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Comparative Markedness

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Symbols used in this article

ː	IPA symbol for length
ɨ	IPA barred <i>i</i> vowel
ə	IPA schwa vowel
ɤ	IPA retroflex schwa vowel
ʌ	IPA caret vowel
ɮ	IPA turned <i>y</i> (palatal lateral)
ʔ	IPA glottal stop
dʒ	IPA voiced palatoalveolar affricate (dʒ and $\widehat{dʒ}$ are also acceptable)
ɮ	IPA retroflex <i>t</i>
ŋ	IPA velar nasal
ɹ	IPA turned <i>r</i>
ɾ	IPA flap consonant
ʀ	IPA small cap <i>R</i>
ʃ	IPA long <i>s</i>
t̪	<i>t</i> overstruck with IPA dental diacritic
ˈ	apostrophe (used as phonetic symbol)
ẉ	<i>w</i> overstruck with apostrophe
ℝ	Gothic <i>R</i> . (Used in mathematics to denote set of real numbers.)
☞	Pointing hand icon
Ł	Polish slash L (only in name Łubowicz)
ć	Croatian acute <i>c</i> (only in name Baković)
á	acute <i>a</i>
é	acute <i>e</i>
ó	acute <i>o</i>
ö	umlaut <i>o</i>
ú	acute <i>u</i>
ã	tilde <i>a</i>
-	hyphen
–	en dash
—	em dash
≫	Two greater-than symbols with tight kerning.
σ	Lower-case Greek sigma

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Abstract

The markedness constraints of classic Optimality Theory assign violation-marks to output candidates without reference to the input or to other candidates. This article explores an alternative conception of markedness: markedness constraints compare the candidate under evaluation with another candidate, the most faithful one. Comparative constraints distinguish two situations: the candidate under evaluation contains an instance of a marked structure that is also present in the fully faithful candidate; or it contains an instance of a marked structure that is not present in the fully faithful candidate. Empirical consequences of comparative markedness are explored, including grandfather effects, derived environment effects, non-iterating processes, and counter-feeding opacity. Comparative markedness is found to have some advantages and some disadvantages in comparison with classic OT and alternatives like local conjunction, stratal OT, sympathy, and targeted constraints.

§1. Introduction

Optimality Theory (Prince and Smolensky 1993) has two types of constraints, faithfulness and markedness. Faithfulness constraints militate against input-output disparity, and markedness constraints impose restrictions on the output without reference to the input. For example, the input-output mapping $/ab/ \rightarrow \lambda ab$ violates the faithfulness constraint DEP (no epenthesis), and the output form λab violates the markedness constraint NOVCDOB (for “No Voiced Obstruents”, i.e. $*[-\text{sonorant}, +\text{voice}]$).

This article presents a different approach to markedness. The idea is that markedness constraints assign violation-marks to output candidates by comparing them to the fully faithful candidate (FFC), which is present in every candidate set. These novel markedness constraints distinguish between:

-Mappings that fail to correct a marked configuration in the FFC. E.g., the mapping $/ab/ \rightarrow \lambda ab$ fails to correct the marked voiced obstruent in the FFC ab . That is, the NOVCDOB violation in λab is “old” because the fully faithful candidate ab has the same violation.

and

-Mappings that introduce new marked configurations. E.g., the mapping $/ampa/ \rightarrow amba$ introduces a voiced obstruent that is not present in the FFC $ampa$. That is, the NOVCDOB violation in $amba$ is “new” because the fully faithful candidate $ampa$ does not have this violation.

According to this hypothesis, every traditional markedness constraint M is eliminated and replaced by two freely rankable constraints, ${}_O M$ and ${}_N M$. Between them, ${}_O M$ and ${}_N M$ divide up all of traditional M 's violation-marks. The constraint ${}_O M$ is sensitive to violations that are old, in the sense that they are shared with the FFC. The constraint ${}_N M$ is sensitive to violations that are new,

in the sense that they are not shared with the FFC. For example, ${}_o\text{NOVCDOB}$ is violated by the /ab/ → *ʔab* mapping, while ${}_N\text{NOVCDOB}$ is violated by the /ampa/ → *amba* mapping. Dividing traditional M up in this way yields some new results, as we will see below. I call this approach **comparative markedness**.

By distinguishing between old and new markedness violations, comparative markedness offers a novel perspective on several famous and not-so-famous problems. In a derived environment effect (§4.2), a phonological process is observed to occur only in contexts that are not present in the FFC. In other words, only ${}_N\text{M}$ is ranked high enough to compel unfaithfulness to the input; ${}_o\text{M}$ is ranked too low to matter. In non-iterative processes (§5.1) and counter-feeding opacity (§5.2), a process affects only those configurations that are already present in the FFC. The ranking is therefore just the opposite: ${}_o\text{M}$ is ranked high and ${}_N\text{M}$ is ranked low.

The next section looks informally at yet another consequence of comparative markedness, the analysis of grandfather effects, where a marked structure is permitted when it is old but forbidden when it is new. Later sections fill in the formal details of the theory as a whole (§3) and of the analysis of grandfather effects (§4.1). In §4.3 and §5.3, comparative markedness is compared with other approaches to these phenomena, and some advantages and disadvantages are noted.

§2. Grandfather Effects

Suppose that typological evidence has established that Universal Grammar contains the classic OT markedness constraint M — for example, some languages permit only M-obeying forms, some languages have processes that actively eliminate M-violators, and so on. Now, suppose there is a language that tolerates M-violating structures inherited from the input but blocks processes from creating those same structures. This is a “grandfather effect”. (This term, suggested to me by Ellen Woolford, is based on the expression “grandfather clause”, which is a provision in a law that

exempts persons who, at the time when the law was adopted, were already engaged in activities prohibited by that law.)

Grandfather effects are by no means uncommon. Archangeli and Pulleyblank (1994: 293-4) and Davis (1995) call them “target conditions”, since they specifically affect the target of a phonological process. Their relevance to comparative markedness theory was discovered by Paul de Lacy, who offers the example in (1) (cf. Mascaró and Wetzels 2001).

(1) Mekkan Arabic [-voice] Assimilation (Abu-Mansour 1996, Bakalla 1973)

a. Voiced obstruent assimilates to following voiceless

/ʔagsam/ ʔaksam ‘he swore an oath’

/mazku:r/ masku:r ‘mentioned’

b. But not vice-versa. Assimilation can’t create marked voiced obstruents

/ʔakbar/ ʔakbar, *ʔagbar ‘older’

/matɖʒar/ matɖʒar, *maddɖʒar ‘shop’

c. Otherwise, voiced obstruents, even codas, are treated faithfully

/ʔibnu/ ʔibnu ‘his son’

/ʔadʒu:z/ ʔadʒu:z ‘old’

/dabdaba/ dabdaba ‘pitter-pat (footsteps)’

Coda obstruents become voiceless before a voiceless obstruent (1a). There is no general process of coda devoicing, however, as shown by (1c). Significantly, voiceless coda obstruents do not become voiced before voiced obstruents (1b). In short, voiced obstruents present in the input are grandfathered (e.g., *dabdaba*), but new voiced obstruents cannot be created by the voicing assimilation process (*/ʔakbar/* → *ʔakbar*, **ʔagbar*). The markedness constraint NOVCDOB blocks assimilation but cannot itself compel unfaithfulness.

In comparative markedness theory, the original NOVCDOB constraint is replaced by $_N$ NOVCDOB and $_O$ NOVCDOB. $_N$ NOVCDOB is violated by new instances of voiced obstruents, those not present in the FFC. $_O$ NOVCDOB is violated by old instances of voiced obstruents, those already present in the FFC. For example, **ʔagbar* violates each of these constraints once: $_N$ NOVCDOB is violated by the *g*, whose counterpart in the FFC *ʔakbar* is not voiced; and $_O$ NOVCDOB is violated by the *b*, whose counterpart in the FFC is also voiced. Assimilation is blocked, so $_N$ NOVCDOB must be ranked above the constraint responsible for assimilation, AGREE(voice),¹ which is itself ranked above the faithfulness constraint IDENT(voice), as shown in (2). (The ranking arguments are surrounded by heavy lines. Here and throughout, markedness constraints that are not the focus of discussion are shown without new/old differentiation (i.e., $_N$ M and $_O$ M are ranked together).)

(2) Mekkan Arabic: $_N$ NOVCDOB \gg AGREE(voice) \gg IDENT(voice)

/ʔagsam/	$_N$ NOVCDOB	AGREE(voice)	IDENT(voice)
a. ʔagsam			*
b. (FFC) ʔagsam		*!	
/ʔakbar/			
c. (FFC) ʔakbar		*	
d. ʔagbar	*!		*

In (2a, b), top-ranked $_N$ NOVCDOB is satisfied by both candidates because neither introduces a new voiced obstruent. This leaves the choice up to AGREE(voice), which favors the candidate with assimilation. In (2c, d), though, the assimilated candidate **ʔagbar* has a new voiced obstruent, and its encounter with $_N$ NOVCDOB is fatal. Assimilation is therefore blocked. (Another way to satisfy AGREE(voice) is by progressive assimilation: **ʔakpar*. I assume, as is now standard (Beckman 1998,

Lombardi 1999), that the positional faithfulness constraint IDENT-ONS(voice) is ranked above AGREE.)

To show that two putatively distinct OT constraints are in fact distinct, it is sufficient to show that they are crucially ranked non-adjacently in some language's hierarchy. In Mekkan Arabic, ${}_o\text{NOVCDOB}$ is indeed ranked at a different place than ${}_N\text{NOVCDOB}$. Because some underlying voiced obstruents make it faithfully to the surface, even in coda position, IDENT(voice) must be ranked above ${}_o\text{NOVCDOB}$, as shown in (3).

(3) Mekkan Arabic: IDENT(voice) \gg ${}_o\text{NOVCDOB}$

	/ʔibnu/	IDENT(voice)	${}_o\text{NOVCDOB}$
a.	ʔibnu		*
b.	ʔipnu	*!	

By transitive closure of the rankings in (2) and (3), ${}_N\text{NOVCDOB}$ and ${}_o\text{NOVCDOB}$ are ranked separately in Mekkan Arabic: $[_N\text{NOVCDOB} \gg \text{AGREE(voice)} \gg \text{IDENT(voice)} \gg {}_o\text{NOVCDOB}]$. With this ranking, ${}_N\text{NOVCDOB}$ is visibly active on candidates derived from inputs like /ʔakbar/, but ${}_o\text{NOVCDOB}$ is not visibly active on any inputs.

The key to analyzing this and other examples of grandfather effects is the ranking of the new-affecting and old-affecting versions of a markedness constraint. (Hereafter, I will avoid the awkward locutions “new-affecting” and “old-affecting” by saying simply “new” and “old”. When the chronologically prior definition of a markedness constraint is referred to, I will use the word “classic”, as in “classic OT”.) The new version, ${}_N\text{M}$, is ranked above the markedness constraint responsible for the process that is blocked. The old version, ${}_o\text{M}$, is ranked below the relevant faithfulness constraint, so it cannot affect M-violating structures that are already present in the

input/FFC. This same schematic ranking is also at work in derived environment effects (see §4.2). The opposite ranking, with ${}_oM$ high and ${}_nM$ low, is attested as well (see §5).

We will return to the analysis of grandfather effects in §4.1, but first it is necessary to formalize some of the ideas that have been treated intuitively up to this point.

§3. Formalization

As the discussion in §2 indicated, ${}_oM$ and ${}_nM$ recognize, respectively, that a candidate retains some instance of a marked configuration and that a candidate introduces a new instance of a marked configuration, relative to the FFC. What we need, then, is a way of talking about a specific instance of a marked configuration in a candidate and a way of talking about what it means to inherit a marked configuration or to introduce a new one. An unambiguous characterization of the FFC is also required.

The intuition to be captured is this: a constraint violation is new if the corresponding material in the FFC does not violate that constraint. For instance, the mapping $/ampa/ \rightarrow amba$ introduces a new NOVCDOB violation relative to the FFC *ampa*. Differences between candidates that are not relevant to a constraint's applicability do not make a violation new — e.g., the mapping $/anba/ \rightarrow amba$, though unfaithful, does not introduce a new NOVCDOB violation relative to the FFC *anba*. Furthermore, a simple count of violation-marks is not enough to determine newness. The mapping $/ampab/ \rightarrow ambap$, with both post-nasal voicing and final devoicing, introduces a new NOVCDOB violation relative to the FFC *ampab*, even though *ambap* and *ampab* have exactly one NOVCDOB violation-mark each.

To express these intuitions formally, it is necessary to define what it means to apply a markedness constraint to a form. Two notions will be essential. One is the **locus of violation** of a markedness constraint in a candidate. This is the spot in the candidate where the constraint is

violated; for example, the locus of violation of NOVCDOB in *amba* is the segment *b*. The other notion is **t-correspondence**. This is a version of correspondence that has been transitivized, using the shared input to link two output candidates. Together, these elements provide a foundation for defining comparative markedness.

The locus of violation of a markedness constraint *M* in a candidate *cand* is determined by the definition of *M* and the contents of *cand*.² Every markedness constraint M_i is defined in terms of its locus-of-violation function Loc_i . Loc_i is a function from a candidate form to a set (strictly speaking, a multi-set) of loci of violation, which are segments in that candidate.

(4) Loc Functions in General

$Loc(cand) \rightarrow \{\text{locus}_1, \text{locus}_2, \dots\}$, where locus_j is a segment in the candidate *cand*.

On this view, Loc_i is simply the definition of M_i , so a Loc function is stipulated for each constraint. Some proposed Loc functions associated with familiar markedness constraints are given in (5).

(5) Some Locus Functions

$Loc_{NOVCDOB} \equiv$ Return every C, where C is [–sonorant, +voice].

$Loc_{ONSET} \equiv$ Return every V, where V is initial in some syllable.

$Loc_{NO-CODA} \equiv$ Return every C, where C is final in some syllable.

$Loc_{PARSE-SYLL} \equiv$ Return every V, where V is the head of an unfooted syllable.

$Loc_{FT-BIN} \equiv$ Return every V, where V is the head of a syllable that is the head of a unary foot.

The definitions in (5) reflect two tentative assumptions: loci are individual segments, not strings; and constraints on structures usually return the heads of those structures as loci.

This first pass through comparative markedness theory will be sufficient for this article. Some further issues should not go unremarked on, however. First, because we will need to talk about

corresponding loci in different candidates, loci must be elements that stand in correspondence (see (6)). Segments, at least, do correspond, but it is controversial whether features or prosodic constituents do, and relations like association lines certainly do not. Whatever the elements of correspondence turn out to be, they will also be the loci of markedness violation. Second, for contextual constraints, the choice of locus may not be obvious and it may ultimately prove necessary to allow strings of segments to be loci. Third, gradient constraints in general, and gradient alignment constraints in particular, cannot be defined in terms of a function that returns instances of a marked structure. For example, $\text{ALIGN}(\text{Ft}, \text{Word}, \text{L})$, as defined in McCarthy and Prince (1993), assigns for every foot one violation mark for every syllable standing between that foot and the left edge of the word. Elsewhere (McCarthy 2002c), I have argued that there are no gradient constraints, and so this potential impediment to redefining markedness in terms of Loc functions has been eliminated.

Under this new approach to defining markedness constraints, a classic constraint M_i could be said to assign its violation marks in the following way. M_i is defined by some locus function Loc_i . The result of applying M_i to *cand* is a number of violation-marks equal to the cardinality of the set obtained by applying Loc_i to *cand*. The comparative markedness constraints ${}_O M_i$ and ${}_N M_i$, which replace M_i , use the same function Loc_i . But the comparative constraints must additionally check whether the members of the locus set are new or old violations.

Therefore, the next step in formalizing comparative markedness theory is defining what it means for two candidates from the same input to share a locus of violation. ${}_O M$ constraints assign marks only for loci that are shared with the FFC; ${}_N M$ constraints assign marks only for loci that are not shared with the FFC. This sharing relation holds between two candidates derived from the same input, so it must be mediated by correspondence. Correspondence theory (McCarthy and Prince 1995, 1999) relates inputs to outputs (though see §4.2 for extension to other correspondence

relations), so a correspondence relation that is transitivized by way of the input is required. This **t-correspondence** is defined in (6).

(6) T-correspondence

Let *cand1* and *cand2* be two candidates from input *inp*. Let *s1* be a segment (or other corresponding element) in *cand1* and *s2* be a segment in *cand2*. Then *s1* **t-corresponds** to *s2* iff *s1* corresponds to some segment *s-inp* in *inp* and *s2* also corresponds to *s-inp*. We say then that $s1 \mathfrak{R}_t s2$, with \mathfrak{R}_t standing for the correspondence relation obtained through transitivity.

In other words, the segments in different candidate forms t-correspond if they correspond to the same elements in the input. Each candidate brings with it its own correspondence relation \mathfrak{R}_i , so different relations are involved in each link of the chain. With $s1 \mathfrak{R}_1 s\text{-inp} \mathfrak{R}_2 s2 = s1 \mathfrak{R}_t s2$, we can sensibly compare loci of violation in different candidates.

We are now ready to combine these two notions, the Loc function and t-correspondence, to form a theory of comparative markedness. A comparative constraint ${}_xM$ is a function from the 3-tuple (cand, FFC, \mathfrak{R}_i) to zero or more violation-marks. The old and new versions of a constraint are distinguished according to the definitions in (7).

(7) Comparative Markedness Defined

${}_N M_i(\text{cand}, \text{FFC}, \mathfrak{R}_t) \equiv$ Let $\text{Loc}_i(\text{cand}) = \{c_1, c_2, c_3, \dots\}$ and let $\text{Loc}_i(\text{FFC}) = \{f_1, f_2, f_3, \dots\}$. For each c_m that lacks a t-correspondent among f_n , assign one violation mark.

${}_O M_i(\text{cand}, \text{FFC}, \mathfrak{R}_t) \equiv$ Let $\text{Loc}_i(\text{cand}) = \{c_1, c_2, c_3, \dots\}$ and let $\text{Loc}_i(\text{FFC}) = \{f_1, f_2, f_3, \dots\}$. For each c_m that has a t-correspondent among f_n , assign one violation mark.

For example, **ʔagbar* in (2d) contains two loci of NOVCDOb violation. One of those loci is *g*. It is a voiced obstruent, but it does not t-correspond to a voiced obstruent in the FFC *ʔakbar*. By virtue of this *g*, then, **ʔagbar* receives one violation-mark from ${}_N \text{NOVCDOb}$. The other locus of violation is *b*. It too is a voiced obstruent, and moreover it t-corresponds to a voiced obstruent in the FFC. By virtue of this *b*, **ʔagbar* receives a violation-mark from ${}_O \text{NOVCDOb}$ as well. On the other hand, *ʔakbar* in (2c) violates only ${}_O \text{NOVCDOb}$. Since *ʔakbar* is itself the FFC, all of its markedness violations are perforce shared with the FFC, and so it can only violate old markedness constraints.

To sum up, ${}_N M$ and ${}_O M$ keep track of new and old markedness violations in a candidate. A markedness violation is new if the corresponding segment in the FFC **is not** similarly marked; a markedness violation is old if the corresponding segment in the FFC **is** similarly marked.³

This leaves one last foundational matter to be dealt with: the why and the what of the FFC. Why are candidates evaluated by comparison with the FFC rather than the input itself? Comparison with the input would simplify the theory by eliminating the need for t-correspondence but runs into problems because inputs may lack fully predictable structure, such as syllabification, or they may have it wrong. If so, then every ONSET violation might appear to be new even if, intuitively, it is not. The FFC, unlike the input, is guaranteed to be fully formed, and so its markedness violations can be

sensibly compared to those of any other candidate. (Also see McCarthy (2002a) and Jun (2002) for parallel discussion of this point. Interestingly, Jun demonstrates a need for the FFC in a very different domain, positional faithfulness.)

Every candidate set emitted by GEN contains a fully faithful candidate (FFC). This assumption is more or less implicit in the basic statements of OT, it is a necessary consequence of correspondence theory, and it is made explicit in Moreton (1996/1999). By definition, the FFC obeys every faithfulness constraint. In correspondence terms, the relation \mathfrak{R} between the input and the FFC is one-to-one, onto, and order-preserving (MAX, DEP, LINEARITY, INTEGRITY, and UNIFORMITY are all obeyed) with only identical elements standing in correspondence (all IDENT(feature) constraints are obeyed).

A candidate set may contain more than one candidate that is fully faithful in this sense. Phonological properties that are universally non-contrastive are not governed by faithfulness constraints, so candidates that differ only in these properties are equivalent, faithfulness-wise. The obvious example is tautomorphemic syllabification, which is claimed never to be contrastive (Blevins 1995: 221, Clements 1986: 318, Hayes 1989: 260). An unsyllabified input like /maba/ or a syllabified input like /mab.a/ will be associated by GEN with many faithful and fully syllabified candidates: *m.a.b.a*, *ma.b.a*, *m.a.ba*, *m.aba*, *m.ab.a*, *ma.ba*, *mab.a*, *maba*. But to evaluate comparative markedness constraints, a unique FFC is required.

A proposal for finding a unique FFC is made in McCarthy (2002a). It selects as FFC the faithful candidate that is, in effect, the most harmonic, using a procedure that is reminiscent of lexicon optimization (Prince and Smolensky 1993). Because space is limited, I am not able to present that proposal here; this lacuna will not interfere with the arguments in this article, however, since only contrastive properties are involved in the comparative constraints under discussion.

§4. Prohibiting New Marked Structures

This section looks at the result of ranking an $_N$ M constraint high and its $_O$ M counterpart low. There are three parts. In §4.1, grandfather effects are re-examined in light of the formalization in §3. In §4.2, I show how derived environment effects can be analyzed. Then §4.3 contrasts comparative markedness with an alternative, local conjunction of markedness and faithfulness constraints.

§4.1 Grandfather Effects Revisited

The discussion in §2 introduced grandfather effects and showed how voicing assimilation in Mekkan Arabic can be analyzed with comparative markedness constraints. This section documents the grandfather phenomenon more fully. (For further exemplification, see McCarthy 2002a.)

In a grandfather effect, a markedness constraint of UG is observed to block an otherwise general phonological process, but not to affect instances of the marked structure that are already there. In Mekkan Arabic, the markedness constraint with this force is NOVCDOB. In its two versions, it blocks assimilation when it would create voiced obstruents ($_N$ NOVCDOB dominates AGREE(voice)) and permits underlying voiced obstruents to emerge unscathed (IDENT(voice) dominates $_O$ NOVCDOB). A similar case is presented by Sri Lankan Portuguese Creole (Hume and Tserdanelis 2002, de Lacy 2002). There is a general process of place assimilation in nasal+stop clusters (8a), but assimilation is blocked from changing unmarked coronals into marked dorsals or labials (8a).

(8) Place Assimilation in Sri Lankan Portuguese Creole

- | | | | |
|----|-------------------------------|------------------------------|-------------------------------------|
| a. | /ma:m/ | ma:nsu, ma:mpə, ma:ŋki | ‘hand (gen. sg./dat. sg./verbal N)’ |
| | /mi:tij/ | mi:tinsu, mi:timpə, mi:tijki | ‘meeting (id.)’ |
| b. | But coronals don’t assimilate | | |
| | /si:n/ | si:nsu, si:npə, si:nki | ‘bell (id.)’ |

A somewhat different kind of grandfather effect comes from the well-known case of vowel harmony in Warlpiri (Nash 1979, 1980, Steriade 1979, van der Hulst and Smith 1985). Warlpiri has four processes that produce *i/u* alternations, but three are highly restricted morphologically. I therefore focus on the fourth, which is general in its effects. The vowel *u* in suffixes harmonizes to a preceding *i* (9a). But this harmony process is blocked by a labial consonant that is immediately followed by *u* (9b).

(9) Warlpiri Vowel Harmony (examples from van der Hulst and Smith 1985)

- | | | |
|-----|----------------------------|------------------------------|
| a. | maliki-kirli-rli-lki-ji-li | ‘dog-COMIT-ERG-then-me-they’ |
| cf. | minija-kurlu-rlu-lku-ju-lu | ‘cat-id.’ |
| | kurdu-kurlu-rlu-lku-ju-lu | ‘child-id.’ |
| b. | ŋamirni-puraji | ‘uncle-your’ |
| | *ŋamirni-piraji | |
| | ŋali-wurru | ‘we two (incl.)-EMPH’ |
| | *ŋali-wirri | |

Roots like *minija*, with root-final *a*, show that the suffixes in (9a) contain underlying /u/, which is changed to *i* under the influence of root-final *i* in *maliki*. The examples in (9b) show that suffixal /u/ is not affected by harmony if it is immediately preceded by a labial consonant.

The special status of *Pu* sequences in Warlpiri harmony is related to the well-attested phenomenon of labial attraction (Campbell 1974). In various languages, a vowel after a labial consonant becomes round. For example, Igbo has *Ci* reduplication except if C is labial, in which case *i* is replaced by *u*: /le/ → *o-li-le* ‘looks’ vs. /be/ → *o-bu-be* ‘cuts’. From phenomena like this, we can safely infer that the universal constraint component CON includes the constraint defined in (10).

(10) $\text{Loc}_{\text{LABATT}}$

Return every i that is immediately preceded by a labial consonant (p, m, w).

But Warlpiri has no active labial attraction process, since sequences of labial+ i are permitted freely in roots and suffixes (examples from Nash 1980): *wapirri-mi* ‘ABS conceal, cover up DAT’, *wipi-mi* ‘ABS radiate out’. Nonetheless, LABATT manages to block unrounding harmony. Comparative markedness allows it to do that.


Since Warlpiri has a process of unrounding harmony, the constraint AGREE(round), defined as in (11) (also see (38)), is visibly active.

(11) $\text{Loc}_{\text{AGREE}(\text{round})}$

Return every u that is in a syllable adjacent to i .


AGREE(round) crucially dominates IDENT(round), as shown in (12). (Spreading is from root to affix because of $\text{IDENT}_{\text{ROOT}}(\text{round})$ (McCarthy and Prince 1995).)

(12) Warlpiri: AGREE(round) \gg IDENT(round)

/maliki-kurlu-rlu-lku-ju-lu/	AGREE(round)	IDENT(round)
a.  maliki-kirli-rli-lki-ji-li		*****
b. maliki-kurlu-rlu-lku-ju-lu	*!	
c. maliki-kirli-rlu-lku-ju-lu	*!	*

Spreading is not allowed to create new Pi sequences, however, showing that N_{LABATT} is ranked above AGREE(round), as (13) proves.


(13) Warlpiri: ${}_N\text{LABATT} \gg \text{AGREE}(\text{round}) \gg \text{IDENT}(\text{round})$

/ŋali-wurru/	${}_N\text{LABATT}$	AGREE(round)	IDENT(round)
a.  (FFC) ŋaliwurru		*	
b. ŋaliwirri	*!		**

This result is key. The problem with **ŋaliwirri* is that it has introduced a new violation of LABATT. This violation is new because the locus of violation, the post-labial *i* of the third syllable, *t*-corresponds to a *u* in the FFC *ŋaliwurru*. Though **ŋaliwirri* better satisfies AGREE(round), it has gotten the worse of the bargain, because ${}_N\text{LABATT}$ is ranked higher than AGREE.

Warlpiri requires comparative markedness because ${}_O\text{LABATT}$ must be ranked below AGREE. This follows from transitivity: ${}_O\text{LABATT}$ is ranked below IDENT(round), which AGREE dominates. The proof that ${}_O\text{LABATT}$ is ranked below IDENT(round) comes from underlying *Pi* sequences, which surface unaltered in Warlpiri (see (14)).

(14) Warlpiri: $\text{IDENT}(\text{round}) \gg {}_O\text{LABATT}$

/wipi-mi/	IDENT(round)	${}_O\text{LABATT}$
a.  (FFC) wipimi		***
b. wupumu	***!	

The form *wipimi* is itself the FFC. Therefore, it violates no faithfulness constraints and any of its markedness violations must be old. Since segments in the FFC *t*-correspond to themselves, *wipimi* incurs three marks from ${}_O\text{LABATT}$. This is how underlying *Pi* is grandfathered.

This argument supports the main claim of comparative markedness theory, that the new and old versions of markedness constraints are distinct. The ranking required in Warlpiri is $\llbracket {}_N\text{LABATT} \gg \text{AGREE}(\text{round}) \gg \text{IDENT}(\text{round}) \gg {}_O\text{LABATT} \rrbracket$, with ${}_N\text{LABATT}$ and ${}_O\text{LABATT}$ ranked separately.

This difference in ranking is necessary to explain why labial attraction blocks harmony but is not otherwise an active process of this language.

There are two alternatives to comparative markedness in analyzing Warlpiri. One is the more or less standard autosegmental treatment, where labial consonants block harmony because they project a feature on the [labial] tier. On this view, the blocking of harmony in Warlpiri is not directly connected with the existence of labial attraction processes in other languages: harmony is blocked because labial consonants project the [labial] feature, whereas labial attraction involves a rule spreading that feature. Already, this seems like a liability. The liability is compounded by the fact that labial consonants do not block one of the morphologically restricted Warlpiri harmony processes, regressive spreading of [+round], as the examples in (15) show.

(15) Regressive [+round] Harmony in Warlpiri (Nash 1980: 93)

/yirrpɪ-rnu/ yurɾpurnu ‘insert-Past’

/kipɪ-rnu/ kupurnu ‘winnow-Past’

If labial consonants block [–round] harmony because they project on the labial tier, why don’t they block [+round] harmony? Comparative markedness has a ready answer: [+round] harmony creates *u*’s, so it cannot introduce violations of $_N$ LABATT. In contrast, autosegmental approaches to blocking like the one in Nash (1980: 94) are forced to adopt special measures to deal with this difference.

Another alternative approach to Warlpiri is based on elaborating the faithfulness theory rather than the markedness theory. Suppose that there are symmetric IDENT(+F)/IDENT(–F) or MAX(F)/DEP(F) constraints (see Lombardi 2001, Pater 1999, Pulleyblank 1996 among others). The constraint IDENT(+round) is violated by /u/ → *i* mappings, while IDENT(–round) is violated by /i/ → *u* mappings. The key to analyzing Warlpiri in these terms is to deploy IDENT(–round) at the top of the hierarchy and IDENT(+round) at the bottom, as in tableau (16).

(16) Warlpiri with IDENT(+F)/IDENT(-F)

	IDENT (-round)	LABATT	AGREE (round)	IDENT (+round)
/maliki-kurlu-rlu-lku-ju-lu/				
a. maliki-kirli-rli-lki-ji-li				*****
b. maliki-kurlu-rlu-lku-ju-lu			*!	
/wipi-mi/				
c. wipimi		***		
d. wupumu	***!			
/ɲali-wurru/				
a. ɲaliwurru			*	
b. ɲaliwirri		*!		**

The problem with this approach is that it fails to generalize. It analyzes grandfather effects as a specific problem in featural faithfulness rather than as a broader issue in the activity of markedness constraints. To see the difference, consider the case of Sundanese, where the IDENT(+F)/IDENT(-F) approach fails because the relevant processes involve mappings that go in the same direction.

The example comes from Cohn's (1992) analysis of Sundanese liquid dissimilation (see also Holton 1995). Sundanese has an infix /ar/ that goes after the initial consonant: *d-ar-amaj* 'well (pl.)', *p-ar-oho* 'forget (pl.)'. This infix is realized as *al* under the conditions given in (17).

(17) /ar/ → *al* in Sundanese

a. If there is another *r* anywhere in the root:

p-al-ərceka	‘handsome’
c-al-ombrek	‘cold’
m-al-otret	‘take a picture’
b-al-ocor	‘leaking’
ŋ-al-umbara	‘go abroad’

b. But dissimilation is blocked when it would create *IVrV* or *rVIV* sequences:

c-ar-uriga	‘suspicious’	*c-al-uriga
r-ar-ahit	‘wounded’	*r-al-ahit

c. /ar/ → *al* assimilatorily to eliminate *IVrV* sequences:

l-al-itik	‘little’	*l-ar-itik
-----------	----------	------------

d. But no assimilation to eliminate *rVIV* sequences:

g-ar-ilis	‘beautiful’
m-ar-ahal	‘expensive’

The basic process is one of *r*-dissimilation (17a): when there are two *r*'s in a word, the affixal *r* dissimilates to *l*. But *r* doesn't always dissimilate. It fails to dissimilate (17b) when it would create a sequence of successive simplex onsets that differ in laterality (Cohn 1992: 207), i.e. *IVrV* and *rVIV*. Furthermore, there is assimilation of affixal *r* to *l* (17c) to eliminate the first of these sequences, *IVrV*. But (17d) shows that *rVIV* sequences are not otherwise eliminated. This is the grandfather effect: dissimilation is blocked from creating *rVIV* sequences, but these sequences are not actively eliminated when they are inherited from the input.

In Sundanese, the entire burden of the analysis involves accounting for the conditions under which /r/ does or does not map to *l*. Therefore, in terms of the IDENT(+F)/IDENT(-F) approach, only one faithfulness constraint is involved, IDENT(-lateral). To account for the basic dissimilation process, it must be ranked below OCP(*r*), which prohibits multiple occurrences of *r* within a word.

(18) Sundanese with IDENT(+F)/IDENT(-F) I: OCP(*r*) \gg IDENT(-lateral)

	/b-ar-ocor/	OCP(<i>r</i>)	IDENT(-lateral)
a.	ꦧꦫꦺꦴꦕꦺꦴꦫꦶꦁ balocor		*
b.	barocor	*!	

The fact that the affix and never the root is affected shows that IDENT_{Root}(-lateral) is undominated.

Since *IVrV* and *rVIV* sequences are treated differently, they must be under the control of different markedness constraints — for present purposes, just call them **IVrV* and **rVIV*. Both dominate OCP(*r*), since both can block dissimilation, as (19) shows.

(19) Sundanese with IDENT(+F)/IDENT(-F) II: **IVrV*, **rVIV* \gg OCP(*r*)

		<i>*IVrV</i>	<i>*rVIV</i>	OCP(<i>r</i>)	IDENT(-lateral)
	/c-ar-uriga/				
a.	ꦕꦫꦸꦫꦶꦁ caruriga			*	
b.	caluriga	*!			*
	/r-ar-ahit/				
c.	ꦫꦫꦲꦶꦠ rarahit			*	
d.	ralahit		*!		*

By transitivity of domination, $*lVrV$ and $*rVlV$ are ranked above $\text{IDENT}(-\text{lateral})$. Therefore, they should also be able force assimilation when the root contains an l near the infix $/ar/$. Assimilation is observed with $/lVrV/$ sequences (20a, b), but not with $/rVlV/$ sequences (20c, d).

(20) Sundanese with $\text{IDENT}(+F)/\text{IDENT}(-F)$ III: Assimilatory effects

	$*lVrV$	$*rVlV$	$\text{OCP}(r)$	$\text{IDENT}(-\text{lateral})$
$/l\text{-ar-}\dot{\text{t}}\text{tik}/$				
a. $\text{lar}\dot{\text{t}}\text{tik}$				*
b. $\text{lar}\dot{\text{t}}\text{tik}$	*!			
$/g\text{-ar-}\dot{\text{i}}\text{lis}/$				
c. $\text{gar}\dot{\text{i}}\text{lis}$		*!		
d. $\text{gal}\dot{\text{i}}\text{lis}$				*

This is a problem. In (20c, d), the candidate with assimilation is wrongly evaluated as optimal. This candidate should win because its competitor, $\text{gar}\dot{\text{i}}\text{lis}$, violates $*rVlV$, and $*rVlV$ is ranked high, just like $*lVrV$. In reality, $\text{gar}\dot{\text{i}}\text{lis}$ is grandfathered. The $\text{IDENT}(+F)/\text{IDENT}(-F)$ analysis is fundamentally unable to capture the difference in treatment of potential $rVlV$ and $lVrV$ sequences. Here, then, is a grandfather effect that cannot be analyzed by differentiating $\text{IDENT}(+F)/\text{IDENT}(-F)$.

On the other hand, Sundanese presents no difficulties for comparative markedness theory. The key is that ${}_N *rVlV$ is ranked high, above $\text{OCP}(r)$, so it can block dissimilation with inputs like $/r\text{-ar-}\dot{\text{a}}\text{h}\dot{\text{t}}\text{t}/$. But its counterpart ${}_O *rVlV$ is ranked below $\text{IDENT}(\text{lateral})$, so it is unable to trigger assimilation with inputs like $/g\text{-ar-}\dot{\text{i}}\text{lis}/$. Tableau (21) summarizes the analysis that comparative markedness theory provides.

(21) Sundanese with Comparative Markedness

$${}_N^*IVrV, {}_N^*rVIV \gg OCP(r) \gg IDENT(lateral) \gg {}_O^*rVIV$$

$${}_O^*IVrV \gg IDENT(lateral) \gg {}_O^*rVIV$$

	${}_N^*IVrV$	${}_O^*IVrV$	${}_N^*rVIV$	OCP(r)	IDENT(lateral)	${}_O^*rVIV$
/c-ar-uriga/						
a. (FFC) \Rightarrow caruriga				*		
b. caluriga	*!				*	
/l-ar-#itik/						
c. \Rightarrow lalitik					*	
d. (FFC) laritik		*!				
/r-ar-ahit/						
e. (FFC) \Rightarrow rarahit				*		
f. ralahit			*!		*	
/g-ar-#ilis/						
g. (FFC) \Rightarrow garilis						*
h. galilis					*!	

In (21a, b), dissimilation is blocked by undominated ${}_N^*IVrV$. Likewise, in (21c, d), assimilation is compelled by undominated ${}_O^*IVrV$. The interesting contrast is (21e, f) vs. (21g, h). In *rarahit*, dissimilation is again blocked, this time by undominated ${}_N^*rVIV$. In *garilis*, though, assimilation is not compelled, because ${}_O^*rVIV$ is ranked below faithfulness. This ranking difference is exactly what the theory of comparative markedness predicts to be possible.

As I noted in §2, grandfather effects are analyzed by Archangeli and Pulleyblank (1994: 293-4) under the rubric of target conditions, which are specific restrictions on the segment targeted by a phonological rule. One of their examples comes from Yawelmani. A certain suffix supplies a

floating glottal feature that attempts to anchor onto the preceding root. It glottalizes a post-vocalic sonorant and otherwise segmentalizes or deletes (Archangeli and Pulleyblank 1994: 346ff., Newman 1944): /caw-’a:hin/ → *caw’a.hin* ‘shout’ vs. /max-’a:hin/ → *maxʔa.hin* ‘procure’, /hogn-’a:hin/ → *hoga.nhin* ‘float’. Yawelmani does not in general prohibit glottalized obstruents, as shown by examples like *bok’en* ‘will find’ or *hiwt’iwlaxoʔ* ‘becomes very happy’. Nonetheless, the process that docks the floating feature is prohibited from creating glottalized obstruents. This shows that the markedness constraint against new instances of [–sonorant, +glottal] segments is ranked high, though its old alter ego is ranked too low to compel unfaithfulness. It seems likely that all examples of target conditions can be reanalyzed in these terms, capturing Archangeli and Pulleyblank’s insight without giving free rein to process-specific constraints (cf. Davis 1995, McCarthy 1997, 2002d: 103-6).

§4.2 *Derived Environment Effects*

In an important paper, Łubowicz (2002) draws our attention to the problem that derived environment effects (DEE’s) present for classic OT. For example, in the Austronesian language Makassarese (Aronoff *et al.* 1987, Broselow 1999, McCarthy and Prince 1994), there is a process of vowel-copying epenthesis that applies after root-final *r*, *l*, and *s* (22a). In addition to the copied vowel, though, a final *ʔ* is epenthésized as well. Yet words with an underlying final vowel do not get an epenthetic *ʔ* (22b).

(22) Epenthesis in Makassarese

a.	/rantas/	rántasaʔ	‘dirty’
	/tetter/	téttereʔ	‘quick’
	/jamal/	jámalaʔ	‘naughty’
b.	/lompo/	lómpo, *lómpoʔ	‘big’

So ζ -epenthesis only affects vowel-final words that are derived by vowel epenthesis, not words that are already vowel-final.

Makassarese is a case of a phonologically derived environment: one process (vowel epenthesis) creates the conditions for another process (ζ -epenthesis). There are also cases, to be discussed shortly, where a process only occurs in an environment that has been derived by the morphology.

Phonological DEE's are problematic for classic OT because there is no way to limit an unfaithful mapping (here, ζ -epenthesis) to contexts where another unfaithful mapping also occurs (here, vowel epenthesis). A classic OT grammar that can map /rantas/ to *rántasa* cannot help but map /lompo/ to **lómpo*. To accommodate cases like Makassarese, the classic theory must be enriched — with local conjunction, as Łubowicz argues (see §4.3), or with comparative markedness, as I claim. If M is the classic markedness constraint responsible for ζ -epenthesis, then in Makassarese only N_M is ranked high enough to compel insertion of ζ .

First, the background to the analysis. Vowel epenthesis is a consequence of undominated CODA-COND, which permits only assimilated codas medially and ζ or η finally. (Presumably, it prevents codas from having their own place specifications (Ito 1989), if η is actually the placeless nasal (Trigo 1988).) Since forbidden codas are eliminated by epenthesis, CODA-COND must dominate the anti-epenthesis constraint DEP-V, as shown in (23).

(23) Makassarese: CODA-COND \gg DEP-V

	/rantas/	CODA-COND	DEP-V
a.	↗ rantasa?		*
b.	(FFC) rantas	*!	

Epenthesis of λ is a response to the markedness constraint FINAL-C (McCarthy and Prince 1994), defined as in (24).

(24) $\text{Loc}_{\text{FINAL-C}}$

Return every V, where V is final in a phonological word.

This constraint is independently justified in the Makassarese reduplicative system⁴ and in other languages (see §5.1). Because only new V-final words show λ -epenthesis, $\text{N}_{\text{FINAL-C}}$ must be the higher-ranked member of this oM/NM pair (see (25)).

(25) Makassarese: CODA-COND \gg DEP-V, DEP-C
 $\text{N}_{\text{FINAL-C}} \gg \text{DEP-C} \gg \text{o}_{\text{FINAL-C}}$

/rantas/	$\text{N}_{\text{FINAL-C}}$	CODA-COND	DEP-V	DEP-C	$\text{o}_{\text{FINAL-C}}$
a. $\text{r} \rightarrow \text{r} \text{a} \text{n} \text{t} \text{a} \text{s} \text{a} \text{?}$			*	*	
b. rantasa	*!		*		
c. (FFC) rantas		*!			
/lompo/					
d. (FFC) $\text{l} \rightarrow \text{l} \text{o} \text{m} \text{p} \text{o}$					*
e. lompo?				*!	

First, consider the consonant-final input /rantas/. Candidate (25b) contains a locus of violation of FINAL-C, the final *a*. This vowel, precisely because it is epenthetic, does not correspond to any segment in the FFC *rantas* (25c). This means that (25b) violates $\text{N}_{\text{FINAL-C}}$ — it contains a new FINAL-C violation, not shared with the FFC.

Now consider a vowel-final input. Candidate (25d) also contains a locus of violation of FINAL-C, the final *o*. Its competitor (25f) does not. But since (25d) is the FFC, its locus of violation of FINAL-C trivially t-corresponds to a locus in the FFC. This is a shared or old violation, which

means that ${}_N\text{FINAL-C}$ is satisfied by (25f), though ${}_O\text{FINAL-C}$ is not. With this ranking, the faithful candidate triumphs over the candidate that merely satisfies low-ranking ${}_O\text{FINAL-C}$.

On the basis of this example, we can devise the ranking schema in (26) for DEE's (and grandfather effects).

(26) Ranking Schema for a Derived Environment Effect

$${}_N\text{M} \gg \text{Faith} \gg {}_O\text{M}$$

Informally, this says that new violations of M are avoided, even at the expense of being unfaithful, but old violations are tolerated. For example, Makassarese /*rantas*/ maps to *rantasaʔ* because the alternative, *rantasa*, would introduce a new instance of a marked configuration (a word-final vowel) that is not present in the FFC *rantas*. But Makassarese also has the mapping /*lompo*/ → *lompo* because *lompo*, which is itself the FFC, only has an old instance of the marked V-final configuration.

Makassarese is representative of the phonological type of DEE. The other type involves a process that takes place only when its conditions are crucially met by virtue of material from two different morphemes. In Korean, for example, alveolar /*t*/ neutralizes with palato-alveolar /*c*/ when followed by *i* across morpheme boundary, though not when followed by tautomorphemic *i*.

(27) Korean Palatalization⁵ (Ahn 1998)

a.	/pat ^h -i/	pac ^h i	‘field-COP’
	/mat-i/	maci	‘eldest-NOM’
b.	/mati/	mati	‘knot’
cf.	/kac ^h i/	kac ^h i	‘value’

In short, there is palatalization only when the alveolar+*i* sequence is heteromorphemic.

Comparative markedness will also account for morphological DEE's like the one in Korean, through a very natural generalization of the theory we've been working with thus far.⁶

Correspondence theory asserts that faithfulness is not just a relation between inputs and outputs; it also extends to base/reduplicant pairs (McCarthy and Prince 1995, 1999) and to morphologically-related output forms (Benua 1997 and others). Separate faithfulness constraints apply to each of these correspondence relations; for instance, the input-output faithfulness constraint IO-MAX is distinct from the output-output faithfulness constraint OO-MAX. The former prohibits deletion in the input-output mapping, while the latter prohibits deletion in the mapping between a morphologically simpler output form (which Benua calls the “base”) and a morphologically more complex output form derived from it by affixation.

Comparative markedness is rooted in the theory of correspondence (see §3). Therefore, if correspondence is extended to base-reduplicant or output-output relations, comparative markedness is also extended to these relations. The comparative markedness constraints discussed previously pertain to the input-output relation. Stricly speaking, this fact should be incorporated into the names of the constraints; e.g., the constraints appearing in the analysis of Mekkan Arabic (2, 3) are really IO-_ONOVCDOB and IO-_NNOVCDOB. To complete the parallel with faithfulness constraints, there will also be comparative markedness constraints like BR-_ONOVCDOB and OO-_NNOVCDOB. The latter, for example, militates against voiced obstruents that are new in the output-output relation. For example, the German word *Bunde* [bʊndə] ‘federations’ violates OO-_NNOVCDOB because the output form of its base, *Bund* [bʊnt] ‘id. sg.’, has a final voiceless obstruent. On the other hand, *Bunde* violates IO-_ONOVCDOB because the [d] is old on the input-output correspondence relation, since the underlying root is /bʊnd/.

Space limitations do not permit full exploration of this aspect of comparative markedness theory, but its relevance to the Korean example should be clear. A markedness violation is new relative to the output-output faithfulness relation if the locus of violation in the derived form is not

matched in the simple form. Korean **mati* from /mat-i/ contains an unpalatalized *ti* sequence that is new relative to the base *mat*, but the tautomorphemic *ti* sequence in *mati* from /mati/ ‘knot’ is old, since there is no simpler base form from which /mati/ is derived by adding *i*.

Assume there is a markedness constraint PAL-L (“L” for left) defined by the locus function in (28).

(28) $\text{Loc}_{\text{PAL-L}}$

Return every C, where C is an anterior coronal that immediately precedes *i*.

Palatalization is restricted to morphologically-derived environments because only $\text{OO}_{\text{-N}}\text{PAL-L}$ is active in Korean. It assigns a mark to *t* preceding *i* if *t*'s OO correspondent does not precede *i*. The ranking responsible for this state of affairs is given in (29).

(29) Korean: $\text{OO}_{\text{-N}}\text{PAL-L} \gg \text{IDENT} \gg \text{IO}_{\text{-O}}\text{PAL-L}$

	$\text{OO}_{\text{-N}}\text{PAL-L}$	IDENT	$\text{IO}_{\text{-O}}\text{PAL-L}$
/tot/			
a. 톳 (FFC) tot			
b. toc		*!	
/tot-i/			
c. 톳 toci		*	
d. (FFC) toti	*!		*
/mati/			
e. 맷 (FFC) mati			*
f. maci		*!	

Obviously, there is no palatalization in the base *tot* (29a). This lack of palatalization in the base is, in a sense, responsible for the presence of palatalization in the derived form, since it is the reason

behind **toti*'s crucial violation of OO-_NPAL-L (29d). The final pair of candidates (29e, f) shows why there is no general palatalization process in Korean: faithfulness dominates IO-_OPAL-L.⁷

This analysis of Korean suggests a general approach to morphological derived environment effects. The constraint OO-_NM is violated only by those loci of M violation that are not shared with the base form in OO correspondence. Violations of OO-_NM are reckoned as new relative to this other output form, rather than the input. If OO-_NM dominates a relevant faithfulness constraint, and if its other OO and IO counterparts are ranked below faithfulness, then a process will be observed to occur only when its conditions are met by virtue of morphological derivation. If both OO-_NM and IO-_NM are ranked high, then a process will be observed to occur in both phonologically and morphologically derived environments, approximating the effect of Mascaró's (1976) Strict Cycle Condition. Because of ranking permutation, phonologically and morphologically derived environments are decoupled from one another, in agreement with other recent work (see Łubowicz 2002 for discussion and references).

One final remark. Grandfather effects and DEE's are both obtained from rankings modeled on the schema (26). In grandfathering and DEE's, _NM dominates some relevant faithfulness constraint, while its _OM counterpart is dominated by the same faithfulness constraint. This is not an accident. Though grandfather effects and DEE's seem rather different when first encountered, they are really the same thing. This is perhaps easiest to see when a grandfather effect is analyzed with a rule-based derivation. For example, the analysis of Mekkan Arabic could be done with a process that devoices only **derived** voiced obstruents in coda position, as shown by the traditional derivation in (30).

(30) Mekkan Arabic Derivationally

Underlying	/ʔagsam/	/ʔakbar/	/ʔibnu/
Regressive [αvoice] assimil.	ʔaksam	ʔagbar	—
Coda devoicing (DEE)	—	ʔakbar	Blocked

In this analysis, coda devoicing is assumed to apply only in a derived environment, so it is limited to undoing the effects of regressive voicing assimilation. The result is an A→B→A Duke-of-York derivation (McCarthy 2003b, Pullum 1976) for /ʔakbar/(McCarthy 2003, Pullum 1976): /k/ → g → k. In rule-based phonology, a grandfather effect is the result of combining a Duke-of-York derivation with blocking in phonologically underived environments.

I have approached grandfather effects and DEE's separately because they are conceptually somewhat different. Grandfather effects are static: a process like assimilation is blocked by the _NM constraint. DEE's are dynamic: a process is triggered by the _NM constraint. But there is no real difference. OT makes no distinction between static restrictions and dynamic processes; the same markedness constraints are responsible for both. Grandfather effects and DEE's have the same schematic ranking because the static and dynamic come from the same source, by a fundamental tenet of OT.

§4.3 Grandfather Effects, DEE's, and Constraint Conjunction

The core of comparative markedness theory is the idea that markedness constraints can look simultaneously at the candidate under evaluation and at the fully faithful candidate. A roughly similar notion is involved in another approach to DEE's, conjunction of markedness and faithfulness constraints. This section compares the two theories.

In the approach to DEE's developed by Łubowicz (2002), faithfulness constraints and classic non-comparative markedness constraints are locally conjoined in the sense of Smolensky (1995).

(The local conjunction of constraints A and B, $[A\&B]_{\delta}$, is a constraint that is violated once for every constituent δ that violates both A and B.) With the right ranking, it is possible to ensure that the markedness constraint in the conjunction is active only when and where the faithfulness constraint is violated. In Makassarese, for instance, the markedness constraint FINAL-C is active — that is, able to compel unfaithful analysis — only on segments that are epenthetic. For example, /rantas/ maps to *rantasa?* and not **rantasa* because the final *a* is epenthetic and so FINAL-C is activated. But FINAL-C is not active on candidates whose final segment is unchanged from the input, such as /lompo/ → *lompo*. Tableau (31) illustrates.

(31) Makassarese via Local Conjunction: $[DEP-V\&FINAL-C]_{seg} \gg DEP-C \gg FINAL-C$

	$[DEP-V\&FINAL-C]_{seg}$	DEP-C	FINAL-C
/rantas/			
a. \Rightarrow rantasa?		*	
b. rantasa	*!		*
/lompo/			
c. \Rightarrow lompo			*
d. lompo?		*!	

In the (31a)/(31b) comparison, the conjoined constraint $[DEP-V\&FINAL-C]_{seg}$ is decisive. By the logic of local conjunction, this constraint is violated by any candidate that simultaneously bears violation-marks from both constraints within the domain of conjunction (here, a segment). And **rantasa* has exactly that problem: it ends in an epenthetic vowel, so both DEP-V and FINAL-C are violated. The conjoined constraint is not active over the (31c)/(31d) comparison because the final *o* of *lompo* is underlying, so it is not in violation of the DEP-V half of the conjoined constraint. In

short, local conjunction of markedness with faithfulness allows the markedness constraint to be active only when and where the faithfulness constraint is violated.

There is an abstract similarity between this model and comparative markedness theory. By locally conjoining a classic markedness constraint with a faithfulness constraint, that markedness constraint is given indirect access to the input — just as comparative markedness constraints have direct access to the FFC, which is a kind of surrogate for the input. But there are also important differences that emerge when we look more closely at how these two approaches deal with DEE's.



For Kiparsky (1973), a derived environment was a matter of rule interaction. Rule A (e.g., V-epenthesis in Makassarese) creates a derived environment for rule B (ζ -epenthesis) if B's structural description would not have been met except for prior application of A. In other words, B will apply if and only if it is forced to as a result of something A does. Comparative markedness theory, though its premises are quite different, comes fairly close to reproducing Kiparsky's conception of a derived environment: some new marked configuration is introduced by the unfaithful mapping that approximates process A, and the unfaithful mapping that approximates process B occurs only when necessary to avoid the new instances of the marked configuration that A threatens to create.

The approach to derived environment effects via local conjunction is much more remote from Kiparsky's original idea, and this is arguably to its detriment. The derived environment is the domain of conjunction in which the conjoined faithfulness constraint has been violated. In other words, an environment is derived if there is nearby violation of a faithfulness constraint. This is a much more flexible notion of a derived environment, since it does not depend on process interaction. In principle, any markedness constraint M could be conjoined with any faithfulness constraint F in any domain δ , making δ a derived environment whenever F is violated.

This greater flexibility of local conjunction is unwarranted and typologically problematic. By conjoining the wrong constraints or conjoining them in the wrong domain, it is possible to produce DEE's that are not only unattested but quite implausible.

For example, imagine that the faithfulness constraint IDENT(back) is conjoined with the classic markedness constraint NOVCDOB in the domain of a syllable. Assume that this language also has a process of umlaut, so root vowels are fronted before suffixal *i*. With a ranking that is abstractly identical to (31), the result is devoicing of obstruents in syllables that contain fronted vowels (see (32)).

(32) Hypothetical: [IDENT(back)&NOVCDOB]_σ ≫ IDENT(voice) ≫ NOVCDOB

	[IDENT(back)&NOVCDOB] _σ	IDENT(voice)	NOVCDOB
/bot-i/			
a.  pöti		*	
b. böti	*!		*
/bot-a/			
c.  bota			*
d. pota		*!	

Attested DEE's don't generally look like this (though see Ito and Mester 2003). Or imagine that the grammar of Makassarese in (31) is changed slightly by substituting word for segment as the domain of conjunction: [DEP-V&FINAL-C]_{word}. The result is that vowel epenthesis anywhere in the word activates FINAL-C, so hypothetical /tarpa/ becomes *tarapa?* DEE's like this seem impossible.

Neither of these cases is a derived environment in Kiparsky's sense. The process of umlaut does not produce conditions that encourage devoicing; rather, the process of umlaut is irrelevant to the process of devoicing. But the theory of local conjunction does not impose any conditions of

relevance or relatedness on the constraints that it combines, beyond the intrinsic requirement that both be evaluable within some domain. Likewise, remote vowel epenthesis should not have any effect on the phonology of the end of the word; the derived environment created by epenthesis should be local to the affected segment and not extend beyond that. But the theory of local conjunction allows the domain of conjunction to be specified independently of the constraints conjoined in that domain, allowing for a domain that is too big, as in this case.

Łubowicz recognizes both of these issues and proposes to address them by imposing additional formal conditions on constraint conjoinability. Nonetheless, the point is clear that local conjunction does not really capture Kiparsky's original idea of a derived environment and this leads to unwanted empirical predictions. Comparative markedness, in contrast, comes closer to expressing the original derived environment notion. In fact, by its very nature, without the need for additional conditions, comparative markedness theory is unable to express absurd generalizations like those in (32). Recall the ranking schema for DEE's in (26): $[\llbracket_N M \gg \text{Faith} \gg \llbracket_O M]$. This schema says that new loci of M-violation are avoided at the expense of unfaithfulness, but old loci remain. In (32a), the mapping /*boti*/ → *böti* does not introduce a new locus of NOVCDob violation, so this more faithful mapping wins over /*boti*/ → **pöti*. And in (32b), the mapping /*tarpa*/ → *tarapa* beats /*tarpa*/ → *tarapa*? because the final *a* is not a new locus of FINAL-C violation. (Formally, a_5 of $t_1 a_2 r_3 a p_4 a_5$ corresponds to a_5 of the FFC $t_1 a_2 r_3 p_4 a_5$.) Cases like these, where another process is occurring either irrelevantly (32a) or remotely (32b) should not be possible derived environment effects, and indeed they aren't in comparative markedness theory.

Though there is insufficient space to make the argument here (for which see McCarthy 2002a), the same goes for grandfather effects, which have also been analyzed with local conjunction (Baković 2000). Overall, the local conjunction of markedness and faithfulness constraints, though

it can deal with DEE's and some kinds of grandfather effects, is both too rich and too poor a theory. Markedness-faithfulness conjunction says, in essence, that an environment is derived if some process — some faithfulness violation — has occurred nearby. There is no requirement that the process be relevant (cf. (32a)) nor that it happen close enough to matter (cf. (32b)). The analysis of Makassarese in (31) highlights this problem: the process that creates the derived environment is both relevant and near enough to interact, but the underlying theory treats this as an accident. Comparative markedness theory encounters no such difficulties, because relevance and locality are assured by the nature of the comparison mechanism.

§5. Eliminating Old Marked Structures

In §4, we looked at hierarchies where $_N M$ is ranked high and $_O M$ low. The opposite is also possible. In this section, I consider two situations where high $_O M$ /low $_N M$ is required: non-iterative processes, such as apocope and local tone spreading; and counter-feeding opacity, where the output of one process unexpectedly fails to undergo another process. Both involve actively eliminating old M-violating structures while tolerating new ones.

§5.1 Non-iterating Processes

In the context of research on iterative rules in the 1970's (e.g., Kenstowicz and Kisseberth 1977: 155-229), a class of processes was identified that should iterate but do not.⁸ For example, rules of apocope typically delete the final vowel mora, but they do not then continue to nibble off additional vowel morae until they run into a consonant (Vago and Battistella 1982). The Siouan language Hidatsa, exemplified in (33), forms the imperative in this way (Harris 1942).

(33) Hidatsa imperative

/cixi/	cix	‘jump!’	cf. cixic ‘jumped’
/kikua/	kiku	‘set a trap!’	cf. kikuac ‘(did) set a trap’
/ikaː/	ika	‘look!’	cf. ikaːc ‘looked’

If the process fed itself, we would expect /kikua/ → *kiku* → **kik*. Similar examples can be found in Latvian (Halle and Zeps 1966), Lithuanian (Lightner 1972), Odawa (Piggott 1975), Ponapean (Howard 1972: 179-81), and Woleaian (Sohn 1975). Some, like Hidatsa, are morphologized, but others are not.

Perhaps the best-known case of this type is Lardil (Hale 1973, Kenstowicz and Kisseberth 1979, Klokeid 1976, Prince and Smolensky 1993, Wilkinson 1988). In nominative-case nouns containing at least three morae, a root-final vowel is apocoped (34). Apocope exposes consonants to word-final position, where some of them (the non-apicals) are deleted in conformity with Lardil phonotactics.

(34) Lardil Apocope

/pulumunitami/	pulumunita	‘young female dugong’
/kurumpuwa/	kurumpu	‘tata-spear’
/pulɲarpa/	pulɲar	‘huge’
/muŋkumuŋku/	muŋkumu	‘wooden axe’
/tʰipitʰipi/	tʰipitʰi	‘rock-cod’

In /pulumunitami/, for example, the final vowel *i* is apocoped and the preceding consonant, *m*, deletes also, since labials are prohibited word-finally. In /pulɲarpa/, apocope and deletion of /p/ leave apical *r*, which is permitted finally.

From an OT perspective, the oddest thing about apocope is that it seems to accomplish nothing, markedness-wise. Faithful **pulumunitami* and apocopated *pulumunita* both end in vowels, so there has been no improvement in performance on FINAL-C or any other classic markedness constraint. If satisfaction of classic FINAL-C were the goal, then we would expect to see apocope delete two syllables in /pulumunitami/ → **pulumun*, since apical *n* is permitted word-finally, and no syllables at all in /muŋkumuŋku/ → **muŋkumuŋku*, which contains no apical consonants. For this reason, Prince and Smolensky (1993: 101) step outside the normal constraint typology to propose that apocope is the result of an anti-faithfulness constraint, FREE-V, that requires non-parsing of the word-final vowel.⁹ By the representational assumptions of the PARSE/FILL faithfulness model current at that time, the unparsed final vowel was present but unpronounced in the output form *kurumpu*⟨*wa*⟩. FREE-V demands a final unparsed vowel, and that is exactly what it gets.

This sort of analysis is not possible under the representational assumptions of correspondence theory, which regards apocope as literal deletion rather than underparsing. Reanalysis of Lardil must proceed either in the direction of a full-blown anti-faithfulness theory (Alderete 1998, 2001, Horwood 1999) or along the lines of comparative markedness theory. The constraint ${}_o\text{FINAL-C}$ is violated by any candidate that contains a word-final vowel, if that vowel stands in correspondence with a vowel that is final in the FFC. The constraint ${}_n\text{FINAL-C}$ is violated by any candidate that presents a new final vowel, one not shared with in the FFC. This is precisely the difference between the candidates **pulumunitami* and *pulumunita* in Lardil. The first candidate, **pulumunitami*, shares a FINAL-C violation with the FFC — trivially, since it is the FFC. The second candidate, *pulumunita*, also has a FINAL-C violation, but in a locus that is not shared with the locus of violation in the FFC, since the *a* of *ta* and the *i* of *mi* are not in t-correspondence. Tableau (35) tells the tale.

(35) Lardil: $o_{\text{FINAL-C}} \gg \text{MAX} \gg n_{\text{FINAL-C}}$

	/pulumunitami/	$o_{\text{FINAL-C}}$	MAX	$n_{\text{FINAL-C}}$
a.	(FFC) pulumunitami	*!		
b.	☞ pulumunita		**	*
c.	pulumun		****!	

Apocope affects only underlying final vowels because the responsible markedness constraint, $o_{\text{FINAL-C}}$, detects only those loci of violation that are shared with the FFC. The other markedness constraint, $n_{\text{FINAL-C}}$, detects the final vowel of *pulumunita*, since this violation locus is not shared with the FFC. It is, moreover, irrelevant, because $n_{\text{FINAL-C}}$ is ranked below MAX. Apocope never takes a vowel other than the underlying final one because only an underlying final vowel can violate $o_{\text{FINAL-C}}$. This holds true even when further apocope would produce a form that is consonant-final, such as **pulumun*.¹⁰

This analysis also explains why apocope has no effect on underlying consonant-final roots. For example, underlying /*tukuŋuŋ*/ ‘lungs’ comes out as *tukuzu*, with the rightmost root vowel preserved intact. The root-final segment is not a vowel but the consonant *ŋ*, which deletes because it is non-apical. This then exposes *u* to word-final position. Since the *u* is not word-final in the FFC, it does not violate high-ranking $o_{\text{FINAL-C}}$. The effect is like Prince and Smolensky’s FREE-V, but comparative markedness uses an independently motivated markedness constraint, FINAL-C, rather than an ad hoc anti-faithfulness constraint.

Another situation where a process could in principle iterate but does not is local spreading. In local spreading, assimilation of tone or a feature affects an immediately adjacent syllable or

segment, but it goes no further. For example, the Bantu language Ekegusii has a process of local tone spreading that spreads root-initial high tone one syllable to the right, as shown in (36).

(36) Ekegusii verbal infinitive (Bickmore 1996: 18)

/ó-go-kór-a/	ó-go- <u>kór</u> -á	‘to do’
/ó-go-kór-er-a/	ó-go- <u>kór</u> -ér-a	‘to do for’
/ó-go-káan-er-a/	ó-go- <u>káán</u> -er-a	‘to deny for’
/ó-ge-símek-er-a/	ó-ge- <u>símék</u> -er-a	‘to plant for’

Research in OT on tone spreading, vowel harmony, and other assimilation processes has tended to focus on long-distance effects, using constraints like ALIGN(Feature) (Kirchner 1993 and others), AGREE(F) (Baković 2000, Lombardi 1999, 2001), or SPREAD(F) (Padgett 1995). The problem with these constraints is that all of them are best-satisfied by long-distance spreading, as in (37).

(37) Ekegusii with Classic AGREE

/...símek-er-a/	AGREE(H)	Faith
a. símekera	*!	
b. símékera	*!	
c. ✗ símékérá		***

The sporadic treatments of local spreading in the literature (Alderete 1998, Bickmore 1996, Myers 1997) have invoked constraints of a somewhat ad hoc character, such as special faithfulness constraints against spreading too far, to put a check on the aggressive ALIGN, AGREE, or SPREAD constraints.

Comparative markedness theory offers a way of more tightly integrating local and long-distance spreading. The AGREE(H) constraint, whose locus function is given in (38), comes in two flavors, ${}_O$ AGREE(H) and ${}_N$ AGREE(H).

(38) $\text{Loc}_{\text{AGREE(H)}}$

Return every V, where V is the head of a non-high-toned syllable that is adjacent to a high-toned syllable.

${}_O$ AGREE(H) is violated only by H/non-H sequences that are shared with the FFC; ${}_N$ AGREE(H) is violated by H/non-H sequences that are not shared with the FFC, such as those that spreading itself has created. The important thing about ${}_O$ AGREE(H) is that it can be satisfied by spreading a H tone locally, even at the expense of creating new ${}_N$ AGREE(H) violations.

Tableau (39) shows how this kind of analysis plays out for Ekegusii.

(39) Ekegusii: ${}_O$ AGREE(H) \gg Faith \gg ${}_N$ AGREE(H)

	/...símek-er-a/	${}_O$ AGREE(H)	Faith	${}_N$ AGREE(H)
a.	(FFC) símekera	*!		
b.	☞ símékera		*	*
c.	símékérá		**! *	

The FFC (39a) has one locus of violation, the *e* in the second syllable, which is non-H and adjoins a syllable with high tone. Since the FFC necessarily shares all of its own markedness violations, this means that (39a) defies ${}_O$ AGREE(H). The next candidate, (39b), has a different locus of violation, the *e* in the third syllable. This locus is not shared with the FFC because the t-corresponding vowel in the FFC is not a locus of violation. Observe that eliminating the violation of ${}_O$ AGREE(H) has caused (39b) to violate ${}_N$ AGREE(H), precisely because of this unshared locus. The remaining candidate,

(39c), shows that long-distance spreading on top of local spreading can eliminate both old and new AGREE(H) violations. This is a fool's bargain, though, because faithfulness is ranked above _NAGREE(H).

This is obviously not a complete theory of tone- and feature-spreading; see McCarthy (2002a) for some additional ideas. But it is sufficient to make the point that non-iteration where iteration is expected shows activity by _OM constraints when their _NM counterparts are ranked below faithfulness. The next section generalizes this result to interactions of different processes.

§5.2 Counter-feeding Opacity

Rule-based phonology of the 1970's recognized certain opaque relationships between rules. One such relationship was called counter-feeding order (Kiparsky 1965, 1968, 1973). Suppose the outputs of process P1 include forms that look like they should undergo process P2. If in fact they do not undergo P2, then P2 must be applied before P1. This is counter-feeding opacity: there are surface forms that look like they should have been affected by P2, but have not.

Rules like apocope or local tone assimilation were said to counter-feed themselves. The idea is that a potentially iterative process does not apply to its own output even when in principle it could. Lopping off a final vowel sometimes exposes a new final vowel, ripe for further lopping. An apocope rule that fed itself would take advantage of this new opportunity to apply; when the rule counter-feeds itself, it applies once and is denied further opportunities.

It is also possible for two different processes to be in a counter-feeding relationship with one another. For example, in Barrow Inupiaq (Archangeli and Pulleyblank 1994, Kaplan 1981), palatalization of anterior coronals is triggered by an *i* derived from underlying /i/, as in (40a), but it is not triggered by a phonetically identical *i* derived from /i/ (or perhaps archisegmental /I/), as in (40b).

(40) Barrow Inupiaq

a. Palatalization after /i/

Stem	<i>-lla</i> ‘be able’	<i>-niaq</i> ‘future’	<i>-vluni</i> ‘3sg realis’	
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/niɾi/	niɾiʎʎa	niɾiɳiaq	niɾivʎuni	‘eat’
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cf. /sisu/	sisulla	sisuniaq	sisuvluni	‘slide’
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b. No palatalization after /ɨ/

/tiɟɨ/	tiɟilla	tiɟiniaq	tiɟivluni	‘take flight’
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In derivational terms, the absolute neutralization rule /ɨ/ → *i* follows and thereby counter-feeds the rule of palatalization. Absolute neutralization could in principle but does not in fact create inputs to the palatalization process. This is counter-feeding opacity.

Counter-feeding opacity cannot be accommodated in a fully general way in classic OT (McCarthy 1999). The reasoning goes like this. In OT, a process — that is, an unfaithful mapping — is compelled by some markedness constraint. But because markedness constraints evaluate outputs alone, the same markedness constraint responsible for making *niɾiʎʎa* more harmonic than **niɾilla* also makes **tiɟiʎʎa* more harmonic than *tiɟilla*. The fact that **tiɟiʎʎa* contains an *i* derived from underlying /ɨ/ can have no effect on how it performs on classic markedness constraints, which evaluate outputs only.

Comparative markedness theory takes a different approach to counter-feeding opacity. Barrow Inupiaq has palatalization only when the FFC (e.g., **niɾilla*) violates the markedness constraint PAL-R, whose Loc function is given in (41).

(41) Loc_{PAL-R}

Return every C, where C is an anterior coronal and the preceding vowel is *i*.

When the FFC satisfies this constraint (e.g., *tiŋʃlla*), there is no palatalization. The mapping /*tiŋ-i*lla/ → **tiŋi*ʃʃa does not eliminate an inherited locus of violation because the FFC *tiŋʃlla* already satisfies PAL-R vacuously. High-ranking _oPAL-R is indifferent to the worsening palatalization situation created by the /*tiŋ-i*lla/ → *tiŋʃlla* map, though _NPAL-R cares about it greatly but futilely. The ranking, then, has _oPAL-R deployed above faithfulness and _NPAL-R below it, as shown in (42).

(42) Barrow Inupiaq: _oPAL-R ≫ IDENT(Place) ≫ _NPAL-R

	/niRi-lla/	_o PAL-R	IDENT(Place)	_N PAL-R
a.	niRiʃʃa		*	
b.	(FFC) niRilla	*!		
<hr/>				
	/tiŋ-i-lla/			
c.	tiŋilla			*
d.	tiŋiʃʃa		*!	
cf. FFC <i>tiŋʃlla</i>				

Candidate (42b) contains a locus of PAL-R violation — the *l* that is preceded by *i* — that t-corresponds with a locus of PAL-R violation in the FFC — trivially, since (42b) **is** the FFC. In candidate (42a), that violation is absent, so (42a) wins, in conformity with the [_oPAL-R ≫ IDENT(Place)] ranking.

Candidate (42c) contains a locus of PAL-R violation — the *i* before *l* — that does not correspond with a locus of PAL-R violation in the FFC, because the t-corresponding segment in the FFC is not in a palatalizing context. So (42c) does not violate _oPAL-R, thereby beating candidate (42d), which satisfies low-ranking _NPAL-R at the expense of a fatal faithfulness violation.

In counter-feeding opacity, a general phonological process P fails to apply to forms that meet P's conditions only by virtue of another process. For example, /*tiŋ-i*lla/ → *tiŋilla* shows no effect of

palatalization because the conditions for palatalization — a preceding *i* — are only met by virtue of the /t/ → *i* neutralization process. Thus, the general schema for counter-feeding opacity in (43) has _oM ranked above faithfulness and _NM below.

(43) Ranking Schema for Counter-feeding Opacity

$${}_oM \gg \text{Faith} \gg {}_N M$$

This is exactly the opposite of the ranking for derived environment effects in (26). Counter-feeding opacity, then, is the antithesis of a DEE (a point made in a different theoretical context by Łubowicz 2003). In a DEE, one process applies only when its conditions are met by virtue of another process. In counter-feeding opacity, one process fails to apply only when its conditions are met by virtue of another process. Comparative markedness reconstructs this antithetical quality directly in the ranking.

§5.3 *Comparison with Alternatives*

The study of opacity in OT is a rich area, with several alternatives to consider: local conjunction of faithfulness constraints, stratal OT, sympathy theory, and targeted constraints. This section sketches those alternatives and uses them as a foil for discussion of comparative markedness.

§5.3.1 Local Conjunction

We have already seen (§4.3) how local conjunction of markedness and faithfulness constraints can produce derived environment effects. Local conjunction of faithfulness constraints has been proposed as a theory of counter-feeding opacity (Ito and Mester 2003, Kirchner 1996, Moreton and Smolensky 2002). For example, Barrow Inupiaq (40) could be analyzed with the ranking in (44).

(44) Barrow Inupiaq with Local Conjunction

$$[\text{IDENT}(\text{back}) \& \text{IDENT}(\text{Place})]_{\text{Adj-}\sigma} \gg \text{PAL-R} \gg \text{IDENT}(\text{Place})$$

The conjoined constraint says that, within the span of two adjacent syllables, it is impossible to have segments that are unfaithful in both [back] and Place. This constraint blocks the mapping /tɨŋi-vluni/ → *tɨŋivʌuni, because the syllable sequence ɨŋi-vʌ contains *i*, which is unfaithful in [back], and ʌ, which is unfaithful in Place.

As I noted in §4.3, conjoining constraints in the wrong domain, or even what looks like the right one, can lead to unattested interactions (McCarthy 1999: 365-6). Though Adj-σ is not a known type of phonological constituent, it is the domain required in Barrow Inupiaq because of examples like *tɨŋivluni*. Worse yet, this domain absurdly predicts that there will be no palatalization in hypothetical /tɨŋi-lla/ → *tɨŋilla*, *tɨŋiʌʌ. In this case, /l/ has failed to palatalize, even though it is preceded by underived *i*, because /ɨ/ has fronted in an adjacent syllable. Fine-tuning the domain of conjunction might help, but domains like Adj-σ are already a distant departure from Smolensky's original idea that the domain of conjunction is an independently required phonological constituent. Furthermore, a local fix for this example does not address the broader typological problem.

Likewise, conjoining the wrong faithfulness constraints can produce impossible results. For example, assume a language with a general coda-devoicing process and the ranking in (45a). This ranking prohibits adjacent segments from changing both [voice] and Place.

(45) a. [IDENT(voice)&IDENT(Place)]_{Adj-σ} ≫ PAL-R ≫ IDENT(Place)

b. Mappings

/batik-lu/ batikʌ

/batig-lu/ batiklu

With the assumed coda-devoicing process, this ranking yields the mappings in (45b). The lack of palatalization in the second example is remarkable: although it is preceded by *i*, the /l/ has failed to palatalize because it adjoins a devoiced segment. Again, this hypothetical example does not seem

possible. The change in voicing is irrelevant to palatalization, and so coda devoicing should not block palatalization.

These unattested patterns of counter-feeding opacity are not attainable using comparative markedness (or rule ordering, for that matter). Recall the ranking schema in (43): $[\text{O}M \gg \text{Faith} \gg \text{N}M]$. This says that old loci of M-violation are eliminated at a cost in faithfulness, but new loci of M-violation may be created if necessary. The blocking of palatalization in $/t\text{̥}ji\text{-}lla/ \rightarrow ti\text{̥}jilla, *ti\text{̥}ji\text{̥}lla$ is not possible under this schema because fronting of $/i/$ in the first syllable cannot make an old locus of PAL-R violation into a new one. Nor does devoicing of $/g/$ in (45b), since the voicing of the intervening consonant has no effect on whether or not PAL-R is satisfied. In the local-conjunction-based analysis of Barrow Inupiaq (44), it is really just an accident that the faithfulness constraint IDENT(back) is included in the conjunction rather than IDENT(voice). But this can be no accident: [back] in vowels is relevant to palatalization in a way that [voice] in consonants is not.

To sum up the results of this section and §4.3, approaches to DEE's and counter-feeding opacity based on local conjunction do not seem to be leading us toward the right language typology (cf. Padgett (2002) and Moreton & Smolensky (2002) for contrasting views of local conjunction). The problem is that locality and interaction are not the same thing. Local conjunction regulates the application of processes in segments that are close to each other. But in observed cases of DEE's and counter-feeding opacity, it is not closeness that matters — it is crucial interaction of the processes, and closeness is just one of many factors that determine interaction. Comparative markedness theory, by its nature, regards interaction as a *sine qua non* for DEE's and counter-feeding opacity. It is hard to see how this problem with conjunction can be remedied, even with the aid of formal conditions on conjoinability (Fukazawa and Lombardi 2000, Fukazawa and Miglio 1998, Łubowicz 2002), because relevancy can in general be determined only by looking at how specific candidates are

affected by a system of constraints in a hierarchy. Formal criteria for relevancy do not seem possible and are not even needed in OT except as a patch for local conjunction's tendency to overpredict.

On the other hand, classic OT, even when supplemented with local conjunction of faithfulness constraints, is more restrictive than comparative markedness in a different respect.¹¹ Moreton (1996/1999, 2000) shows that classic OT has a property called harmonic ascent. A classic OT grammar is a ranking of markedness constraints and faithfulness constraints. Therefore, it can never produce an output that is more marked than the fully faithful candidate, because the only reason to be unfaithful is to get less marked. Since the local conjunction of two faithfulness constraints is also a faithfulness constraint, admitting this type of conjunction into the theory does not alter the result. For details, see Moreton's work; for a fuller summary than I have provided here, see McCarthy (2002d: 101-3).

Harmonic ascent has two important empirical consequences. First, it means that no OT grammar can describe a process of unconditional augmentation, where every form grows in size (e.g., /ba/ → *baŋ*, /bat/ → *bati*, /bata/ → *bataŋ*, ...). This is not possible because there is no way for a classic markedness constraint to favor unconditional growth. Second, harmonic ascent entails that no OT grammar can produce a circular chain-shift, such as /a/ → ... → *i* co-existing with /i/ → ... → *a*. This is impossible because the ranking in a grammar must be consistent: there is no way for both of the unfaithful mappings /A/ → *B* and /B/ → *A* to improve markedness relative to a single constraint hierarchy, so these two processes can never coexist (in identical or overlapping contexts) within a single language. (See Anderson and Browne (1973), Crowhurst (2000), Horwood (2000), Moreton (1996/1999), and Zonneveld (1976), among others, on whether this generalization is correct.)

Comparative markedness changes OT enough so that harmonic ascent is no longer guaranteed. Therefore, comparative markedness can produce unconditional augmentation. Imagine

we have a CV language, with ONSET and NO-CODA undominated, and that MAX dominates DEP. If ${}_{\text{o}}\text{FINAL-C}$ is ranked above DEP and ${}_{\text{N}}\text{FINAL-C}$, then every word will grow by the addition of one syllable, as (46) shows.

(46) Unconditional Augmentation with Comparative Markedness

	/pata/	${}_{\text{o}}\text{FINAL-C}$	DEP	${}_{\text{N}}\text{FINAL-C}$
a.	↔ pataʔi		**	*
b.	(FFC) pata	*!		

In a sense, this language is the opposite of Lardil. Lardil satisfies ${}_{\text{o}}\text{FINAL-C}$ by dropping the old final vowel. In this hypothetical language, ${}_{\text{o}}\text{FINAL-C}$ is satisfied by epenthesis of a new final vowel. Either way, ${}_{\text{o}}\text{FINAL-C}$ is satisfied even at the expense of creating a violation of ${}_{\text{N}}\text{FINAL-C}$.

Comparative markedness can also produce circular chain-shifts, which are a type of counter-feeding opacity. Assume that there are markedness constraints against both high and mid vowels. According to the comparative theory, they come in both old and new versions and can be ranked according to the schema for counter-feeding opacity in (43). If certain other ranking conditions are met, the result is a circular chain-shift, with /e/ mapping to *i* and /i/ mapping to *e*, as shown in (47).

(47) Circular Chain-shift: /e/ → i and /i/ → e

	_o *HIGH	_o *MID	IDENT(high)	_N *HIGH	_N *MID
/e/					
a. $\text{[e]} \rightarrow \text{[i]}$			*	*	
b. (FFC) e		*!			
/i/					
c. (FFC) i	*!				
d. $\text{[i]} \rightarrow \text{[e]}$			*		*

In classic OT, this circular chain shift is impossible because markedness constraints are not sensitive to the source of the violation. Comparative markedness constraints are, by design, sensitive to the source of the violation, and so they can favor elimination of old violations even at the expense of introducing new ones, exactly as in (47).

These differences between classic OT and comparative markedness tell us something important about the latter. In classic OT, no unfaithful mapping occurs unless it improves the markedness performance of the entire candidate relative to the FFC. In comparative markedness theory, this is not true; as we have just seen, the unfaithful mapping /pata/ → patã is possible even though the candidates patã and pata perform equally well on the classic markedness constraint FINAL-C. Rather, in comparative markedness theory, an _oM constraint can induce an unfaithful mapping even if it only improves the markedness performance of an individual segment in a candidate relative to the FFC. In the mapping /pata/ → patã, the markedness performance of the second a has improved: it is no longer word-final, so it doesn't violate FINAL-C. In a sense, the whole point of the formalization in §3 is to give meaning to the notion of an individual segment's markedness status.

This property of ${}_oM$ comparative markedness constraints is also crucial to understanding how they differ from anti-faithfulness constraints (Alderete 1998, 2001). Anti-faithfulness constraints are the negation of faithfulness; for example, $\neg DEP$ is satisfied by all and only those candidates that contain at least one epenthetic segment. Anti-faithfulness constraints can produce unconditional augmentation or circular chain-shifts; for example, in Alderete's (1998) analysis of Luo, an underlying /t/ is mapped to a surface *d* and underlying /d/ to surface *t* to satisfy the anti-faithfulness constraint $\neg IDENT(\text{voice})$.

There is an important difference between ${}_oM$ comparative markedness constraints and anti-faithfulness constraints, however. Comparative markedness is based on the theory of markedness, while anti-faithfulness is based on the theory of faithfulness. Less enigmatically, anti-faithfulness constraints can and do favor outputs that are more marked than the FFC at the level of the entire candidate and of the individual segment. That is the case, for instance, when Luo /t/ maps to *d*. But comparative markedness cannot produce this mapping because no classic markedness constraint favors the segment *d* over the segment *t* in the relevant context. Anti-faithfulness constraints can trigger unfaithful mappings with callous disregard for their markedness consequences. ${}_oM$ comparative constraints must always improve at least an individual segment's markedness performance.

§5.3.2 Stratal OT

Stratal OT links several OT grammars serially, like the strata of the theory of Lexical Phonology (for extensive references, see McCarthy (2002d: 185)). Instead of rule ordering, as in *SPE*-style phonology, stratal OT attributes opaque interactions to the ordering between these strata. For example, the counter-feeding relationship between vowel neutralization and palatalization in

Barrow Inupiaq would be attributed to differences in the grammars of two strata and the ordering between strata, as shown in (48).

(48) Barrow Inupiaq in Stratal OT

Lexical Stratum: PAL-R \gg IDENT(Place); IDENT(back) \gg **ɨ*

Input	/niɾi-lla/	/tiŋɨ-lla/
Output	niɾiʎʎa	No change

Word-level Stratum: IDENT(Place) \gg PAL-R; **ɨ* \gg IDENT(back)

Input	/niɾiʎʎa/	/tiŋɨlla/
Output	No change	tiŋilla

In the lexical stratum, PAL-R dominates IDENT(Place), so there is palatalization after *i*. But there is no neutralization of /ɨ/ to *i*, because IDENT(back) dominates **ɨ*. In the word-level stratum, both of these rankings are reversed. The constraint **ɨ* dominates IDENT(back), so input /ɨ/ is mapped to surface *i*. But there is no palatalization before the *i*'s derived by this process because IDENT(Place) dominates PAL-R.

The grammars of different strata differ in the same way that the grammars of different languages do: in the ranking of the same set of constraints. Stratal OT produces a serial derivation, so it duplicates the main effect of rule ordering, and therefore it addresses counter-feeding opacity in exactly the same way as rule ordering did (except that the depth of ordering is limited to the number of strata). Concomitantly, stratal OT sheds no light on problems where rule ordering is of no help, such as grandfather effects (§4.1), DEE's (§4.2), and processes that counter-feed themselves (§5.1).

Although comparative markedness does have something to say about these problems, overall it is a much more restrictive theory of counter-feeding opacity than stratal OT — probably too

restrictive. Here I will present three differences in restrictiveness between comparative markedness and stratal OT.

In comparative markedness theory, counter-feeding opacity is a property of whole grammars rather than specific processes. The basic ranking $[\text{O}M \gg \text{Faith} \gg \text{N}M]$ says that Faith will not be violated solely to avoid new violations of M, no matter what their source. If several processes produce new M-violating structures, then all are predicted to be in a counter-feeding relationship with the process defined by the $[\text{O}M \gg \text{Faith}]$ ranking. For example, Bedouin Arabic has a process raising /a/ to *i* in an open syllable (49a). It is counter-fed by two processes that create open syllables (49b), vocalization of high glides and epenthesis into rising-sonority clusters.

(49) Bedouin Arabic Raising (Al-Mozainy 1981, Johnstone 1967)

a. The vowel /a/ is raised to *i* in an open syllable.

/katab/	kitab	‘he wrote’
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b. But not if the syllable is open by virtue of glide vocalization or vowel epenthesis

/badw/	badu	‘Bedouin’
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/gabr/	gabur	‘grave’
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In rule-ordering theories, it is possible to order, say, glide vocalization before raising but epenthesis after raising. In stratal OT, it is likewise possible to construct the grammars of the strata so that raising and glide vocalization occur together in one stratum (feeding relation), with vowel epenthesis delayed until a later stratum (counter-feeding relation). It is therefore possible in rule-based phonology or stratal OT to get a hypothetical language with raising in *kitab* and *bidu* but not *gabur*.

If comparative markedness is the right theory of counter-feeding opacity, then this sort of behavior should be impossible, *ceteris paribus*. Without additional constraints that would render the

ceteris more or less *imparibus*, this imagined behavior is impossible to analyze with comparative markedness. Because the ranking $[[\text{Faith} \gg_{\text{N}} \text{M}]]$ appears in the grammar, new instances of *a*'s in open syllables, regardless of what process created them, are not avoided by raising them to *i*. In general, comparative markedness predicts that, if a process is counter-fed by at least one process, then it can never be fed by any other process in the same language. Ordering theories of counter-feeding opacity, including stratal OT, do not make this prediction. Is the prediction right? I don't know. (See McCarthy (1999: 344-5) on an apparent counterexample in Yawelmani.)

A related prediction of comparative markedness theory concerns the relationship between counter-feeding opacity and derived environment effects.¹² Because the rankings for counter-feeding opacity and DEE's are the opposite of one another, it is predicted that no process will be both counter-fed and restricted to applying in a phonologically derived environment. Such a situation is easy to describe in rule-based phonology (and stratal OT, if it is supplemented with a mechanism like local conjunction for dealing with DEE's). Suppose there were a language identical to Bedouin Arabic except that raising is restricted to applying in a derived environment, so /katab/ → *katab* (no change), but /gabr/ → *gibur* (epenthesis creates derived environment). Suppose the raising rule is also followed and counter-fed by glide vocalization, so /badw/ → *badu*. If comparative markedness theory is right, then this pattern of behavior should be impossible. Again, this is an interestingly strong claim, not obviously wrong or correct.

Another strong claim made by comparative markedness theory but not stratal OT concerns the analysis of counter-feeding opacity involving basically allophonic processes. (This class of problems was first noted by Ito and Mester (2003) in the context of a critique of sympathy theory.) The claim is best explained with an example.

afoul of none of the relevant markedness or faithfulness constraints. (See the appendix of McCarthy 2002a for the details.)

More generally, the problem is this. In cases of allophony, richness of the base entails that the input is relatively indeterminate. But comparative markedness theory relies on the input through its surrogate, the FFC, to evaluate markedness. Opacity of basically allophonic processes presents the same challenge to comparative markedness or sympathy as it did to the structuralists (e.g., *writer* [ʌʎrə̃] vs. *riɖer* [ɹɹʎrə̃]) (Chomsky and Halle 1965): it looks as if another level of representation is required. Stratal OT, for example, supplies that level.

§5.3.3 Sympathy and Targeted Constraints

Sympathy theory (McCarthy 1999, 2003) attributes opacity to the influence of a failed candidate on the output. The idea in sympathy theory is that, in addition to the actual output form, EVAL may select a sympathetic candidate, which is the most harmonic candidate that obeys some specified faithfulness constraint, called the selector. Rankable constraints compare the output with the sympathetic candidate, requiring resemblance between them. In Barrow Inupiaq, for example, the selector constraint is IDENT(back), and, for the input /tiŋʃ-lla/, the most harmonic candidate that obeys this constraint is *tiŋʃlla, without palatalization. The actual output is forced to share *tiŋʃlla's lack of palatalization, even at the expense of violating PAL-R.

Like sympathy, targeted-constraints theory (Wilson 2000, 2001) also involves comparing candidates. Targeted constraints are primarily intended to explain why markedness constraints can produce certain unfaithful mappings but not others (though see McCarthy (2002b) on why this goal remains elusive and Jun (2002) for an alternative that uses the FFC and sympathy), but they have also been applied to opacity. Targeted constraints compare candidates that are identical in all respects but one. For example, the targeted version of PAL-R judges *niRiʌʌa* as superior to faithful **niRilla*,

since they are identical except for the palatalization. But targeted PAL-R is unable to compare **tiŋiʎʎa* with faithful **tiŋʃʎla*, however, since they differ in two respects (*i/ʃ* and *ʎ/l*) and not just one. In the context of the rest of the theory (for which see Wilson 2000), this means that **tiŋiʎʎa* loses to *tiŋilla*.

Neither sympathy nor targeted constraints is applicable to grandfather effects, derived environment effects, or non-iterative processes. On the other hand, both of them, as well as stratal OT, are applicable to counter-bleeding opacity, in which a process is sensitive to contextual information that is present only in the input. For example, in Odawa (Piggott 1980) a nasal assimilates to a following /k/ that is not present at the surface: /takoššin-k/ → *takoššiŋ* ‘(that) he arrives’. In sympathy theory, **takoššiŋk* is the sympathetic candidate; in targeted constraints theory, a targeted constraint favors *takoššiŋ* but not **takoššin* over **takoššiŋk*; in stratal OT, assimilation occurs on a stratum prior to deletion of *k*.

For present purposes, though, the most important thing about sympathy and targeted constraints is the abstract resemblance they bear to aspects of comparative markedness. All three theories posit constraints that use one output candidate to help evaluate another output candidate. This formal resemblance is important because the three theories have incompletely overlapping empirical coverage, suggesting that some broader synthesis is needed and may even be possible. The hoped-for synthesis, though, is well outside my grasp at this point, though the similarities are intriguing.

§6 Conclusion

In this article, I have explored a very different way of treating markedness constraints in Optimality Theory. Instead of evaluating output forms alone, comparative markedness constraints look at the markedness consequences of input-output mappings. The fully faithful candidate, which

assumes the role of the input in this comparison, has certain markedness violations. Every other output candidate will eliminate some of those violations, add others, or stay the same. Comparative markedness constraints are sensitive to this difference: ${}_oM$ constraints demand elimination of old markedness violations, while ${}_N M$ constraints militate against addition of new markedness violations.

Taken together, ${}_oM$ and ${}_N M$ constraints assign the same violation-marks as traditional markedness constraints. The interesting cases arise when ${}_oM$ and ${}_N M$ are ranked separately, with some faithfulness constraint ranked between them. If ${}_oM$ is higher ranked, then unfaithful mappings will be possible to eliminate pre-existing markedness violations, but not to prevent the introduction of new ones. This is counter-feeding opacity: a process affects configurations present in the input, but not configurations that are produced by other processes. On the other hand, if ${}_N M$ is higher ranked, then unfaithful mappings will be possible to prevent the introduction of new markedness violations (as a result of some other process or the morphology), but not to eliminate pre-existing ones. Derived environment effects are like this: a markedness constraint is visibly active only on configurations that are the result of some other process.

These and other phenomena served as the basis for contrasting comparative markedness with classic OT, using differences between them to illuminate aspects of the comparative theory. Other enhancements or modifications to classic OT, such as local conjunction, stratal OT, targeted constraints, and sympathy were also considered. A critical assessment showed that comparative markedness enjoys some advantages and suffers from some disadvantages relative to classic OT and these other alternatives.

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Notes

1. For now, I assume Lombardi's (1999: 272) definition of AGREE: "Obstruent clusters ... agree in voicing." For discussion, see §5.1.
2. I am grateful to Marc van Oostendorp for suggesting an approach along these lines. Something like this is also implicit in Crowhurst and Hewitt's (1997) notion of the focus of a constraint.
3. Only markedness constraints make the old/new distinction. Because the FFC has no faithfulness violations, all faithfulness violations are new, in the sense that they are not shared with the FFC. If σ F constraints existed, they could never be violated, and so they would contribute nothing to language typology.
4. In Makassarese, epenthetic ʔ also appears in reduplication: *manaʔ-manara* 'sort of tower'. It is found only when exact copying of the root is ruled out independently (cf. *batu-batu*, **batuʔ-batu* 'small stones'). This is perhaps evidence for a derived environment under BR correspondence (see the discussion of Korean at the end of §4.2).
5. In Korean, plain obstruents are voiced intervocalically. The examples abstract away from this process.

6. Thanks to John Alderete and Ken Safir for discussion of this point.
7. It has been proposed (Bradley 2002, Cho 1998) that Korean and similar cases can be accounted for under the assumption that gestural timing is lexically specified for tautomorphemic but not heteromorphemic sequences. This approach is simply incompatible with richness of the base (for explanation and references, see the discussion of (50) in §5.3.2). (I am grateful to Travis Bradley for discussion of this point. See N. Hall (2003) for parallel discussion.)
8. Thanks to Bert Vaux for his feedback on this section.
9. Prince and Smolensky also describe FREE-V as morphologized because it is limited to nominative nouns (see also Kirchner 1992), but Klokeid (1976) makes a persuasive case that it is in fact quite general, though opaque.
10. Tableau (35) highlights an incidental effect of comparative markedness: If a constraint ${}_N M_i$ is violated by a winning candidate, then some ${}_O M_j$ must dominate ${}_N M_i$. In other words, violation of ${}_N M$ constraints can never be compelled by faithfulness alone. Because ${}_N M$ constraints are only ever violated by unfaithful candidates, there must be at least one high-ranking ${}_O M$ constraint to keep the unfaithful candidates in the running. (Thanks to Elliott Moreton for pointing this out.)
11. I am grateful to Paul de Lacy and Elliott Moreton for their challenges on this point.
12. Thanks to Paul Kiparsky for pointing this out.

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The annotation [ROA-xxx] indicates that a work is available for download as number xxx on the Rutgers Optimality Archive, <http://roa.rutgers.edu>.

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