Prince (1988). On language and connectionism: Analysis of a parallel distributed processing model of language acquisition. *Cognition* 28, pp. 73-193.
- Plag, Ingo (1999). *Morphological Productivity: Structural Constraints in English Derivation*. Berlin: Mouton de Gruyter.
- Plank, Frans (1984). Romance disagreements: Phonology interfering with syntax. *Journal of Linguistics* 20, pp. 329-350.
- Pluymaekers, Mark, Mirjam Ernestus, Harald Baayen and Geert Booij (to appear). The role of morphology in fine phonetic detail: The case of Dutch *-igheid*. In Cécile Fougeron (ed.), *Laboratory Phonology 10: Variation, Detail, and Representation*. Berlin: Mouton de Gruyter.
- Polgárdi, Krisztina (1998). *Vowel Harmony: An Account in Terms of Government and Optimality*. Ph.D. dissertation, HIL.

- Poser, William J. (1982). Phonological representation and action-at-a-distance. In Harry van der Hulst and Norval Smith (eds.), *The Structure of Phonological Representations*. Dordrecht: Foris, pp. 121-158.
- Poser, William J. (1990). Word-internal phrase boundary in Japanese. In Sharon Inkelas and Draga Zec (eds.), *The Phonology-Syntax Connection*. Chicago: University of Chicago Press, pp. 279-287.
- Poser, William J. (1993). Are strict cycle effects derivable? In Sharon Hargus and Ellen M. Kaisse (eds.), *Phonetics and Phonology 4: Studies in Lexical Phonology*. San Diego: Academic Press, pp. 315-321.
- Posner, Rebecca (1985). Non-agreement on Romance disagreements. *Journal of Linguistics* 21, pp. 437-451.
- Potter, Brian (1994). Serial Optimality and Mohawk prosody. In Katherine Beals, Jeannette Denton, Robert Knippen, Lynette Melmar, Hisami Suzuki, and Erica Zeinfeld (eds.), *Proceedings of the Thirtieth Annual Regional Meeting of the Chicago Linguistic Society*. Chicago: CLS, pp. 347-361.
- Potts, Christopher (2005). Lexicalized intonational meaning. In Shigeto Kawahara (ed.), *University of Massachusetts Occasional Papers in Linguistics 30: Papers on Prosody*. Amherst: GLSA, pp. 129-146.
- Potts, Christopher, and Geoffrey K. Pullum (2002). Model theory and the content of OT constraints. *Phonology* 19, pp. 361-393.
- Prince, Alan (1975). *The Phonology and Morphology of Tiberian Hebrew*. Ph.D. dissertation, MIT, Cambridge, MA.
- Prince, Alan (1983). Relating to the grid. *Linguistic Inquiry* 14, pp. 19-100.
- Prince, Alan (1990) Quantitative consequences of rhythmic organization. In Karen Deaton, Manuela Noske, and Michael Ziolkowski (eds.), *Parasession on the Syllable in Phonetics and Phonology*. Chicago: Chicago Linguistic Society, pp. 355-398.
- Prince, Alan (2002). *Entailed Ranking Arguments*. Ms., Rutgers University, New Brunswick, NJ. [ROA-500]
- Prince, Alan (2003). Arguing optimality. In Angela C. Carpenter, Paul de Lacy, and Andries W. Coetzee (eds.), *University of Massachusetts Occasional Papers in Linguistics 26: Papers in Optimality Theory II*. Amherst: GLSA, pp. 269-304.
- Prince, Alan (2007). The pursuit of theory. In Paul de Lacy (ed.), *The Cambridge Handbook of Phonology*. Cambridge: Cambridge University Press, pp. 33-60.
- Prince, Alan, and Paul Smolensky (2004 [1993]). *Optimality Theory: Constraint Interaction in Generative Grammar*. Oxford: Blackwell. [ROA-537]

- Prince, Alan, and Bruce Tesar (2004). Learning phonotactic distributions. In René Kager, Joe Pater, and Wim Zonneveld (eds.), *Fixing Priorities: Constraints in Phonological Acquisition*. Cambridge: Cambridge University Press, pp. 245-291. [ROA-353]
- Pruitt, Kathryn (in prep.). Concerning foot assignment, and Sundry Matters, rationally explicated with Due Attention to the nature of Alignment Const's. Ms., University of Massachusetts Amherst.
- Pulleyblank, Douglas (1983). *Tone in Lexical Phonology*. Ph.D. dissertation, MIT, Cambridge, MA.
- Pullum, Geoffrey K., and Arnold M. Zwicky (1988). The syntax-phonology interface. In Frederick J. Newmeyer (ed.), *Linguistics: The Cambridge Survey; Volume I, Linguistic Theory: Foundations*. Cambridge: Cambridge University Press, pp. 255-280.
- Pyatt, Elizabeth (2003). Relativized mutation domains in the Celtic languages. In Elsi Kaiser and Sudha Arunachalam (eds.), *University of Pennsylvania Working Papers in Linguistics 9.1: Proceedings of the 26th Annual Penn Linguistics Colloquium*. Philadelphia: PLC, pp. 213-226.
- Quigley, Edward C. (2003). *Awara Phonology*. MA thesis, University of North Dakota, Grand Forks.
- Ranier, Franz (1995). Inflection inside derivation: Evidence from Spanish and Portuguese. In Geert Booij and Jaap van Marle (eds.), *Yearbook of Morphology 1995*. Dordrecht: Kluwer, pp. 83-91.
- Repetti, Lori (1992). Vowel length in Northern Italian dialects. *Probus* 4, pp. 155-182.
- Repetti, Lori (1994). Degenerate syllables in Friulian. *Linguistic Inquiry* 25, pp. 186-193.
- Reynolds, William (1994). *Variation and Phonological Theory*. Ph.D. dissertation, University of Pennsylvania, Philadelphia.
- Rice, Curt (2007). Gaps and repairs at the phonology/morphology interface. *Journal of Linguistics* 43, pp. 197-221.
- Rice, Curt, and Peter Svenonius (1998). Prosodic V2 in Northern Norwegian. Ms. of paper presented at WCCFL 17, University of British Columbia, Vancouver. [Available online at <http://www.hum.uit.no/a/rice/v2/writing/ProsodicV2RiceSvenonius.pdf>]
- Rice, Keren (1988). Continuant voicing in Slave (Northern Athapaskan): The cyclic application of default rules. In Michael Hammond and Michael Noonan (eds.), *Theoretical Morphology: Approaches in Modern Linguistics*. San Diego: Academic Press, pp. 371-388.
- Rice, Keren (1989). *A Grammar of Slave*. Berlin: Mouton de Gruyter.

- Rice, Keren (1990). Prosodic constituency in Hare (Athapaskan): Evidence for the foot. *Lingua* 82, pp. 201-254.
- Richards, Norvin (2006). Beyond strength and weakness. Ms., MIT, Cambridge, MA. [lingbuzz/000325]
- Robins, R.H. (1957). Vowel nasality in Sundanese. *Studies in Linguistic Analysis: Special Volume of the Philological Society*, pp. 87-103.
- Rodriguez-Fornells, Antoni, Bernadette M. Schmitt, Marta Kutas, and Thomas F. Münte (2002). Electrophysiological estimates of the time course of semantic and phonological encoding during listening and naming. *Neuropsychologia* 40, pp. 778-787.
- van Rooy, Bertus, and Daan Wissing (2001). Distinctive [voice] implies regressive voicing assimilation. In Tracy Alan Hall (ed.), *Distinctive Feature Theory*. Berlin: Mouton de Gruyter, pp. 295-334.
- Ross, John R. (1982). The sound of meaning. In The Linguistic Society of Korea (ed.), *Linguistics in the Morning Calm*. Seoul: Hanshin, pp. 275-290.
- Rotenberg, Joel (1978). *The Syntax of Phonology*. Ph.D. dissertation, MIT, Cambridge, MA.
- Rubach, Jerzy (1984). *Cyclic and Lexical Phonology: The Structure of Polish*. Dordrecht: Foris.
- Rubach, Jerzy. (1986). Abstract vowels in three-dimensional phonology: the yers. *The Linguistic Review* 5, pp. 247-280.
- Rubach, Jerzy (1997). Extrasyllabic consonants in Polish: Derivational Optimality Theory. In Iggy Roca (ed.), *Derivations and Constraints in Phonology*. Oxford: The Clarendon Press, pp. 551-582.
- Rubach, Jerzy (2000a). Glide and glottal stop insertion in Slavic languages: A DOT analysis. *Linguistic Inquiry* 31, pp. 271-317.
- Rubach, Jerzy (2000b). Backness switch in Russian. *Phonology* 17, pp. 39-64.
- Rubach, Jerzy (2003a). Polish palatalization in Derivational Optimality Theory. *Lingua* 113, 197-237.
- Rubach, Jerzy (2003b). Duke-of-York derivations in Polish. *Linguistic Inquiry* 34, pp. 601-629.
- Rubach, Jerzy (2004). Derivation in Optimality Theory: A reply to Burzio. *Linguistic Inquiry* 35, pp. 656-670.
- Rubach, Jerzy (to appear). An overview of Lexical Phonology. *Language and Linguistics Compass*.

- Rubach, Jerzy, and Geert Booij (2001). Allomorphy in Optimality Theory: Polish Iotation. *Language* 77, pp. 26-60.
- Rubenstein, Herbert, Lonnie Garfield, and Jane Millikan (1970). Homographic entries in the internal lexicon. *Journal of Verbal Learning and Verbal Behavior* 9, pp. 487-494.
- Rudin, Catherine, Christina Kramer, Loren Billings, and Matthew Baerman (1999). Macedonian and Bulgarian *li* questions: Beyond syntax. *Natural Language and Linguistic Theory* 17, pp. 541-586.
- Russell, Kevin (1993). *A Constraint-Based Approach to Phonology and Morphology*. Ph.D. dissertation, University of Southern California, Los Angeles.
- Russell, Kevin (1997). Optimality Theory and morphology. In Diana Archangeli and D. Terence Langendoen (eds.), *Optimality Theory: An Overview*. Oxford: Blackwell, pp. 102-133.
- Russell, Kevin (1999). *MOT: Sketch of an Optimality Theoretic Approach to Morphology*. Ms., University of Manitoba, Winnipeg.
- Samek-Lodovici, Vieri (2005). Prosody-syntax interaction in the expression of focus. *Natural Language and Linguistic Theory* 23, pp. 687-755.
- Sauerland, Uli (1995). The late insertion of Germanic inflection. Ms., MIT, Cambridge, MA.
- Schaefer, Ronald P. (1987). *An Initial Orthography and Lexicon for Emai: An Edoid Language of Nigeria*. Bloomington: IULC.
- Schein, Barry (1981). Spirantization in Tigrinya. In Hagit Borer and Youssef Aoun (eds.), *MIT Working Papers in Linguistics 3: Theoretical Issues in the Grammar of Semitic Languages*. Cambridge, MA: MITWPL, pp. 32-42.
- Schein, Barry, and Donca Steriade (1986). On geminates. *Linguistic Inquiry* 17, pp. 691-744.
- Schlenker, Philippe (1999). La flexion de l'adjectif en allemand: La morphologie de haut en bas. *Recherches linguistiques de Vincennes* 28.
- Schülter, Julia (2005). *Rhythmic Grammar: The Influence of Rhythm on Grammatical Variation and Change in English*. Berlin: Walter de Gruyter.
- Schwarze, Christoph (1999). Inflectional classes in Lexical Functional Morphology: Latin -sk- and its evolution. In Miriam Butt and Tracy Holloway King (eds.), *The Proceedings of the LFG '99 Conference*. Stanford: CSLI.

- Schwarzloze, Rebecca, and Ann R. Bradlow (2001). What happens to segment durations at the end of a word? Paper presented at 141st Meeting of the Acoustical Society of America. [Abstract in *Journal of the Acoustical Society of America* 109.5.2, p. 2292.]
- Seidl, Amanda (2001). *Minimal Indirect Reference: A Theory of the Syntax-Phonology Interface*. New York: Routledge.
- Selkirk, Elisabeth (1980). Prosodic domains in phonology: Sanskrit revisited. In Mark Aronoff and Mary-Louise Kean (eds.), *Juncture*. Saratoga, CA: Anma Libri, pp. 107-129.
- Selkirk, Elisabeth (1982). *The Syntax of Words*. Cambridge, MA: MIT Press.
- Selkirk, Elisabeth (1984). *Phonology and Syntax: The Relation between Sound and Structure*. Cambridge, MA: MIT Press.
- Selkirk, Elisabeth (1986). On derived domains in sentence phonology. *Phonology Yearbook* 3, pp. 371-405.
- Selkirk, Elisabeth (1995). The prosodic structure of function words. In James L. Morgan and Katherine Demuth (eds.), *Signal to Syntax: Bootstrapping from Speech to Grammar in Early Acquisition*. Mahwah, NJ: Lawrence Erlbaum, pp. 187-213.
- Selkirk, Elisabeth (2000). The interaction of constraints on prosodic phrasing. In Merle Horne (ed.), *Prosody: Theory and Experiment: Studies Presented to Gosta Bruce*. Dordrecht: Kluwer, pp. 219-255.
- Selkirk, Elisabeth (2002). On the phonologically driven non-realization of function words. In Charles Chang, Michael J. Houser, Yuni Kim, David Mortensen, Mischa Park-Doob, and Maziar Toosarvandani (eds.), *Proceedings of the Twenty-Seventh Annual Meeting of the Berkeley Linguistics Society*. Berkeley: BLS, pp. 257-270.
- Semenza, C., C. Luzzatti, and S. Carabelli (1997) Naming disorders for compounds in aphasia: A study in Italian. *Journal of Neurolinguistics* 10, pp. 33-43.
- Semenza, Carlo, Claudio Luzzatti, and Sara Mondini (1999). Lemma theory and aphasiology. *The Behavioral and Brain Sciences* 22, p. 56.
- Sezer, Engin (1981). The k/Ø alternation in Turkish. In George N. Clements (ed.), *Harvard Studies in Phonology*. Bloomington: IULC, pp. 354-382.
- Shaw, Jason (2007). Compensatory lengthening via mora preservation in OT-CC. Ms., New York University. [ROA-916]
- Shaw, Patricia A. (1985). Modularization and substantive constraints in Dakota Lexical Phonology. *Phonology Yearbook* 2, pp. 173-202.

- Shen, Ya-Ming (1992). The role of the cycle in prosodic phonology. In Jeannette Marshall Denton, Grace P. Chan, and Costas P. Canakis (eds.), *Papers from the 28th Regional Meeting of the Chicago Linguistic Society: Volume 2: The Parasession: The Cycle in Linguistic Theory*. Chicago: CLS, pp. 288-302.
- Sherer, Tim (1994). *Prosodic Phonotactics*. Ph.D. dissertation, University of Massachusetts, Amherst. [ROA-54]
- Shih, Chi-Lin. (1986). *The Prosodic Domain of Tone Sandhi in Chinese*. Ph.D. dissertation, University of California, San Diego.
- Siddiqi, Daniel (2006). *MINIMIZE EXPONENCE: Economy Effects on a Model of the Morphosyntactic Component of the Grammar*. Ph.D. dissertation, University of Arizona, Tucson. [lingBuzz/000514]
- Siegel, Dorothy (1974). *Topics in English Morphology*. Ph.D. dissertation, MIT, Cambridge, MA.
- Skinner, Tobin (to appear). A post-spell-out explanation of variation in reduplication. In Eva Dobler and Moti Lieberman (eds.), *McGill Working Papers in Linguistics 22*. Montréal: McGill WPL.
- Smith, Jennifer L. (1997). Noun faithfulness: On the privileged behavior of nouns in phonology. Ms., University of Massachusetts Amherst. [ROA-242]
- Smith, Jennifer L. (1998a). Noun faithfulness: Evidence from accent in Japanese. In Noriko Akatsuka, Hajime Hoji, Shoichi Iwasaki, Sung-Ock Sohn, and Susan Strauss (eds.), *Japanese/Korean Linguistics 7*. Stanford: CSLI, pp. 611-627.
- Smith, Jennifer L. (1998b). Noun faithfulness and word stress in Tuyuca. In Jennifer Austin and Aaron Lawson (eds.), *Proceedings of ESCOL '97*. Ithaca: CLC, pp. 180-191.
- Smith, Jennifer L. (1999). Noun faithfulness and accent in Fukuoka Japanese. In Sonya Bird, Andrew Carnie, Jason D. Haugen, and Peter Norquest (eds.), *Proceedings of WCCFL XVIII*. Somerville, MA: Cascadilla Press, pp. 519-531.
- Smith, Jennifer L. (2001). Lexical category and phonological contrast. In Robert Kirchner, Joe Pater, and Wolf Wilkey (eds.), *Papers in Experimental and Theoretical Linguistics 6: Workshop on the Lexicon in Phonetics and Phonology*. Edmonton: Department of Linguistics, University of Alberta, pp. 61-72.
- Smith, Jennifer L. (2002). *Phonological Augmentation in Prominent Positions*. Ph.D. dissertation, University of Massachusetts Amherst.
- Smith, Neilson V. (1973). *The Acquisition of Phonology: A Case Study*. Cambridge: Cambridge University Press.

- Smolensky, Paul (1993). Harmony, markedness, and phonological activity. Talk presented at Rutgers Optimality Workshop I, Rutgers University, New Brunswick, NJ. [Handout available as ROA-87]
- Smolensky, Paul (1995). On the structure of the constraint component CON of UG. Talk presented at University of California, Los Angeles. [Handout available as ROA-86]
- Smolensky, Paul (1997). Constraint interaction in generative grammar II: Local conjunction, or random rules in Universal Grammar. Talk presented at Hopkins Optimality Theory Workshop/Maryland Mayfest, Baltimore.
- Smyth, Herbert Weir (1956). *Greek Grammar*. [Revised by Gordon M. Messing.] Cambridge, MA: Harvard University Press.
- Sparks, Randall B. (1984). Here's a few more facts. *Linguistic Inquiry* 15, pp. 179-183.
- Sproat, Richard (1985). *On Deriving the Lexicon*. Ph.D. dissertation, MIT, Cambridge, MA.
- Stemberger, Joseph Paul (1980). Morphological haplology. *Language* 57, pp. 791-817.
- Stemberger, Joseph P., and Barbara Hanford Bernhardt (1999). Contiguity, metathesis, and infixation. In Kimary Shahin, Susan Blake, and Eun-Sook Kim (eds.), *Proceedings of the Seventeenth West Coast Conference on Formal Linguistics*. Stanford: SLA/CSLI, pp. 610-624.
- Steriade, Donca (1982). *Greek Prosodies and the Nature of Syllabification*. Ph.D. dissertation, MIT, Cambridge, MA.
- Steriade, Donca (1987). Vowel tiers and geminate blockage. Ms., MIT, Cambridge, MA.
- Steriade, Donca (1988). Reduplication and syllable transfer in Sanskrit and elsewhere. *Phonology* 5, pp. 73-155.
- Steriade, Donca (2000a). Paradigm uniformity and the phonetics-phonology boundary. In M.B. Broe and J. Pierrehumbert (eds.), *Papers in Laboratory Phonology V: Acquisition and the Lexicon*. Cambridge: Cambridge University Press.
- Steriade, Donca (2000b). Lexical conservatism and the notion "base of affixation". Ms., University of California, Los Angeles.
- Steriade, Donca (2008). A pseudo-cyclic effect in Romanian morpho-phonology. Ms., MIT, Cambridge, MA.
- Stevens, Alan M. (1977). On local ordering in Sundanese. *Linguistic Inquiry* 8, pp. 155-162.
- Strauss, Steven (1982a). *Lexicalist Phonology of English and German*. Dordrecht: Foris.

- Strauss, Steven (1982b). On “relatedness paradoxes” and related paradoxes. *Linguistic Inquiry* 13, pp. 694-700.
- Strigin, Anatoli (2007). Paradigmatic scale building in OT: The case of strong verbs in German. Ms., Zentrum für Allgemeine Sprachwissenschaft, Typologie und Universalienforschung, Berlin. [ROA-936]
- Struijke, Caro, and Paul de Lacy (2000). Overkill in dissimilation. Paper presented at NELS 31, Georgetown University, Washington.
- Stump, Gregory (1993). On rules of referral. *Language* 69, pp. 449-479.
- Stump, Gregory T. (2001). *Inflectional Morphology: A Theory of Paradigm Structure*. Cambridge: Cambridge University Press.
- Sturgeon, Anne (2003). Paradigm uniformity: Evidence for inflectional bases. In Gina Garding and Mimura Tsujimura (eds.), *WCCFL 22: Proceedings of the 22nd West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadia Press, pp. 464-476.
- Sugahara, Mariko, and Alice Turk (2004a). Phonetic reflexes of morphological boundaries at a normal speech rate. In Bernard Bel and Isabelle Marlien, *Proceedings of Speech Prosody 2004*, pp. 353-356.
- Sugahara, Mariko, and Alice Turk (2004b). Phonetic reflexes of morphological boundaries under different speech rates. Paper presented at 9th Conference on Laboratory Phonology, Urbana-Champaign. [Abstract available online at http://www.linguistics.uiuc.edu/labphon9/Abstract_PDF/sugahara.pdf]
- Suh, Chang-Kook (1995). Palatalization, opacity, and umlaut in Korean. *Harvard Studies in Korean Linguistics* 11, pp. 121-137.
- Swiggers, Pierre (1985). How to order eggs in French. *Folia Linguistica* 19, pp. 63-66.
- Szpyra, Jolanta (1985). Cyclic phonology—a counterproposal to the SPE model? *Studia Grammatyczne* 6, pp. 97-131.
- Szpyra, Jolanta. (1987). Inputs to WFRs—Phonological, intermediate, or phonetic? The case of verbs and deverbal nouns in Polish. In Edmund Gussman (ed.), *Rules and the Lexicon*. Lublin: Katolickiego Uniwersytetu Lubelskiego, pp. 169-203.
- Szpyra, Jolanta (1989). *The Phonology-Morphology Interface: Cycles, Levels, and Words*. London: Routledge.
- Taeldeman, Johan (1980). Inflectional aspects of adjectives in the dialects of Dutch-speaking Belgium. In Wim Zonneveld, Frans van Coetsem, and Orrin W. Robinson (eds.), *Studies in Dutch Phonology*. Den Haag: Martinus Nijhoff, pp. 265-292.

- Taeldeman, Johan (2002). Vlaamse klankfeiten en fonologische theorieën. In Georges de Schutter and Steven Gillis (eds.), *Fonologische kruispunten*. Ghent: KANTL.
- Teeple, David (2006). Lexical selection and strong parallel OT. Ms., University of California, Santa Cruz.
- Telfer, Corey (2006). *Coronalization as Assibilation*. MA thesis, University of Calgary.
- Tesar, Bruce (1995). *Computational Optimality Theory*. Ph.D. dissertation, University of Colorado, Boulder. [ROA-90]
- Tesar, Bruce, and Paul Smolensky (1998). Learnability in Optimality Theory. *Linguistic Inquiry* 29, pp. 229-268.
- Tesar, Bruce, and Paul Smolensky (2000). *Learnability in Optimality Theory*. Cambridge, MA: MIT Press.
- Tessier, Anne-Michelle (2004). Input “clusters” and contrast preservation in OT. In Vineeta Chand, Ann Kelleher, Angelo J. Rodríguez, and Benjamin Schmeiser (eds.), *WCCFL 23: Proceedings of the 23rd West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Press, pp. 759-772.
- Tessier, Anne-Michelle (2007). *Biases and Stages in Phonological Acquisition*. Ph.D. dissertation, University of Massachusetts Amherst. [ROA-883]
- Ting Pang-Hsin (1975). Tonal relationship between the two constituent of the coordinate construction in the Analects, the Meng-tze, and the Book of Odes. *Bulletin of the Institute of History and Philology, Academia Sinica* 47, pp. 17-52.
- Topintzi, Nina (to appear). On the existence of moraic onset geminates. *Natural Language and Linguistic Theory*.
- Tranel, Bernard (1996a). Exceptionality in Optimality Theory and final consonants in French. In Karen Zagana (ed.), *Grammatical Theory and Romance Languages*. Amsterdam: John Benjamins, pp. 275-91. [ROA-61]
- Tranel, Bernard (1996b). French liaison and elision revisited: A unified account within Optimality Theory. In Claudia Parodi, Carlos Quicoli, Mario Saltarelli, & Maria Luisa Zubizarreta (eds.), *Aspects of Romance Linguistics*. Washington: Georgetown University Press, pp. 433-455. [ROA-15]
- Trommer, Jochen (1999). Morphology consuming syntax’ resources: Generation and parsing in a minimalist version of Distributed Morphology. In *Proceedings of the ESSLi Workshop on Resource Logic and Minimalist Grammars, Utrecht*. [lingBuzz/000116]
- Trommer, Jochen (2001). *Distributed Optimality*. Ph.D. dissertation, Universität Potsdam.

- Trommer, Jochen (2008). Syllable-counting allomorphy by indexed constraints. Paper presented at Old World Conference on Phonology 5, Toulouse. [Slides available online at <http://www.uni-leipzig.de/~jtrommer/ocp5.pdf>]
- Trubetzkoy, Nikolai S. (1939). *Grundzüge der Phonologie*. Göttingen: van der Hoeck & Ruprecht.
- Truckenbrodt, Hubert (1995). *Phonological Phrases: Their Relation to Syntax, Focus, and Prominence*. Ph.D. dissertation, MIT, Cambridge, MA.
- Truckenbrodt, Hubert (2002). Variation in p-phrasing in Bengali. *Linguistic Variation Yearbook 2*, pp. 259-303.
- Tuttle, Siri G. (1998). *Metrical and Tonal Structures in Tanana Athabaskan*. Ph.D. dissertation, University of Washington, Seattle.
- Van Tourenhout, M., P. Hagoort, and C.M. Brown (1997). Electrophysiological evidence on the time course of semantic and phonological processes in speech production. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 23, pp. 787-806.
- Van Tourenhout, M., P. Hagoort, and C.M. Brown (1998). Brain activity during speaking: From syntax to phonology in 40 msec. *Science* 280, pp. 572-574.
- Vaux, Bert (2003). Syllabification in Armenian, Universal Grammar, and the lexicon. *Linguistic Inquiry* 34, pp. 91-125.
- Velten, H.V. (1943). The growth of phonemic and lexical patterns in infant language. *Language* 19, pp. 281-292.
- Vogel, Irene, and István Kenesei (1990). Syntax and semantics in phonology. In Sharon Inkelas and Draga Zec (eds.), *The Phonology-Syntax Connection*. Chicago: University of Chicago Press, pp. 339-363.
- Wackernagel, J., and A. Debrunner (1954). *Altindische Grammatik II. 2*. Göttingen: van den Hoeck & Ruprecht.
- Wagner, Michael (2005). *Prosody and Recursion*. Ph.D. dissertation, MIT, Cambridge, MA.
- Walker, Rachel (1997). Faith and markedness in Esimbi feature transfer. In Rachel Walker, Motoko Katayama, and Daniel Karvonen (eds.), *Phonology at Santa Cruz 5*. Santa Cruz: LRC Publications, pp. 103-115.
- Walker, Rachel (1998). *Nasalization, Neutral Segments, and Opacity Effects*. Ph.D. dissertation, University of California, Santa Cruz. [ROA-405]

- Walker, Rachel, and Bella Feng (2004). A ternary model of phonology-morphology correspondence. In Benjamin Schmeiser, Veneeta Chand, Ann Kelleher, and Angelo Rodríguez (eds.), *Proceedings of the Twenty-Third West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Press, pp. 773-786. [ROA-772]
- Walsh Dickey, Laura (1997). *The Phonology of Liquids*. Ph.D. dissertation, University of Massachusetts, Amherst.
- Walsh Dickey, Laura (1999). Syllable count and Tzeltal segmental allomorphy In John R. Rennison and Klaus Kühnhammer (eds.), *Phonologica 1996: Syllables!?*. The Hague: Thesus, pp. 323-334.
- Walter, Mary Ann, and T. Florian Jaeger (to appear). Constraints on optional *that*: A strong word form OCP effect. In *Proceedings of CLS 41*.
- Wells, John C. (1982). *Accents of English, vol. 2: The British Isles*. Cambridge: Cambridge University Press.
- Wells, Rulon S. (1949). Automatic alternation. *Language* 25, pp. 99-116.
- Werle, Adam (2002). Sonority-determined clitic order. Paper presented at Western Conference on Linguistics, University of British Columbia, Vancouver. [Handout available online at http://people.umass.edu/nrwan/werle_02_Sonoritydeterminedcliticorder.pdf]
- Wescott, Roger W. (1970). Types of vowel alternations in English. *Word* 26, pp. 309-343.
- Wetzels, W. Leo, and Joan Mascaró (2001). The typology of voicing and devoicing. *Language* 77, pp. 207-244.
- Whitley, M. Stanley (1978). *Generative Phonology Workbook*. Madison: University of Wisconsin Press.
- Wier, Thomas R. (2004). Comparative Markedness and opacity in Meskwaki palatalization. In Marc Ettlenger, Nicholas Fleisher, and Mischa Park-Doob (eds.), *Proceedings of the Thirtieth Annual Meeting of the Berkeley Linguistics Society*. Berkeley: BLS, pp. 426-434.
- Wilkinson, Robert W. (1974). Tense/Lax vowel harmony in Telugu: The influence of derived contrast on rule application. *Linguistic Inquiry* 5, pp. 251-270.
- Williams, Edwin (1981). On the notions 'lexically related' and 'head of a word'. *Linguistic Inquiry* 12, pp. 245-274.
- Williams, Edwin (2007). Dumping lexicalism. In Gillian Ramchand and Charles Reiss (eds.), *The Oxford Handbook of Linguistic Interfaces*. Oxford: Oxford University Press, pp. 353-382.

- Wilson, Colin (2000). *Targeted Constraints: An Approach to Contextual Neutralization in Optimality Theory*. Ph.D dissertation, The Johns Hopkins University, Baltimore.
- Wilson, Colin (2001). Consonant cluster neutralization and targeted constraints. *Phonology* 18, pp. 147-197.
- Wilson, Colin (2004). Analyzing unbounded spreading with constraints: Marks, targets, and derivations. Ms., University of California, Los Angeles.
- Withgott, Mary Margaret (1982). *Segmental Evidence for Phonological Constituents*. Ph.D. dissertation, University of Texas, Austin.
- Wojdak, Rachel (2008). *The Linearization of Affixes: Evidence from Nuu-cha-nulth*. Dordrecht: Springer.
- Wolf, Matthew (2005). An autosegmental theory of quirky mutations. In John Alderete, Chung-hye Han, and Alexei Kochetov (eds.), *Proceedings of the Twenty-Fourth West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 370-378. [<http://www.lingref.com>, #1243.]
- Wolf, Matthew (2007a). For an autosegmental theory of mutation. In Leah Bateman, Michael O'Keefe, Ehren Reilly, and Adam Werle (eds.), *University of Massachusetts Occasional Papers in Linguistics 32: Papers in Optimality Theory III*. Amherst: GLSA, pp. 315-404. [ROA-754]
- Wolf, Matthew (2007b). What constraint connectives should be permitted in OT? In Michael Becker (ed.), *University of Massachusetts Occasional Papers in Linguistics 36: Papers in Theoretical and Computational Phonology*. Amherst: GLSA, pp. 151-179. [ROA-926]
- Wolf, Matthew (to appear). Lexical insertion occurs in the phonological component. In Bernard Tranel (ed.), *Understanding Allomorphy: Perspectives from Optimality Theory*. London: Equinox Publishing. [ROA-912]
- Wolf, Matthew, and John J. McCarthy (to appear). Less than zero: Correspondence and the null output. In Curt Rice (ed.), *Modeling Ungrammaticality in Optimality Theory*. London: Equinox Publishing. [Earlier version available as ROA-722]
- Wright, Sandra, Jennifer Hay, and Tessa Bent (2005). Ladies first? Phonology, frequency, and the naming conspiracy. *Linguistics* 44, pp. 531-561.
- Wunderlich, Dieter (1996). A minimalist model of inflectional morphology. In Chris Wilder, Hans-Martin Gärtner, and Manfred Bierwisch (eds.), *The Role of Economy Principles in Linguistic Theory*. Berlin: Akademie Verlag, pp. 267-298.
- Wunderlich, Dieter (2000). A correspondence-theoretic analysis of Dalabon transitive paradigms. In Geert Booij and Jaap van Marle (eds), *Yearbook of Morphology 2000*. Dordrecht: Kluwer, pp. 233-252.

- Wunderlich, Dieter (2001). How gaps and substitutions can become optimal: The pronominal affix paradigms of Yimas. *Transactions of the Philological Society* 99, pp. 315-366.
- Wunderlich, Dieter (2003). On generating and constraining morphological objects: A reply to Harbour. *Transactions of the Philological Society* 101, pp. 137-147.
- Wunderlich, Dieter, and Ray Fabri (1995). Minimalist Morphology: An approach to inflection. *Zeitschrift für Sprachwissenschaft* 14, pp. 236-294.
- Xu, Zheng (2007). *Inflectional Morphology in Optimality Theory*. Ph.D. dissertation, Stony Brook University. [ROA-949]
- Yearley, Jennifer (1995). Yer vowels in Russian. In Jill N. Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk (eds.) *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*. Amherst: GLSA, pp. 533-571.
- Yip, Moira (1998). Identity avoidance in phonology and morphology. In Steven G. Lapointe, Diane K. Brentari, and Patrick M. Farrell (eds.), *Morphology and its Relation to Phonology and Syntax*. Stanford: CSLI Publications, 216-246.
- Young, Robert, and William Morgan (1987). *The Navajo Language: A Grammar and Colloquial Dictionary*. Albuquerque: University of New Mexico Press.
- Yu, Alan C.L. (2003) *The Morphology and Phonology of Infixation*. Ph.D. dissertation, University of California, Berkeley.
- Yu, Alan C.L. (2007). Tonal phonetic analogy. In Jürgen Trouvain and William J. Barry (eds.), *16th International Congress of Phonetic Sciences: Book of Abstracts*. Saarbrücken: Universität des Saarlandes, pp. 1749-1752. [Available online at <http://www.icphs2007.de/conference/Papers/1572/1572.pdf>]
- Yun, Jiwon (2008) Noun-verb asymmetries in Korean phonology. Paper presented at 27th West Coast Conference on Formal Linguistics, University of California, Los Angeles. [Abstract available online at http://www.linguistics.ucla.edu/wccfl27/abstracts/general/noun-verb_asymmetries.pdf]
- Zec, Draga (1995). Sonority constraints on syllable structure. *Phonology* 12, pp. 85-129.
- Zec, Draga, and Sharon Inkelas (1990). Prosodically constrained syntax. In Sharon Inkelas and Draga Zec (eds.), *The Phonology-Syntax Connection*. Stanford: CLSI, pp. 365-378.
- Zhang, Jie (2000). Non-contrastive features and categorical patterning in Chinese diminutive suffixation: MAX[F] or IDENT[F]? *Phonology* 17, pp. 427-478.

- Zhang, Jie, Yuwen Lai, and Craig Turnbull-Sailor (2006). Wug-testing the “tone circle” in Taiwanese. In Donald Baumer, David Montero, and Michael Scanlon (eds.), *Proceedings of the 25th West Coast Conference on Formal Linguistics*. Somerville, MA: Cascadilla Proceedings Project, pp. 453-461. [Lingref #1479]
- Zhang, Nina Ning (2007). Root merger in Chinese compounds. *Studia Linguistica* 61, pp. 170-184.
- Zimmer, Karl, and Barbara Abbott (1978). The k/Ø alternation in Turkish: Some experimental evidence for its productivity. *Journal of Psycholinguistic Research* 7, pp. 35-46.
- Zoll, Cheryl (1996). *Parsing Below the Segment in a Constraint-Based Framework*. Ph.D. dissertation, University of California, Berkeley. [ROA-143]
- Zoll, Cheryl (1998). Positional asymmetries and licensing. Ms., MIT, Cambridge, MA.
- Zsiga, Elizabeth C. (1995). An acoustic and electropalatographic study of lexical and post-lexical palatalization in American English. In Bruce Connell and Amalia Arvaniti (eds.), *Phonology and Phonetic Evidence: Papers in Laboratory Phonology IV*. Cambridge: Cambridge University Press, pp. 282 - 302.
- Zubizarreta, Maria-Luisa (1998). *Prosody, Focus, and Word Order*. Cambridge, MA: MIT Press.
- Zuraw, Kie (2000). *Patterned Exceptions in Phonology*. Ph.D. dissertation, University of California, Los Angeles.
- Zuraw, Kie (2006a). Prescient ‘an’. Post on Phonoloblog, December 25. [Available online via <http://camba.ucsd.edu/phonoloblog>]
- Zuraw, Kie (2006b). More on a vs. an. Post on Phonoloblog, December 29. [Available online via <http://camba.ucsd.edu/phonoloblog>]
- Zwicky, Arnold M. (1969). Phonological constraints in syntactic descriptions. *Papers in Linguistics* 1, pp. 411-463.
- Zwicky, Arnold M. (1985a). How to describe inflection. In Mary Niepokuj, Mary VanClay, Vassiliki Nikiforidou, Deborah Feder, Claudia Brugman, Monica Macaulay, Natasha Beery, and Michele Emanatian (eds.), *Proceedings of the Eleventh Annual Meeting of the Berkeley Linguistics Society*. Berkeley: BLS, pp. 372-386.
- Zwicky, Arnold M. (1985b). Rules of allomorphy and phonology-syntax interactions. *Journal of Linguistics* 21, pp. 431-436.
- Zwicky, Arnold M., and Geoffrey K. Pullum (1986a). The Principle of Phonology-Free Syntax: Introductory remarks. *Ohio State University Working Papers in Linguistics* 32, 63-91.

Zwicky, Arnold M., and Geoffrey K. Pullum (1986b). Two spurious counterexamples to the Principle of Phonology-Free Syntax. *Ohio State University Working Papers in Linguistics* 32, 92-99.