For an Autosegmental Theory of Mutation

Matthew Wolf

University of Massachusetts Amherst

1 Introduction[1]

Within the 'familiar European languages', morphemes generally appear to be *objects*—roots and affixes with some lexically-specified segmental contents. Other morphemes attested in the world's languages might be more aptly described (to use loose, pre-theoretical terms)—as *processes*. Under this heading one might group reduplication, subtractive truncation, and morphological metathesis.

There is at least one class of morphological phenomena whose disposition with respect to this dichotomy is controversial. This is the set of instances in which some morpheme manifests itself, in whole or in part, as a change to the segmental features, tone, or moraic pattern of some other morpheme. I will adopt the traditional label of *mutation* to refer to this category.

Mutation has typically been viewed in autosegmental frameworks as an instance of 'object'-type morphology. The central claim of autosegmental phonology (Goldsmith 1976) is that tones, features, and length/weight (that is, moras, in the currently prevailing view) are representational entities in their own right, not simply attributes of segments. Mutation can therefore be analyzed as the docking onto segments (or other bearing units)

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of features, tones, and/or moras which are underlyingly floating—that is, which are present as objects in the underlying representations of mutation-triggering morphemes.

An alternative view is to view the featural, tonal, and length changes that obtain in mutation as being of a class with phenomena like subtractive truncation. Within OT, there are two major proposals about how to account for such processes—MORPHREAL constraints (Kurisu 2001, among others) and Transderivational Anti-Faithfulness (or TAF; Alderete 1999, 2001, Horwood 2000). Proponents of each have suggested that mutation might come under their purview and that floating autosegments could therefore be wholly or partly eliminated from phonological theory.

Constraints of the MORPHREAL family may be viewed as enforcing faithfulness to morphemes: they demand that every morpheme have an 'exponent' or a 'realization' in the output, with 'exponent' and 'realization' variously defined. TAF (as well as certain formulations of MORPHREAL) may be thought of as calling for the distinctiveness of morphemes: these constraints demand that affixed forms differ from unaffixed ones in some way, specified to varying degrees.

In this paper, I will be arguing in favor of the autosegmental view, suggesting instead that attested patterns of mutation are the result of constraints demanding faithfulness to and distinctive realization of *structure*. The core of the proposal consists of three new constraints to govern the behavior of floating autosegments (defined informally for the moment):

(1)
MAXFLT: All autosegments that are floating in the input have output correspondedents.

NOVACDOC: Floating features cannot dock onto segments that already bore the same feature value in the input.

NOTAUMORDOC: Floating autosegments cannot dock onto bearing units that are exponents of the same morpheme.

The remainder of this paper is organized as follows: section 2 lays out my basic assumptions about floating features and their docking. Section 3 motivates MAXFLT based on cases of mutation which change multiple features, or in which the mutation-triggering morpheme has segmental content. I argue such cases to problematic for proposals of the MORPHREAL family. Section 4 reanalyzes polar mutations (i.e. feature-value exchange processes) as allomorph selection conditioned by NOVACDOC, and argues that at least one such case is problematic for TAF. Further applications of NOVACDOC are also discussed. Section 5 argues that NOVACDOC is violated in so-called 'quirky' mutation patterns, in which vacuous docking can be used to account for idiosyncratic distribution of featural changes among different target segments. Section 6 discusses the motivation for NOTAUMORDOC, and presents cases in which it is violated.

Section 7 demonstrates the analytical usefulness of the inverse of floating features: root nodes that are featurally empty in the input. Section 8 discusses cases in which roots mutate affixes or in which one morpheme mutates an adjoining one in external sandhi. I argue such cases to be inaccessible to both MORPHREAL and TAF, which only permit affixes to mutate their bases of affixation. Section 9 takes up issues related to the locality of mutation and why floating autosegments dock where they do. Section 10 discusses a few other competing proposals, and section 11 concludes.

2 Basic Assumptions about Floating Features

This section frames the basic framework in which this paper will operate. Section 2.1 presents the problem of how to induce docking of floating features and introduces MAXFLT, arguing it to be superior to other possible approaches. Section 2.2 considers the MAX(Feature) vs. IDENT debate, and Section 2.3 deals with some remaining matters.

2.1 What drives docking of floating features?

A straightforward example of autosegmental morphology comes from Aka, a Zone C Bantu language spoken in the Central African Republic (data from Akinlabi 1996, §A3). This language marks the singular of noun class 5 by voicing of the root-initial consonant. That some root-initial consonants are underlyingly voiceless can be seen by comparing the plural class 6 form of the same roots, which is marked by the prefix /ma-/:

(2)Aka

Underlyingly [-voice]-initial noun roots:

Class 5 singular	*Class 6 plural*	*Gloss*
dèŋgé	màtèŋgé	‘piercing tool’
gásá	màkásá	‘palm branch’
bàpùlàkà	màpàpùlàkà	‘lung’

Underlyingly [+voice]-initial roots:

Class 5 singular	*Class 6 plural*	*Gloss*
gɔ̀àlà	màgɔ̀àlà	(game of imitation)
bèlèlè	màbèlèlè	‘sound of a waterfall’
dʒámbà	màdʒámbà	‘mud’

We may assume that the UR of the class 5 singular prefix is /[+voice]/. I will assume further that input features bear correspondence relations to output features, and that hence deletion of input features is militated against by MAX(Feature) constraints. The broader MAX(Feature) vs. IDENT debate will be taken up in §2.2. To induce preservation of floating features specifically, Formally, I propose the constraint in (3):

(3)
MAXFLT (*in constraint definitions, I=input, O=output)*

$\forall F \in I$, where F is a feature:

$[\neg[\exists S \in I$ such that S is a segment and F is attached to S$]] \rightarrow$

$[\exists F' \in O$ such that $F \Re F']$

Likewise, *mutatis mutandis*, for floating tones and moras.

Informally, MAXFLT states that features that are floating in the input have correspondents in the output. Together with a markedness constraint against output floating autosegments (call it *FLOAT), MAXFLT can induce docking of floating features in just the way we want:

(4) Aka: 'palm branch.CLASS5.SG.'

$[+voi]_1$ kasa | $[-voi]_2$	MAXFLT	*FLOAT	DEP	IDENT[voi]	*VCDOBS
a. ► gasa | $[+voi]_1$ ~~$[-voi]_2$~~				*	*
b. kasa | $[+voi]_1$ $[-voi]_2$		$[+voi]_1$!			
c. kasa | ~~$[+voi]_1$~~ $[-voi]_2$	$[+voi]_1$!				
b. gakasa / \\ $[+voi]_1$ $[-voi]_2$			g!a		*

The winner, as wanted, is (4a), where the floating [+voi] has docked to the root-initial segment. Doing so violates IDENT(voi) (or various MAX(Feature) constraints), as well as markedness constraints against voiced stops. These violations can be avoided, but only at the expense of violating higher-ranked constraints. Deleting the floating feature, as in (4c), violates MAXFLT. Preserving the floating feature in the output but leaving it undocked violates *FLOAT. Epenthesizing a new root node for the floating feature to dock to avoids the violation of IDENT (though not necessarily of *VCDOBS), but this incurs an additional violation of the anti-epenthesis constraint DEP.

Let's now consider what other constraints might be employed for floating-feature docking. As Zoll (1996) notes, it cannot be a general MAX(Feature), because this constraint will have no preference between a candidate that deletes the floating feature and one in which the floating feature docks and a differently-valued feature underlyingly linked to the segment in question is lost:

(5) Incorrect prediction of MAX(Feature) in Aka: 'palm branch.CLASS5.SG.'[2]

[+voi]$_1$ kasa | [-voi]$_2$	MAX(Feature)	MAX(Feature)$_{root}$	IDENT(voice)	*VCDOBS
a. ► gasa | [+voi]$_1$ ~~[-voi]$_2$~~	[-voi]$_2$	[-voi]$_2$(!)	*(!)	*(!)
b. 💣 kasa | ~~[+voi]$_1$~~ [-voi]$_2$	[+voi]$_1$			

To simply delete the floating [+voi] of the class 5 singular affix, as in (5b), violates MAX(Feature), but to dock floating [+voi] onto a segment underlyingly bearing [-voi], as in (5a), also violates MAX(Feature) if the [-voi] token is deleted to accommodate the floating [+voi]. The choice will then be passed to other constraints, which, as shown in (5), will in this case exercise the wrong preference.

It has generally been assumed that roots are subject to greater faithfulness protection than affixes (McCarthy & Prince 1995). This may be implemented either as a fixed ranking between constraints (e.g., MAX(Feature)$_{root}$ >> MAX(Feature)$_{affix}$) or via stringency, by assuming that every faithfulness constraint has general and root-specific versions, which is the option shown in (5). MAX(Feature)$_{root}$ will, clearly, prefer deletion of the floating [+voice] of the affix rather than the [-voice] of the root.[3] Moreover, if there are IDENT constraints in addition to MAX(Feature) constraints, then IDENT will exert a preference against docking floating features that will change the featural specification of the docked-to segment. Finally, voiced obstruents are more marked than voiceless ones, so markedness constraints will also militate against docking the affixal [+voice]. This last problem is not unique to Aka; there are numerous mutations in the world's languages that increase markedness, via nasalization, voicing, spirantization, vowel lengthening, gemination, high-tone insertion, contour-tone creation, and so on.

One might propose that preference for docking of the floating feature was induced by having faithfulness to [+voice] tokens be ranked higher than faithfulness to [-voice] tokens. Such a move would be consistent with the generalization, made by de Lacy (2002a) and others[4], that there is greater faithfulness pressure to preserve marked structures. For Aka, the ranking would be as in (6):

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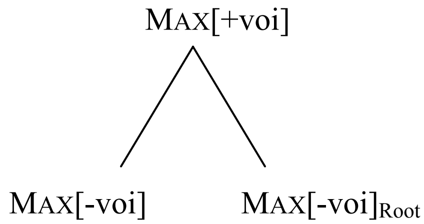
[2] Notational conventions used throughout in tableaux: the intended winner is indicated by '►'. The incorrect winner chosen by a hypothetical tableau is indicated by '💣'. Features that are ~~struck through~~ have been deleted.

[3] Revithiadou (1999) suggests that faithfulness to morphological heads outranks general faithfulness, arguing that this accounts for certain apparent exceptions to McCarthy & Prince's meta-constraint. See §10.2 for further discussion of this proposal in comparison with the model being developed here.

[4] See, for instance, Kiparsky (1993), Jun (1995), Gnanadesikan (2004), and Howe & Pulleyblank (2004).

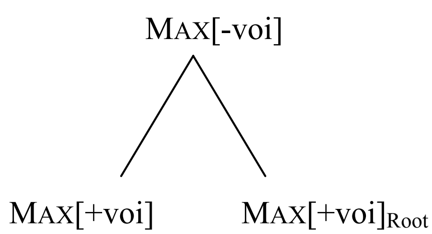
(6)



For Aka, (6) will work for the mutation system of the class 5 singular morpheme. However, this approach will not work for other languages which have mutations that move in opposite directions. For instance, in Nuer (discussed in section 3), some inflectional suffixes induce voicing, others devoicing; some induce hardening, and others spirantization. In the Celtic family, Breton (Press 1986, Willis 1982) and Cornish (Brown 1993, Willis 1982, Jenner 1904) have both 'Lenition' series, which induce voicing, and 'Provection' series, which induce devoicing. The most extreme cases of this sort are those of featural polarity, in which a single mutation-triggering morpheme induces reversal of some feature-value of a targeted segment; these phenomena are discussed in §4.

If a language docks [+voi] onto [-voi] segments, it will require the ranking in (6), but to dock [-voi] onto [+voi] segments, a contradictory ranking will be required:

(7)



The ranking of the general constraints MAX[-voi] and MAX[+voi] is different in (6) and (7). Worse still, (7) contradicts the assumption that there is greater faithfulness to the marked. This approach will clearly not do.

A simpler and more effective solution, in the same spirit, is to suppose that there is particular faithfulness pressure to preserve features that are underlyingly floating. This is exactly what MAXFLT does. If floating autosegments are permitted in outputs, they are doubtless marked, so this approach too may be regarded as an example of greater faithfulness to marked structure.

Specific faithfulness to floating features has been argued for already by Zoll (1996)[5], whose proposed constraint is given in (8):

[5] MAX(SUBSEG) is also adopted by McLaughlin (2000).

(8) (=Zoll's (55), p. 82)

MAX(SUBSEG) Every subsegment of Sj has a correspondent in S_0

(i) $\forall x\ (S_j\,(x) \wedge \text{Subsegment}\ (x) \rightarrow \exists y (S_0(y) \wedge x\mathit{R}y))$

(ii) Assess one mark for each value of x for which (i) is false

MAX(SUBSEG) makes use of the suggestion of McCarthy & Prince (1995) that the association of tones to TBUs is mediated by Correspondence. Formally, MAX(SUBSEG) is quite similar to MAXFLT—both demand that floating autosegments in the input have correspondents in the output—but MAX(SUBSEG) assumes that input floating autosegments stand in correspondence with output bearing units: root nodes in the case of floating segmental features and moras, and the TBU category of the language in question for floating tones.

As S. Myers (1997) notes, a theory of floating tone docking where input floating tones correspond to output TBUs is effectively equivalent to one where tones correspond to tones and docking is compelled by a markedness constraint against floating tones. Given this equivalence, the adoption of the MAXFLT/*FLOAT approach is preferable to MAX(SUBSEG) because of a variety of conceptual and empirical problems with the latter.

First, allowing representational objects of unlike types (features and root nodes) to stand in the correspondence relation adds a considerable degree of oddity to the theory of correspondence. Since there seems to be no other case that calls for correspondence between unlike entities, it would seem inadvisable to adopt a proposal like MAX(SUBSEG) that requires this assumption when an alternative that does not is available.

Second, there is a formal difficulty with MAX(SUBSEG): it is not actually a faithfulness constraint, since it will penalize a fully-faithful candidate where an input floating feature remains floating. MAX(SUBSEG) is in actuality a kind of anti-faithfulness constraint: it detects a particular input situation (presence of floating autosegments) and demands that it be changed in a specified manner (docking the autosegments to bearing units). Seen in this light, MAX(SUBSEG) is especially troublesome because it is anti-faithfulness along the IO-dimension. Admitting such constraints into CON raises, among other unattested phenomena, the possibility of purely phonological exchange processes (see §4 for discussion).

A third problem with MAX(SUBSEG) is that it discourages input floating autosegments from being floating in the output, since, as just mentioned, it calls not only for the preservation of floating elements but for their docking as well. It is intuitive that the presence of floating autosegments (if not universally banned by GEN) in outputs should be marked, implying the existence of *FLOAT. As shown in (9), a candidate that leaves an input floating autosegment floating in the output will violate MAX(SUBSEG) as well as *FLOAT, and is therefore harmonically bounded by a candidate that simply deletes the floating autosegment, since that violates only MAX(SUBSEG):

(9) Incorrect harmonic bounding effect of MAX(SUBSEG)

Root | [+F] [-F]	MAX(SUBSEG)	*FLOAT
a. Root | [+F] [-F]	*(!)	*(!)
b. ► Root | ~~[+F]~~ [-F]	*	

Now, it would of course still be possible for floating autosegments to be inserted in the output if some markedness constraint that favored their presence dominated *FLOAT. However, autosegments that were floating in the input could not remain floating in the output unless markedness constraints of the same sort dominated *FLOAT. MAXFLT, on the other hand, only cares that a feature (tone, mora) that is floating in the input have a correspondent in the output; it is wholly indifferent to whether that output correspondent is floating or docked. A theory based on MAXFLT can easily yield output floating features, so long as *FLOAT is dominated by constraints that disfavor docking. For instance, in (4), the * FLOAT-violating candidate (4b) would win if *FLOAT were bottom-ranked.

MAX(SUBSEG) would, then, risk closing the door on the many proposals which argue that outputs can contain floating autosegments whose presence must be specified in the input and whose floating status in the output cannot be rationalized on markedness grounds. The most frequent use of output floating tones is the use of floating L to induce downstep (Clements & Ford 1979). Downstep can be constrastive, so this L would presumably have to be specified in the input, at least in certain cases. Within the intonational literature, it has also been argued that certain intonational tones are not associated to any TBU, which is inferred from the fact that the timing properties of these tones are defined strictly relative to those of other tones, and not with reference to segmental material; see Beckman & Pierrehumbert (1986) on English, and Gussenhoven (2004: §11.3) on Stockholm Swedish. The possibility that GEN produces candidates containing floating tones is also raised by McCarthy (2002b) with respect to the observation in Clements & Ford (1979) and elsewhere that underlyingly floating tones spread in preference to underlyingly linked ones; the suggested analysis within the proposed Comparative Markedness framework crucially assumes that in the fully-faithful candidate input floating tones remain floating.[6] For a mora to be floating in the output

[6] To reason that the existence of a fully-faithful candidate with floating tones implies the violability of *FLOAT assumes that the candidate set emitted by GEN contains no forms that violate universally surface-inviolable well-formedness conditions. R. Walker (1998: ch. 3) argues that GEN in fact produces such candidates. This, however, amounts to the claim that CON contains two sets of constraints: universally unviolated ones, and ones which languages may violate, and that all constraints of the former group are fixedly-ranked above all those of the latter group. Fixed rankings among violable constraints are presumably unnecessary, due to the possibility of expressing markedness and faithfulness scales via stringency relations (Prince 1997, de Lacy 2002a). Parsimony would then advise against admitting fixed

presumably means for it to be unassociated to any segmental root node. Such unfilled output moras are also proposed by van Oostendorp (2005a) to account for the certain segmental processes that occur in the feminine form of Limburg Dutch adjectives.[7] [8]

Swingle (1992) proposes a theory of mutation in Irish that uses never-docked floating features to induce dissimilation in mutated segments. There are also cases of featural morphology where only underlyingly floating features spread; an example is the Arawakan language Terena (Bendor-Samuel 1960) where the 1st person singular is marked by nasalization of all segments to the left of the leftmost obstruent in the noun root, even though the language otherwise has no nasal harmony. Any of these proposals about the permissibility of floating autosegments in outputs may or may not prove to be correct, but it does seem clear that to take *FLOAT as violable is well within the range of current theoretical debate. Further, as noted, even with violable *FLOAT, the grammar will have difficulty preserving floating autosegments in outputs if MAX(SUBSEG) exists. For all of the reasons discussed here, it seems clear that a MAXFLT/*FLOAT account of autosegmental docking is to be preferred to one based on MAX(SUBSEG).

2.2 MAX(FEATURE) VS. IDENT

One of the persistent and unresolved debates current in OT is whether faithfulness to input feature-specifications is governed by MAX(Feature) constraints, IDENT, or both. MAXFLT is a special case of MAX(Feature), so it is already clear that I will be using the MAX(Feature) approach to faithfulness to features that are floating in the input. Indeed it is difficult to see how it could be otherwise: since floating features are, by definition, not linked to any segment in the input, they have no properties to which to be faithful, other than their existence (and possibly their linear order relative to other structures).

I will, however, attempt to remain as agnostic as possible regarding whether MAX(Feature) or IDENT govern faithfulness to features underlyingly linked to segments. For the remainder of this paper, for convenience, I will use IDENT for this purpose. There does seem to be some empirical justification for this. First of all, MAX(Feature) demands the preservation in the output of features in the input, but it says nothing about faithfulness to their segmental linkages (or lack thereof). Something clearly has to enforce faithfulness to linkages, and one might as well as call it IDENT. More seriously, if MAX(Feature) constraints exist and exhibit stringency relations reflecting the principle of greater faithfulness to the marked, then MAX(Feature) could conspire with segmental deletion to yield unattested disharmonic segment inventories (de Lacy 2002a: §6.4.2.1).

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rankings into our theory. A further problem of the same kind is that universally-inviolable conditions would be arbitrarily divided between GEN and CON.

[7] However van Oostendorp (2005b) takes a different approach to the same facts.

[8] The existence of 'catalectic' moras unassociated to a segment has been argued for by Kager (1995), and empty moras of this sort are presumably equivalent to the word-final null vowels posited in various theories of stress such as Burzio (1994). However, proposals like these are not quite the same as the other examples being discussed, since the empty moras presumably do not need to be specified in inputs.

A natural objection then is: why permit floating features at all, if faithfulness to them requires the assumption of a MAX constraint, when such a constraint would be problematic for underlyingly-linked features?[9] To address this objection, consider first what would have to be assumed if features could not be floating in inputs. If features are objects, rather than simply attributes of segments, then Richness of the Base should allow for inputs in which features happen not to be linked to any segment. To exclude floating features from inputs *in principle* would require one to assume that features are not entities at all, but instead attributes of segments, as in structuralist and *SPE*-type theories; versions of the features-as-attributes position are staked out in much OT work, including Keer (1999), Baković (2000), Struijke (2002), and de Lacy (2002a).

It is far from clear, though, that the features-as-attributes view could be tenable. Outside of the domain of mutation, the various theories of harmony that treat features as bracketed intervals[10] potentially spanning more than one segment make a features-as-attributes theory redundant: features would exist both as the interval and as attributes of the segments in it. To stick closer to the concerns at hand, a theory without floating autosegments simply cannot give a satisfactory account of mutation. Such a theory could make use of MORPHREAL, Anti-faithfulness, or one of the other approaches considered in §10, but, as I will argue throughout, all of these leave much to be desired. Particularly relevant in this regard are cases of non-automatic spreading such as that of Terena, which, I argue in §10.3, can only be satisfactorily explained in terms of a theory that views features as entities capable of being pressured to align with prosodic edges.

2.3. Residual representational assumptions

A few more small points remain to be made. First, what happens when a floating feature [+F] docks to a segment that is already [+F]? What happens to the token of [+F] underlyingly linked to the segment: does it delete, or does it fuse with the floating [+F] token? In order to cut down on needless ambiguities of analysis, I will assume throughout that either fusion of identical feature tokens has no faithfulness cost in and of itself, i.e. that there is no UNIFORMITY(feature)[11], or that UNIFORMITY(feature) is low-ranked in all of the languages under consideration. That fusion of features is for free is consistent with the program of Span Theory (McCarthy 2004) in which for two [αF] segments to become part of a single [αF] feature-span violates a faithfulness constraint, called FAITHHEADSPAN[αF], requiring all input [αF] segments to head [αF] spans (spans are

[9] It may bear noting on this point that there the set of faithfulness constraints is asymmetric in other ways. For instance, it is standardly assumed that there is faithfulness to input moraic structure (and loci of lexical stress) but not to syllabic constituency.

[10] These include Headed Feature Domains (Smolensky 1995, 2005), Optimal Domains (Cole & Kisseberth 1994, 1995, Cassimjee & Kisseberth 1997, 1998, Cassimjee 1998) and Span Theory (McCarthy 2004, Key 2005). The use of bracketed intervals to represent features is also adopted for computational reasons by Eisner (1999) in the Primitive OT framework. Also relevant are frameworks that seek to derive the No-Crossing Constraint by defining autosegmental linkage as temporal overlap, e.g. Sagey (1988) and Bird & Klein (1990).

[11] Keer (1999) argues for essentially the same thing, though within a quite different set of assumptions.

assumed to be universally monocephalous). An additional constraint that militates against the fusion of the input [αF] tokens would be entirely superfluous.

A second simplifying assumption will be that autosegments, like all other representational objects, can only stand in correspondence with identical objects. This means that, say, input [+coronal] can correspond to an output [+coronal] but not to an output [-coronal]. Non-identical *segments* can still stand in correspondence, because, I assume, the objects standing in correspondence are the root nodes.[12]

Finally, following Padgett (1995), I assume that there are no class nodes, and that all (non-floating) features are directly linked to segmental root nodes.

3 Mutation Triggers Bigger than a Feature

An important property of MAXFLT is that it demands preservation of *all* floating features present in the input. This means that a single morpheme can trigger two or more featural (and/or tonal or length) changes at once, so long as it contains multiple floating autosegments in the input, and MAXFLT dominates the faithfulness constraints that militate against those changes. Also, MAXFLT makes it easy to account for cases in which the mutation-triggering morpheme has some segmental content: mutation will occur so long as the morpheme underlyingly contains floating autosegment(s), and MAXFLT dominates the relevant faithfulness constraints. As I will argue, both of these cases are problematic for constraints of the MORPHREAL family, since these constraints only demand that every morpheme have *some* realization, and hence will be satisfied by only a single featural change, or the presence of a single piece of structure affiliated with the given morpheme.

Mutations which work more than one featural, tonal, or length change are not altogether widespread but are clearly attested. More common are mutations in which feature-changes are triggered by a morpheme which also has segmental content. One language that exhibits both of these situations (in two cases, within a single morpheme) is the Western Nilotic language Nuer, spoken in Sudan and Ethiopia. Crazzolara (1933) identifies three grades of segments that occur in the final consonant of various inflectional forms of these verbs:

[12] This entails discarding the idea that [sonorant] and [consonantal] *are* the root node, as was assumed in many versions of Feature Geometry (Sagey 1986, Schein & Steriade 1986, Halle 1988, McCarthy 1988), since a segment's value for these features can be changed between the input and the output. The failure of these features to harmonize or exhibit OCP effects will instead demand a non-representational treatment, presumably assuming the non-existence of harmony driving constraints for these features.

(10) (from Crazzolara's (318), p. 156)

	voiced	voiceless fricative	voiceless stop
Labial	b	f	p
Interdental	ð	θ	t̪
Alveolar-dental	d	r̥	t
Palatal	j	ç	c
'Laryngo-guttural'	γ	h	k

A brief word is in order about the Nuer consonant system. Crazzolara (1933), p. 6, reports that "whether a b or a f is pronounced it is often hard to say." Given the ambiguity, Lieber (1987) argues that the labial sound in the 'voiced' grade that Crazzolara writes as [b] is in fact [β], which would make all of the sounds in the voiced grade [+voi, +cont], except for the 'alveolar-dental' member [d], which occurs at a place of articulation for which Crazzolara reports no voiced continuant. According to Frank (1999), Nuer does not contrast stops and fricatives at any place of articulation, but [v] 'frequently' occurs allophonically and is written as 'b' by his consultant. (Frank also reports that Nuer speakers of L2 English have difficulty with the English p/f contrast.) Given these ambiguities, and my current lack of phonetic data, I will suspend judgment as to whether final [b] in 'voiced'-grade inflected verbs is [+] or [-cont]. (The fact that Nuer does not support a stop/fricative contrast means that the inflectional mutations that give rise to fricatives are non-structure preserving; the theoretical implications of cases of this sort are discussed in §6.)

In accordance with Crazzolara's identification of the grades associated with various inflectional categories, Lieber (1987) identifies the following four suffixes as containing the pairs of floating features shown in (11):

(11)

3rd. sg. ind. pres. act. =	[+voi, +cont] ɛ	=*voiced*
1st pl. ind. pres. act. =	[-voi, +cont] kɔ	=*voiceless fricative*
Negative pres. pple. =	[-voi, -cont]	=*voiceless stop*
Past pple. =	[-voi, +cont]	=*voiceless fricative*

The alternations induced by these affixes are shown in the paradigms in (12); the [b]s are all as given by Crazzolara:

(12)

	'overtake'	*'hit'*	*'pull out'*	*'scoop hastily'*
Infinitive/verbal noun	co**b**	jaa**ç**	gu**ð**	kɛ̂**p**
3rd. sg. ind. pres. act.	có**b**ɛ́ jɛ	jaa**y**ɛ̀ jɛ̀	gú**ð**ɛ́ jɛ̀	kɛ́**b**ɛ́ jɛ̀
1st pl. ind. pres. act.	còɔ**f**kɔ jɛ	jaa**ç**kɔ jɛ	gwɔ̀**θ**kɔ̀ jɛ	kɛ̀a**f**kɔ̀ jɛ
Negative pres. pple.	cò**p**	jaa**c**	gu**t̪**	kɛ**p**
Past pple.	co**f**	jaa**ç**	gu**θ**	kɛ̀**f**

As the reader can verify, the bolded consonants alternate according to the features that Lieber identifies as being associated with each inflectional position. This happens reliably, even when the inflectional suffix has segmental content of its own, or when the inflected form differs from the infinitive in two features, as in [cob]~[cof].

The constraint MAXFLT, coupled with the assumption that the URs of the inflectional suffixes are as in (11), easily captures these facts. First, mutation happens even when the trigger has segmental content:

(13) Nuer: 'pull out-neg. pres. pple.'

guð + [-voi]$_2$[+cont]$_3$ kɔ | [+voi]$_1$	MAXFLT	IDENT[contin]	IDENT[voi]
a. gwɔð-kɔ / \\ [+voi]$_1$[+cont]$_3$ ~~[-voi]$_2$~~	[-voi]$_2$!		
b. ►gwɔθ-kɔ / \\ [-voi]$_2$[+cont]$_3$			*

The winning candidate, (13b), violates IDENT[voi] by docking a floating token of [-voi] to an underlyingly [+voi] segment. However, (13b) still wins because to avoid this violation by deleting the floating [-voi], as candidate (13a) does, violates the higher-ranked MAXFLT.

Similarly, because it requires faithfulness to all floating autosegments in the input, MAXFLT can easily induce mutations that change more than one feature:

(14) Nuer: 'overtake-1st. pl. ind. pres. act.'

cob + [-voi]$_2$[+cont]$_3$ kɔ	MAXFLT	IDENT[contin]	IDENT[voi]
a. coɔb-kɔ ~~[-voi]$_2$[+cont]$_3$~~	[-voi]$_2$!, [+cont]$_3$		
b. ►coɔf-kɔ / \\ [-voi]$_2$[+cont]$_3$		*	*
c. coɔβ-kɔ \\ ~~[-voi]$_2$~~[+cont]$_3$	[-voi]$_2$!	*	
d. coɔp- kɔ / [-voi]$_2$~~[+cont]$_3$~~	[+cont]$_3$!		*

The optimal candidate, as desired, is (14b), which has docked both of the floating features in the 1st person plural indicative present active suffix, thereby violating both IDENT(contin) and IDENT(voi). Despite these violations, it still wins because to avoid one or both of these violations by deleting one or both of the floating features violates a higher-ranked constraint, MAXFLT.

The ability of MAXFLT to give the correct result in (13-14) crucially distinguishes it from constraints of the MORPHREAL family. These constraints are notably diverse in their definitions; three general types can be identified, as given in (15-17):

(15) “Preserve something”
e.g. Akinlabi’s (1996) PARSE-MORPH:
Some part of every morpheme must be preserved in the output.

(16) “Preserve something distinctive”
e.g. Gnanadesikan’s (1997) MORPH-REAL or de Lacy’s (2002) MORPHDISF:
Some part of every morpheme that will make a difference on the surface must be preserved in the output.

(17) “Make something different”
Kurisu’s (2001) REALIZE-MORPHEME:
The phonological realization of an affixed form must not be identical to the phonological realization of the related unaffixed form.

Constraints of type (15-17) have been proposed as mechanisms for driving the docking of floating features, but crucially, they quantify existentially rather than universally: they only demand the preservation of some portion of a morpheme, possibly with a requirement that it be surface-distinct. As such they cannot induce feature-docking when the morpheme with which some floating features are affiliated also has segmental content, as (18) shows:

(18) Failure of MORPHREAL to induce mutation when trigger contains segments

guð +[-voi]$_2$[+cont]$_3$ kɔ	MORPHREAL	IDENT[contin]	IDENT[voi]
a. 💣 gwɔð-kɔ ~~[-voi]$_2$[+cont]$_3$~~			
b. ► gwɔθ-kɔ / \\ [-voi]$_2$[+cont]$_3$			*!

(cf. success of MAXFLT in (13))

Both candidates in (18) satisfy MORPHREAL, because the output contains the segments [kɔ], which are affiliated only with the negative present participle suffix, and whose presence renders the affixed form different from the infinitive. Therefore, to dock the floating [-voi], as in (18b), will incur a gratuitous and therefore (incorrectly) fatal violation of IDENT[voi].[13, 14]

Kurisu (2001) proposes a way to deal with this problem for the MORPHREAL theory. He makes use of the Sympathy approach to phonological opacity (McCarthy 1999). In Sympathy, some constraint (indicated in tableaux by the symbol ✯) is designated the *selector*. The *sympathetic* candidate is the most harmonic candidate that obeys the ✯-constraint, and is indicated with the symbol ❀. Opaquely-motivated changes can then be made to occur in the optimal candidate via constraints demanding that the output be faithful to the ❀-candidate.

Kurisu's proposal runs as follows: in morphological processes realized as a segmental affix plus a feature change (or some other change), the ✯-constraint is one whose satisfaction demands deletion of the segmental content of the affix material, so in the ❀-candidate REALIZE-MORPHEME is satisfied by the feature change. The following example of umlaut triggered by the plural suffix /-e/ in German (Kurisu's (5), p. 196) will serve to illustrate:

(19) German: 'guests'

/gast-e/$_{pl.}$	MAX	REALIZE-MORPHEME	IDENT-❀O [back]	IDENT-IO [+back]	✯STEM≡PRWD
a. gast	*!	*	*		
b. gaste			*!		*
c. ❀ gäst	*!			*	
d. ► gäste				*	*

The ✯-constraint demands that the Prosodic Word be co-extensive with the stem, and therefore satisfaction of it necessitates deletion of the vowel /-e/ of the plural suffix. Since REALIZE-MORPHEME is undominated, however, the ❀-candidate will have to differ from the bare stem in some way; given the constraint hierarchy, this is achieved by fronting the stem vowel: /a/→[e]. IDENT-❀O[back] is also undominated, so this change is reflected in the optimal candidate. Both realizations of the plural morpheme—the segment [e] and the vowel umlaut—therefore appear in the winning candidate due to *faithfulness*: the suffixal segment due to IO-MAX, and the backness change due to ❀O-IDENT[back].

Thus, crucially, part of the double-realization—the part that the winner is IO- rather than ❀O-faithful to—has to be *representationally present in the input*. But, if there are no floating features, it is impossible to produce double-realization in the form of two feature changes, since there's nothing extra to be IO-faithful to. Consider the [-voi, +cont] past participle marker in Nuer. Suppose the following ranking:

[13] A similar argument about MORPHREAL's inability to produce more than minimal realization of a morpheme is made by Ussishkin (2000); see §10.2 for further discussion of his counter-proposal.

[14] The need for MAXFLT in cases like this is anticipated by Piggott (2000: 91): 'some constraint… commands the surface presence of an input feature whenever possible'.

(20) Nuer: ‘overtake-past pple.’—Incorrect failure to change two features

/cob/$_{\text{past.pple.}}$	REALIZE-MORPH	IDENT-❀O [contin]	IDENT-IO [+contin]	✯IDENT-IO [+voi]
a. cob	*!	*		
b. cop		*!		*
c. 💣❀ coβ			*	
d. ▶ cof			*	*!

Because neither of the desired feature changes results from faithfulness to anything in the *input*, the ❀-candidate wins, because no candidate that’s ❀O-faithful to it has any reason to change in voicing. The only way out of this is to suppose that the desired winner (20d) has to be IO-faithful to an input [-voi] specification. But this is to acquiesce to floating features, which eliminates the need for this Sympathy account in the first place.

A deeper empirical problem is that this approach can in principle only produce double realization of a morpheme: one realization resulting from IO-faithfulness and a second from ❀O-faithfulness. It therefore cannot handle clear cases of *triple* morphological exponence in Dinka, a close genetic relative of Nuer. With variation across four verb classes, inflectional and derivational morphology on verbs can be marked by alternations to tone, vowel length, and voice quality, as well as affixation of segments (Andersen 1995):

(21) Dinka

root	*2P*	*Benefactive*	*gloss*
wḛ̀c	wá̰ckà̤	wê̤ːc	‘kick’
tḛ̀ŋ	tá̰ŋkà̤	tê̤ːŋ	‘dust’

2P = {H, [+low], /-kà̤/}
Benefactive = {HL, [breathy voice], μ}

In the second person forms, the Sympathy approach proposed in Kurisu (2001) could induce changes to the tone or the length of the base, but not both. Likewise, with the absence of floating features in the input, this approach could induce one of the changes (tone, voice quality, length) in the benefactive, but not two, let alone all three.

Lest the skeptic imagine that multi-featural mutations are some areal quirk of Western Nilotic, at least two cases are attested elsewhere. One comes from the Zoquean language Texistepec Popoluca (Reilly 2002, 2005; Wichmann 1994). In this language, verbal pronominal agreement markers can induce nasalization (or voicing), palatalization, or both:

(22) Texistepec Popoluca: ‘dig’

Inf.	*1P*	*2P*	*3P*
dastah	nastah	ɲastah	dʲastah

The facts in this language are quite complex, and a full analysis would go far beyond the purposes of this paper. However, we can quite easily justify the claim that Texistepec Popoluca has multi-featural mutations. One can be seen in the [d]~[ɲ] alternation in the 2P shown in (22). This suggests an interpretation of the 2P marker as having the UR [-back, +nasal]. It couldn't be just one of these features, with the other featural changes occurring for markedness reasons, because, as the 1P and 3P show, just nasality or just palatality can be added to the infinitive's /d/.

The second reason to believe that Texistepec Popoluca has multi-featural mutation concerns the 3P forms of verbs with root-initial nasals:

(23) Texistepec Popoluca: denasalization and palatalization in 3P

Infinitive	*3P*	*gloss*
naj	dʲaj	'sprout'
naraŋkaʔ	dʲaraŋkaʔ	'cut an orange'
miɲ	biɲ	'come'
maːŋkoʔ	bjaːŋgoʔ	'cut a mango'

Why should we get /d/→[ɲ] in the 2P but /n/→[dʲ] in the 3P? This fact suggests that the 3P marker consists of [-back, -nasal].[15]

A final case of mutation changing two segmental features at once comes from Breton (Willis 1982). Some dialects of Breton have a 'lenition-and-provection' mutation in which /b m g/ become [f f x]. There seems to be no markedness reason for both [voice] and [continuant] to change, since Breton has initial [v] and (rarely) [ɣ], as well as [p] and [k]. It therefore seems justified to assume that the morphemes triggering this mutation contain floating [-voice, +continuant].[16]

This only exhausts examples of mutations changing two *segmental* features at once. Bitonal morphemes are by no means rare in tone languages, and even in languages as familiar as English, it is arguable that certain multi-tonal intonation contours have the status of lexically-listed morphemes (Potts 2005). Finally, it is quite common for affixes with segmental content to trigger mutation in the base of affixation; examples include Inor (Chamora & Hetzron 2000), where the impersonal is marked by /-n/ plus labialization of the rightmost non-coronal consonant in the root; Hua (Haiman 1972) where various suffixes trigger fronting of stem vowels; and the many umlaut-triggering affixes of German (Wiese 1996). Segmentally-contentful affixes which insert floating

[15] Initial nasals of Proto Mixe-Zoque were evidently changed to oral stops in Texistepec Popoluca, though initial /m, n/ are not entirely lacking from the native vocabulary. The elimination of nasality in the 3P may be related to this. See Wichmann (1994) and Reilly (2002: §2.4) for discussion.

[16] Willis reports that the 'full' version of this mutation also features devoicing (but not spirantization) of /d/, so this mutation could be given an allomorphic analysis identical to that presented for the 'mixed mutation' in §5, with the exception that floating [-voice] would be added to allomorph taken by non-coronals.

moras on roots are also found in Basque (Hualde 1990) and Zuñi (Newman (1996); see also Sprague (2005) on these last two.). The collective weight of all of these cases strongly militates in favor of an autosegmental theory of mutation with MAXFLT.

A final historical note: the inability of MORPHREAL constraints to induce more than one change is ironic in light of the fact that the first morpheme-realization constraint proposed, the AFX ('Affix realization') of Samek-Lodovici (1992), can produce these effects: it demands that *every* portion of an affix be distinctly realized, and therefore can handle multiple-autosegment mutations like the Alabama imperfective (gemination or vowel lengthening, plus high tone) for which Samek-Lodovici proposes the constraint. AFX thus resembles MAXFLT in calling for the preservation of all floating autosegments in the input, but crucially it goes beyond MAXFLT in requiring all of those segments to be realized distinctively. As we will see in §4, the ability of MAXFLT to require the preservation of floating features, even if invisibly, can do useful work in accounting for 'quirky' mutation patterns, where the featural change observed varies from one class of targeted segments to another. I therefore leave the job of penalizing non-distinctive realization of floating autosegments to a separate constraint, NOVACDOC, which is the topic of the next section.

4 Featural polarity and NOVACDOC

This section discusses the second of the major new constraints proposed here, NOVACDOC. Section 4.1 introduces the phenomenon of featural polarity and applies NOVACDOC to its analysis. Section 4.2 discusses some further applications of the constraint.

4.1 Polarity

One of the major controversies surrounding the theoretical framework proposed by Chomsky & Halle (1968) concerned that fact that the use of alpha-variable notation in phonological rules permitted the formulation of exchange rules, which convert +F segments to –F, and –F segments to +F, in the same environment:

(24)
$\alpha F \rightarrow -\alpha F$ / X_Y

The debate surrounding these rules eventually more or less settled on an empirical generalization that exchange processes do exist, but are always conditioned by morphological factors (McCawley 1974, and especially Anderson & Browne 1973).[17]

[17] Fitzpatrick, Nevins, & Vaux (2004) argue for a counter-example in Zok Armenian; however, as they note (fn. 5), half of their proposed exchange rule occurs only before nasals. They also offer a putative example from Brussels Flemish (Zonneveld 1976), but the status of this process as an exchange rule is refuted by Moreton (1996: §4.4) and the references cited therein. The one set of robust (apparent) exceptions to this generalization are the exchanges seen in the tone sandhi systems of certain Chinese languages, most famously Taiwanese. See Wang (1967) and Yue-Hashimoto (1986) for overviews, and Moreton (1996: §4.5) and the references cited there on Taiwanese. A three-step tone sandhi circle has also

Within OT, the exclusion of exchange mappings in 'purely phonological' situations follows from the formal structure of the theory, as Moreton (1996) proves. The argument runs along these lines: if underlying /A/ maps unfaithfully to surface [B] in the environment X_Y, then this can only be because [XBY] is less marked than [XAY]; that is, because some markedness constraint that prefers [XBY] dominates all markedness constraints that prefer [XAY], as well as the faithfulness constraints that militate against the /A/ → [B] mapping. If this is the ranking situation of the language in question, then it is impossible for underlying /XBY/ to map to surface [XAY], because that would require a contradictory ranking, in which some [XAY]-preferring markedness constraint dominated all [XBY]-preferring markedness constraints.

The upshot of this is, then, that the interaction of markedness and faithfulness constraints cannot, by itself, give rise to exchange processes like that schematized by the rule in (24). Something else must be added to produce the attested range of exchange processes, which should be in some sense restricted to morphophonological contexts in light of the generalization just mentioned. One option is for this 'something else' to take the form of a new class of constraint(s) that are neither markedness nor faithfulness; MORPHREAL and anti-faithfulness are proposals of this sort, whose adequacy *vis-à-vis* attested exchange processes will be considered later in this section.

Within the autosegmental theory of mutation phenomena being advanced here, I will pursue a different approach to defining the 'something else'. Specifically, I will argue that exchange processes arise through the selection of listed allomorphs.

Before turning to exchanges, I will present a brief theoretical excursus on listed allomorphy in OT. There are many languages in which some morpheme alternates between two (or more) forms that do not appear to be phonologically derived from each other, but whose distribution is predictable from phonological factors. A by-now standard approach to such cases (following Mester 1994, Mascaró 1996, Kager 1996, Tranel 1996a, 1996b, and others) is to suppose that the lexical entries of such morphemes consist of listings of both forms (the 'allomorphs') and that GEN produces candidates standing in correspondence with each of them. All of these candidates then compete in a single tableau. Crucially, every candidate bears a correspondence relation to, and therefore is pressured to be faithful to, only one input allomorph. As such, picking one allomorph rather than another does not in and of itself make a difference in faithfulness cost.

Mascaró (1996) gives a straightforward example from Catalan, where the personal article appears as [ən] (orthographic *en*) before a consonant-initial name, and [l] (orthographic *l'*) before a vowel-initial name. Mascaró analyzes these facts with the ranking showing in tableaux (25-26):

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been reported in Choapan Zapotec (Lyman & Lyman 1977). Mortensen (2004) discusses some cases of tone-sandhi exchanges in Hmongic languages.

(25) Catalan: /ən/ wins with consonant-initial name

{ən, l} + pɾins *Inputs:*	*Outputs:*	*lC	DEP	ONSET	NOCODA
ən + pɾins	a. ►ən.pɾins			*	**
l + pɾins	b. lpɾins	*!			*
l + pɾins	c. lə.pɾins		*!		*

The candidate where the /ən/ allomorph surfaces faithfully, (25a), creates violations of ONSET and NOCODA that are not present in candidates corresponding to the /l/ allomorph. However, the candidate that is fully faithful with respect to the /l/ allomorph, (25b), creates an illegal cluster [lpɾ] which violates a markedness constraint ranked above both ONSET and NOCODA. Eliminating this violation via vowel epenthesis, as in (25c), creates a DEP violation, which is also more serious than violation of either ONSET or NOCODA.

(26) Catalan: /l/ wins with vowel-initial name

{ən, l} + alən pɾins *Inputs:*	*Outputs:*	*lC	DEP	ONSET	NOCODA
ən + alən pɾins	a. ə.na.lən.pɾins			*!	**
l + alən pɾins	b. ► la.lən.pɾins				**

By contrast, when the name begins with a vowel, as in (26), the faithful realizations of both allomorphs are phonotactically licit, and so ONSET crucially decides in favor of /l/ - or, more rigorously speaking, in favor of a candidate bearing a correspondence relation to the /l/ allomorph, namely (26b).

Now we return to the matter of featural polarity. The best-known example comes from DhoLuo, a Nilotic language spoken in Kenya, where the Plural and Genetive morphemes reverse the voicing value of the last consonant in the stem (data from Okoth-Okombo 1982; see also Gregersen 1974)[18]:

(27)

Nom.Sg.	bat	kidi
Nom.Pl.	bede	kite
Gen.Sg.	bad	kit
Gen.Pl.	bede	kite
	'arm'	*'stone'*

Importantly, the [voice] value of the final consonant in the Genitive Plural is the same as that of the corresponding consonant in the Nominative Plural and the Genitive Singular. The significance of this fact will be discussed momentarily.

[18] Gregersen (1974) reports that essentially identical voicing inversion happens in plural formation in Shilluk, another Nilotic language, though not as pervasively.

The proposal I will pursue here is that the Plural and Genitive morphemes each have two listed allomorphs, containing oppositely-valued floating tokens of [voice]:

(28)
Plural: {[+voi] E, [-voi] E}
(/E/ is a vowel that surfaces as /ɛ/ or /e/ under harmony)
Genitive: {[+voi], [-voi]}

I assume that the deletion of the stem-final V in mappings like /kidi/ → [kit] obtains because constraints demanding the contiguity of all parts of the affix and for it to be aligned at the right edge dominate MAX. (The details of this constraint, MORPH-O-CONTIG, are presented in Section 9.)

The following constraint makes the crucial choice between allomorphs:

(29)
NOVACUOUSDOCKING
∀F∈I, where F is a feature: [¬[∃S∈I such that S is a segment and F is attached to S]]→
[[∃F′∈O such that F𝔑F′ and F′ is attached to a segment δ′∈O] →
[¬[∃δ∈I such that δ𝔑δ′ and δ is attached to a feature identical to F]]

Less formally, NOVACDOC says: if a feature F is floating in the input, then if F has an output correspondent F′ that's docked to a segment δ′, then δ isn't in correspondence with an input segment that already bore a feature value identical to F. Informally, it says: floating features cannot be docked onto segments that already bore the same feature-value in the input.

For DhoLuo, what NOVACDOC will do is to exert a preference for the allomorph whose floating token of [voice] does not match that of the stem-final consonant. Tableau (30) illustrates how allomorph selection takes place for the Genitive singular:

(30) DhoLuo: ‘arm.GEN.SG.’

bat + {[-voi]$_2$, [+voi]$_3$} | [-voi]$_1$ *Inputs:*	 *Outputs:*	MAXFLT	NOVAC DOC	IDENT [voi]
bat [-voi]$_2$ | [-voi]$_1$	a. bat | [-voi]$_{1,2}$		[-voi]$_2$!	
bat [-voi]$_2$ | [-voi]$_1$	b. bat ~~[-voi]$_2$~~ | [-voi]$_1$	[-voi]$_2$!		
bat [+voi]$_3$ | [-voi]$_1$	c. bat ~~[+voi]$_3$~~ | [-voi]$_1$	[+voi]$_3$!		
bat [+voi]$_3$ | [-voi]$_1$	d.► bad | [+voi]$_3$			*

In candidate (30a), the chosen allomorph contains a floating [-voi] which has docked to an underlyingly [-voi] segment, and this fatally violates NOVACDOC. Candidates (30b-c) fatally violate MAXFLT by failing to preserve in the output the floating feature of the allomorph to which they bear a correspondence relation. Candidate (30d) is optimal because, though it violates IDENT[voi] by docking [+voi] underlying /t/, this is less serious than violating MAXFLT or NOVACDOC. (Another imaginable candidate in which [voi] docks to /b/, resulting in the mapping /bat + [-voi]/ → /pat/, is ruled out by constraint(s) demanding that the Genitive morpheme appear at the right edge of the word; see §9 for discussion.)

This analysis also easily handles the fact that the last consonant of the Genitive Plural, like the Genetive Singular and Nominative Plural, has the opposite voicing value from the corresponding consonant in the Nominative Singular, as shown in (31):

(31) DhoLuo: ‘arm.GEN.PL.’

bat + {[+voi]$_2$, [-voi]$_3$} + {[+voi]$_4$E, [-voi]$_5$E} | [-voi]$_1$ *Inputs:*	*Outputs:*	MAXFLT	NOVACDOC	IDENT [voi]
bat [-voi]$_3$ [-voi]$_4$E | [-voi]$_1$	a. bete | [-voi]$_{1,3,5}$		[-voi]$_3$!, [-voi]$_5$	
bat [-voi]$_3$ [-voi]$_5$E | [-voi]$_1$	b. bete ~~[-voi]$_3$ [-voi]$_5$~~ | [-voi]$_1$	[-voi]$_3$!, [-voi]$_5$		
bat [+voi]$_2$ [+voi]$_4$ E | [-voi]$_1$	c.► bede | [+voi]$_{2,4}$			*

Since, we may assume, it is impossible for a single segment to bear two different values of [voice], the undominated status of MAXFLT will force selection of ‘matching’ allomorphs of the Genetive and of the Plural: the grammar has to pick either the two [-voi] allomorphs, as in (31a), or the two [+voi] allomorphs, as in (31c). The latter option violates IDENT[voi], but it still wins because the former violates the higher-ranked NOVACDOC.

The approach to DhoLuo for which I am arguing here closely resembles the one proposed by de Lacy (2002b)[19], using the constraint in (32):

(32)
MORPHDISF:
For all morphemes M,
there is some faithful exponent E of M,
and E is not a faithful exponent of any other morpheme M_2,
where M and M_2 are in the same [morphological] stem.

This constraint is violated by the docking of, say, affixal [-voice] to an underlyingly [-voice] root segment because the [-voice] borne on the output segment counts as a ‘faithful exponent’ both of the root and of the affix.

MORPHDISF is a MORPHREAL constraint of the ‘preserve something distinctive’ variety, and therefore suffers from the problems with MORPHREAL that were discussed in Section 2. In the case of DhoLuo, it encounters trouble with the plural suffix, which consists of a vocalic suffix plus the voicing reversal. The problem is that the suffixal vowel would appear to suffice as a ‘faithful exponent’ of the affix, meaning that the

[19] This constraint is also used by Pullman (2004). Listed allomorphy has also been applied to L↔H alternations in Zahao by Yip (2003), to tonal polarity in Mundurukú by Picanço (2002), and to the circular tone-sandhi system of Taiwanese by Tsay & J. Myers (1996).

candidate with the suffix plus voicing reversal (33c below) is incorrectly harmonically bounded by the candidate with vacuous docking (33b):

(33) DhoLuo: ‘arm.PL’

bat + {[-voi]$_2$ E, [+voi]$_3$ E} | [-voi]$_1$ *Inputs:*	 *Outputs:*	MORPHDISF	IDENT(voi)	MAX
bat [-voi]$_2$ E | [-voi]$_1$	a. bat | [-voi]$_{1,2}$	*!		*
bat [-voi]$_2$ E | [-voi]$_1$	b. 💣 bate | [-voi]$_{1,2}$			
bat [+voi]$_2$ E | [-voi]$_1$	c. ▶ bade | [+voi]$_2$		*!	
bat [+voi]$_2$ E | [-voi]$_1$	d. bad | [+voi]$_2$		*!	*

The problems faced by MORPHDISF are shared by the other constraints of the MORPHREAL category, due to their satisfiability by a single minimal change, as was discussed in §3. NOVACDOC avoids these difficulties because it is violated by vacuous docking in and of itself; the existence of segments or other units of structure among the surface exponents of the morpheme to which the vacuously-docked feature belongs is irrelevant to its assessment.

Now to take up the theoretical significance of the fact, illustrated in (31), that there are no ‘double reversals’ in the Genetive Plural. (Okoth-Okombo 1982, p. 33: “in regular cases, the genitive plural form of a noun is identical to the nominative plural form.”) Under a traditional derivation-like understanding of how bases are related to derived forms, the base of affixation for the Genetive Plural would presumably be the Genetive Singular and/or the Nominative Plural, relative to which the Genetive Plural has not reversed the [voice] value of its stem-final consonant. De Lacy (2002b) argues that this is problematic for an anti-faithfulness account of the DhoLuo facts, because the Genetive Plural would seem to be reversing [voice] relative to its *input*—the UR of the simplex root—rather than to its morphological base (the Genitive Singular and/or Nominative Plural). In light of the generalization that exchange processes are always morphologically-induced, anti-faithfulness constraints are assumed in Alderete (1999, 2001) to exist only on the OO-dimension of correspondence, and therefore cannot induce polarity relative to inputs.

The theory of OO-correspondence proposed in Alderete (1999) does in fact have a means of avoiding this criticism, but one whose adoption would not be clearly desirable. This is the notion of Base Optimization:

(34) Base Optimization (=Alderete's (1999) (11), p. 120)
"If a set of words created by some morphological process stands in the correspondence relation $\mathfrak{R}$, then the base for $\mathfrak{R}$ is the member of the base-output pair which is most harmonic with respect to the constraint hierarchy."

This means that the base for all OO-correspondence relations in a paradigm is a single member of the paradigm.[20] In Alderete's example, the 'most harmonic' member of the paradigm is that which best satisfies morphological markedness constraints: the masculine, singular, Nominative, (etc.), form. Base Optimization thus serves, in effect, to justify treating this form as the base of morphological operations even in obligatory-inflecting languages where it will not be simplex relative to forms with other numbers, genders, cases, or the like. Given this assumption about the structure of paradigms, an anti-faithfulness analysis of DhoLuo would then be able to appeal to the assumption that the Nominative Singular were the optimal base, and that therefore all Plural and Genitive forms reverse voicing relative to it.

However, it is by no means clear that a theory of intraparadigmatic correspondence along these lines is viable. First, some researchers have noted the existence of *sub*paradigm-uniformity effects (see, e.g., Gafos & Ralli 2001). Such cases are inconsistent with the claim that all members of a paradigm stand in OO-correspondence with a single member: they show that paradigms are not 'flat' in terms of uniformity pressures. A different sort of challenge comes from McCarthy (2005), who argues that is necessary to assume that *all* members of an inflectional paradigm stand in OO-correspondence with each other (or, in the terminology of the proposal, OP-['optimal paradigms'] correspondence). Within a model of this sort, the viability of anti-faithfulness becomes even more tenuous. Alderete's approach to DhoLuo attributes the voicing reversal in the Plural and Genitive to an anti-faithfulness constraint ¬IDENT(voice). Under Optimal Paradigms, the effect of such a constraint would be to pressure the Gen.Sg., Nom.Pl, and Gen.Pl. to differ in voicing not only from the Nom.Sg., but also from *each other*. This results in the odd prediction that the voicing reversal should underapply in one of these forms for the sake of reducing the total number of anti-faithfulness violations:

(35) DhoLuo: incorrect underapplication of [voice] reversal in paradigm for 'arm'

/batNOM.SG., bat-eNOM.PL., batGEN.SG, bat-eGEN.PL./	¬OP-IDENT(voice)	IO-IDENT(voice)
a. ► bat, bade, bad, bade	**, **!, **	***
b. 💣 bat, bade, bat, bade	*, *, *	**

[20] That some (not necessarily simplex) surface member of an inflectional paradigm is selected as the base has also been argued by Albright (2002a, 2002b, 2004) and Dowd (to appear).

If OP is an empirically-necessary move for intraparadigmatic correspondence, then the DhoLuo facts mean that anti-faithfulness constraints would need to be evaluated over a distinct OO-correspondence relation that related each member of a paradigm to a *single* base. The unparsimoniousness of such a move would significantly dilute the conceptual appeal of anti-faithfulness theory. The imposition of this extra form of OO-correspondence might be less bothersome if it were based on intuitive, derivation-like simplex/complex relations, but, as de Lacy shows, the DhoLuo facts are inaccessible to a version of anti-faithfulness that uses such a notion of 'base'.

The NOVACDOC model of featural polarity, on the other hand, requires *no* particular assumptions about the nature (or even the existence) of OO-correspondence, because under this proposal, the relevant evaluations take place on the IO-dimension. NOVACDOC is, formally, an IO-faithfulness constraint: it will disfavor a mapping from an input containing floating features to a non-identical output in which the floating features have docked to a segment that underlyingly bore the same feature values, but it will not penalize a fully-faithful candidate in which the floating features remain floating.

Despite its status as an IO-faithfulness constraint, NOVACDOC also captures the generalization that exchange processes are always morphologically-conditioned. This is because it can only give rise to exchanges when there are listed allomorphs with opposite-valued floating tokens of the relevant feature.[21] When an affix has two allomorphs, different allomorphs can be chosen depending on the properties of the base of affixation. But in the word-internal phonology of a single morpheme, NOVACDOC could only ever pick the same result all of the time.

It should be noted at this juncture is that not all attested exchange processes take the form of featural polarity (the following examples are from Anderson & Browne 1973). In the Pari dialect of Anuak, another Nilotic language, the plural induces an exchange between stem-final nasal consonants and prenasalized stops (or homorganic stop-nasal clusters)[22]. Several languages also exhibit morphologically-induced exchanges between long and short vowels; examples include plurals in Dinka, plurals in Diegueño, and diminutives in Czech. An analysis of these is given in §7. Also, see Anderson & Browne (1973), Wolfe (1970), Wang (1967, 1968), Yue-Hashimoto (1986), Malone (1972), Moreton (1996), and the references they cite, for other claimed cases of varying plausibility, discussion of which would run well beyond the scope of this paper.[23]

[21] Paul de Lacy points out that, rather than positing two allomorphs, one could also posit a single allomorph with two floating features with contradictory feature-values: [+voi][-voi]. This would have the same effect of restricting polarity to morphological processes, since, again, within a single morpheme, the choice of which floating feature to dock would always be the same. (Trommer's (2005) analysis of tonal polarity in Kanuri is similar in spirit to this suggestion.)

[22] This could conceivably be polarity of a single feature, though, depending on one's assumptions about the representation of prenasals.

[23] Three more cases that I have not found cited elsewhere in the exchange rule literature: Ngo (1984) and Burton (1992) propose tonal exchange rules for Vietnamese; see Pham (2001) for an alternative account. Wang (1967) alludes to a flip-flop process in Palantla Chinantec; this is presumably the exchange between 'controlled' and 'ballistic' stress in certain inflectional contexts described by Merrifield (1968); this process does not appear to be very productive, but is in any case morphologically-conditioned. The

There are, however, several other attested examples of morphological feature polarity. Chomsky & Halle (1968: pp. 356-357) discuss the case of exchange processes in the imperfects of Hebrew, Arabic, and Aramaic. In Tiberian Hebrew (see also Malone 1972), the stem vowel [a, o, e] in the perfect alternate with [o, a, a] in the imperfect:

(36) (from Chomsky & Halle's (74), p. 356)

alternation	*perfect*	*imperfect*	*gloss*
a→o	lamad	jilmod	'learn'
o→a	qaton	jiqtan	'be small'
e→a	zaqen	jizqan	'age' (i.e., 'become older')

We might then analyze the imperfect morpheme as containing two allomorphs with different floating features: {[+low], [-low, +back]}. Assuming that the theme vowel seen on the surface in the perfect is present in the input,[24] forms with underlying /a/ will take the [-low, +back] allomorph under the ranking NoVacDoc >> Ident[low], Ident[back].

Similar alternations are seen in Arabic (Chomsky & Halle 1968: 357, McCarthy 1979, 1994). Forms with class vowel [a] in the perfect unpredictably change that vowel to either [i] or [u] in the imperfect, unless the following consonant is a guttural. If the stem vowel is [i] in the perfect, it becomes [a] in the imperfect. Forms with [u] in the perfect can be set aside; this occurs more or less only in statives, and their stem vowel does not alternate.

These facts can be analyzed as follows: first, since it is unpredictable whether the perfect's [a] changes to [i] or [u] in the imperfect, we may assume the existence of two verb classes which take different imperfect morphemes. For the *a/i* class, the allomorphs of the imperfect affix will be {[+low], [+high, -back]}, and for the *a/u* class, the allomorphs will be {[+low], [+high]}.[25] The ranking NoVacDoc >> Ident[low], Ident[back] then assures selection of the correct allomorph, just as in Tiberian Hebrew.

(37) Arabic: 'beat.IMPERF'

Darab + {y[+low]$_1$, y[+high]$_2$[-back]$_3$}	NoVacDoc	Ident[low]	Ident[back]
a. ► yaDrib /\\ [+high]$_2$[-back]$_3$		*	*
b. yaDrab | [+low]$_1$	[+low]$_1$!		

exchange might prove to be a case of polarity of some phonation-type feature; see Merrifield & Edmonson (1999) for phonetic details. In Hiligaynon (Wolfenden 1971, Urbanczyk 2005) stress in the prefixed diminutive reduplicant symmetrically flops relative to the base.

[24] See Ussishkin (1999, 2000a,b) on the elimination of the consonantal root as a separate morpheme in Semitic; we may consider ourselves justified in assuming that the root underlyingly has vowels in it.

[25] These allomorphs mirror McCarthy's (1979: 293) polar ablaut rule (51).

The Arabic example also crucially shows that polarity processes can fail to apply due to markedness. As mentioned, the perfect's [a] remains [a] in the imperfect if the vowel is followed by a guttural. We may analyze this as domination of MaxFlt and/or NoVacDoc by a markedness constraint against guttural/high-vowel sequences which we may denote $*C_{phar}V_{hi}$.

(38) Arabic: 'do.IMPERF' – underapplication of height polarity

faʕal + {y[+low]$_1$, y[+high]$_2$}[26]	$*C_{phar}V_{hi}$	NoVacDoc	MaxFlt
a. yafʕul | [+high]$_2$	*!		
b. ►? yafʕal | [+low]$_1$		[+low]$_1$	
c. ►? yafʕal ~~[+low]$_1$~~			[+low]$_1$
d. ►? yafʕal ~~[+high]$_2$~~			[+high]$_2$

Tableau (38) also makes clear an analytic and learning ambiguity in the MaxFlt/NoVacDoc theory. When a mutation does not realize distinctly on the surface, is this because a feature has docked vacuously (as in 38b) or is it because the floating feature has deleted (as in 38c-d)? The same question is posed by Aka: when the root begins with a [+voice] consonant, does the floating [+voice] of the Class 5 prefix dock to it vacuously (as we expect if MaxFlt >> NoVacDoc) or does the floating feature delete (as will happen if NoVacDoc >> MaxFlt). In Aka and Arabic, where there is no evidence for the ranking of these constraints, it is impossible to say from the phonological data. Moreover, we cannot (non-stipulatively) assume one ranking rather than another as the default, left over from the initial state, because MaxFlt and NoVacDoc are both faithfulness constraints.[27]

A final possible case of featural polarity comes from Northern Sahaptin (Penutian; Washington State). According to Nichols (1971), the diminutive induces, among other consonantal changes, an exchange between all instances of /s/ and /ʃ/. According to Cole (1987), the grammar of Jacobs (1931) contains no cases of /s/ and /ʃ/ in the same word, so if this is a genuine exchange process, it could plausibly be treated as a choice by NoVacDoc between {[-back], [+back]}, coupled with sibilant harmony. Cole gives several reasons to be skeptical that there is in fact an exchange process taking

[26] Of course, verbs in the 'a/a class' could take the {[+low], [+high, -back]} morpheme instead, but the result would be the same.

[27] I am grateful to Adam Werle for raising this issue.

place, but in any case Northern Sahaptin does not clearly contradict the approach to featural polarity being pursued here.

4.2 The non-polar uses of NOVACDOC

Despite its role in motivating the constraint, nothing in the definition of NOVACDOC explicitly refers to polarity. As mentioned, it only contributes to creating featural polarity when coupled with the presence of an affix that has two allomorphs with opposite floating values for some feature. It would therefore be desirable to consider what other typological predictions this constraint will make.

First, if the preferred docking site for some feature would be a segment that already bore that feature-value, NOVACDOC could induce displacement of the feature away from the preferred docking site. Consider hypothetical Aka´:

(39) Aka´: Class 5 marker docks on initial consonant

kap | $[+voi]_2$ $[-voi]_1$	NOVACDOC	ALIGN(Class 5, L, PWd, L)
a. ► gap | $[+voi]_2$		
b. kab / \\ $[-voi]_1$ $[+voi]_2$		*!

(40) Aka´: Class 5 marker docks on non-initial consonant

bat | $[+voi]_2$ $[+voi]_1$	NOVACDOC	ALIGN(class 5, L, PWd, L)
a. bat | $[+voi]_{1,2}$	*!	
b. ► bad / \\ $[+voi]_1$ $[+voi]_2$		*

In (39), the class 5 morpheme, which consists of the floating feature [+voice], docks on the consonant at the left edge of the prosodic word; this is enforced by an alignment constraint ALIGN(MCat, L, PCat, L), just as with other prefixes. (Constraints on the localization of autosegmental morphemes will be discussed in more detain in §9.) However, when, as in (40), the consonant at the right edge is underlyingly [+voice], docking the floating feature of the class 5 morpheme on that segment incurs a NOVACDOC violation, forcing violation of the ALIGN constraint as the feature migrates into the word to find a segment to which it can dock non-vacuously.

Does this in fact happen? A possible example comes from the Ethiopian Semitic language Harari (Rose 2004). In this language, the 2nd pers. singular feminine non-perfective suffix /-i/ triggers palatalization of the stem-final consonant (if it is an alveolar other than /r/); otherwise, one or more stem-internal alveolar segments are palatalized. Rose (2004) reports that palatalization does take place to the left of segments that are underlyingly palatal:

(41) Harari: floating [-back] docks to left of underlying palatals

2P.SG.MASC	2P.SG.FEM	*gloss*
a-t-biʃak'i	a-tʃ-biʃak'i	'wet/soak.IMP.NEG'
at-nitʃ'i	at-ɲitʃ'i	'reap.IMP.NEG'[28]

We can analyze the suffix in question as having the UR /[-back] i/, with NoVacDoc dominating the constraints favoring realization of the floating [-back] near the right edge.

An additional case resembling (41) is reported in Chaha, another Ethiopian Semitic language, but is disputed. In Chaha (Polotsky 1938, Leslau 1950, 1967, Hetzron 1971, Johnson 1975, McCarthy 1983, 2003, Petros 1997, Rose 1997, Piggott 2000), verbs in the impersonal or with 3rd person masculine singular objects labialize the rightmost non-coronal consonant in the root, which McCarthy (1983a) analyzes as the docking of floating [+round]:

(42)

näkäb	'find.3SG.PERF.MASC'	näkäbʷ 'find. 3SG.PERF.MASC/MASC.SG.OBJ'
näkäs	'bite.3SG.PERF.MASC'	näkʷäs 'find. 3SG.PERF.MASC/MASC.SG.OBJ'

Like other Ethiopian Semitic languages, Chaha contrasts plain and labialized non-coronals. The question then is, when the rightmost non-coronal consonant in a verb is underlyingly labialized, does the floating [+round] dock vacuously to it, or does it migrate further to the left to seek a plain consonant? Leslau (1967) gives one example where this does seem to happen, but Petros (1997: 249), a native speaker, and Robert Hetzron, whose p.c. is cited by Johnson (1975, fn. 4) say that the data is mistaken:

(43) Chaha: 'rinse'

	personal	*impersonal*
(Leslau)	tägmʷämʷätä	tägʷmʷämʷäči
(Petros)	tə-gʷməmət'	tə-gʷmʷəmʷəc'

Another role for NoVacDoc is in morphologically-triggered chain-shifts, for instance the vowel-height chain shifts seen in the masculine singular form of nouns in Lena Bable Spanish (Hualde 1989) and certain tense/aspect contexts in Nzɛbi (Guthrie 1968, Clements 1991, Kirchner 1996), or the voiceless stop → voiced stop → nasal chain shift in the eclipsis mutation of Irish (Ó Siadhail 1989, Ní Chiosáin 1991).

[28] Rose gives the caveat that this second example was offered by one of her eight consultants but not checked with the others.

Consider the Lena Bable example. In this dialect of Austurian Spanish, a three-step chain shift of a → e → i takes place in the stressed syllable of masculine singular countable nouns:

(44) Lena Bable chain shift (from Hualde's (1989) (18))

masc. sg.	masc. pl.	fem. sg.	gloss
gétu	gátos	gáta	'cat'
kaldíru	kaldéros	kaldéra	'pot'
fíu	fíos	fía	'son/daughter'

A possible analysis might run as follows: there are two listed allomorphs of the masculine singular morpheme: {[-low]u; [+high]u}. Nouns with the stressed vowel underlyingly [+low] will then take the /[-low]u/ allomorph:

(45): Lena Bable Spanish: 'cat.MASC.SG.'

gat + {[-low]u; [+high]u} *Inputs:*	*Outputs:*	MAXFLT	IDENT[low]	IDENT[high]
gat [-low]u	a. ► getu		*	
gat [+high]u	b. gitu		*	*!

Picking either allomorph (raising from low to mid or from low to high) incurs a violation of IDENT[low], but raising from low to high also violates IDENT[high], and is therefore harmonically bounded (so long as we neglect the effect of markedness constraints preferring high vowels, which must be low-ranked anyway, since, as the data in (44) indicate, Lena Bable permits vowels of any height in stressed syllables).

If we have the ranking NOVACDOC >> IDENT[high], then the other allomorph will win when the noun's stressed vowel is underlying mid:

(46): Lena Bable Spanish: 'pot.MASC.SG.'

kalder + {[-low]u; [+high]u} *Inputs:*	*Outputs:*	MAX FLT	NOVAC DOC	IDENT(low)	IDENT(high)
kalder [-low]u	a. kalderu		*!		
kalder [+high]u	b. ► kaldiru				*

In candidate (46a), the floating [-low] has docked to the mid vowel [e], which is [-low] underlyingly, resulting a violation of NOVACDOC. Candidate (46b), which violates the lower-ranked IDENT(high), therefore wins.

There are also cases of this character in which only one of the allomorphs would have to be analyzed as containing floating features. In Grebo, a Kru language spoken in Liberia, the deverbal noun and pronominal verbal adjective suffixes have two allomorphs which Innes (1966) represents as follows:

(47) Grebo deverbal noun/pronominal verbal adjective allomorphy
-R(C)V
-V
where:
R=raise root-final low vowel to mid
(C)=a partly reduplicative consonant
(only if last consonant in root is p, b, m̥, m, t, d, l, ɬ, n̥, or n)
V=a (more or less) fixed vowel

Grebo has a four-way height contrast, presumably a three-height contrast coupled with an ATR contrast in mid vowels. It also disallows codas, so these suffixes are always occurring adjacent to the root-final vowel. If this vowel is underlyingly [+low], then the –R(C)V allomorph appears; otherwise the –V allomorphs appears. The surface generalization is, then, that the reduplicative C can (subject to certain factors) appear after a [-low] vowel morphologically derived from an underlyingly [+low] vowel via the 'R' process, but that it *never* appears after a [-low] vowel that is underlyingly [-low].

(48) Grebo

Infinitive	*Gerund*	*gloss*
la	lela	'kill/killing'
dɔ	dodɛ	'be blind/being blind'
pã	pema	'be rich/being rich'
bi	biɛ	'beat/beating'
du	duɛ	'pound/pounding'

Without wandering too far astray from the present discussion by giving a full account of the reduplication process at work here, we may hypothesize that in Grebo the default allomorph of these two affixes is something like /[-low] RED/; if the [-low] cannot dock non-vacuously, the language then switches to the elsewhere allomorph, /V/. (See the discussion of Sibe suffix allomorphy in the next section for the formal implementation of arbitrary preferences among allomorphs.)

Now to consider possible alternative analyses. The Lena Bable chain shift is an instance of counterfeeding opacity, and so one might consider it preferable to account for it within a more general theory of opacity. Vowel-height chain shifts do occur under purely phonological conditioning (e.g. in Basque: Hualde 1991), and selection of floating-feature allomorphs could not account for such cases. This does not, however, represent a reason to be skeptical of NOVACDOC. First of all, even if a different account of Grebo or Lena Bable is possible in terms of an independently-motivated theory of opacity, the fact would remain that a pattern predicted to be possible by the existence of NOVACDOC is attested; the existence of another possible analysis of the facts would simply amount to an ambiguity for the learner to resolve, which is hardly unprecedented in linguistic theory. The core point—that the NOVACDOC theory does not overgenerate—will still stand.

Moreover, it is not clear that the Lena Bable facts are amenable to existing analyses of phonologically-conditioned chain shifts. In the theory of Kirchner (1996), the 'fell swoop' mapping /a/ → [i] would be ruled out by the local conjunction [IDENT[low] & IDENT[high]]$_{seg}$. This would have to dominate some constraint that exerted the preference high > mid > low, which, as Kirchner does in his analysis of Nzɛbi, we may give the cover name of RAISING:

(49) Hypothetical local-conjunction account of Lena Bable raising

/gat-u/	[IDENT(low) & IDENT(high)]$_{seg}$	RAISING	IDENT(low)	IDENT(high)
a. gatu		**!		
b. ►getu		*	*	
c. gitu	*!		*	*

So, what could RAISING actually be? Higher vowels are favored in stressed positions (de Lacy 2002a), but, as mentioned, Lena Bable tolerates [a] and [e] in stressed syllables, so the markedness constraints that exert this preference would have to be ranked below IDENT(low) and IDENT(high). One could propose that the masculine singular affix imposes higher-ranked, morpheme-specific versions of these markedness constraints on noun roots, but to permit this to occur directly seems implausible. As will be gone into in the next section, it is possible for constraints to be rendered *de facto* inviolable just in certain morphological environments as a result of their being ranked above morpheme-specific instantiations of the anti-paradigm-gap constraint MPARSE, but this won't do for Lena Bable, since the local-conjunction analysis requires that RAISING still be violated in the /a/→[e] candidate, since otherwise there would be no reason for the /e/→[i] raising.[29] On top of this, there is also the fact that local conjunction overgenerates severely (see, among others, Padgett (2002) and the references cited therein). For all of these reasons, a MAXFLT approach to the Lena Bable data seems clearly superior to one based on a local-conjunction approach to opacity.

[29] Moreover, MPARSE is incapable of triggering unfaithful repairs at all. Suppose that a language in general tolerates some marked structure Γ. This means that the markedness constraints against Γ, which we may represent as M, are dominated by all conflicting faithfulness constraints, which we may represent as F. The ranking F >> M gives us three possibilities for the ranking of MPARSE(X), the constraint that forbids the null output for an input of morphological category X:

MPARSE >> F >> M, which results in no change for category X, since the null output, which violates MPARSE, loses to a faithful candidate.

F >> MPARSE >> M, which again results in no change: F is still top-ranked, so unfaithful candidates that repair Γ lose to faithful ones. Likewise, the MPARSE-violating null output loses to candidates with Γ, which violate the lower-ranked M.

F >> M >> MPARSE, which results in a gap (or selection of an elsewhere allomorph), rather than repair: M-violating candidates that retain Γ and F-violating candidates that eliminate Γ both lose to the null output, which violates only MPARSE.

Another possible approach to the Grebo and Lena Bable facts would be to invoke Contrast Preservation, as in the proposals of Łubowicz (2002) and Tessier (2004). Here, the second step of the vowel-raising chain shift would take place in order to maintain a contrast on the surface between inputs with vowels that were underlyingly low and those with vowels that were underlyingly mid.

(50) Contrast preservation account of Lena Bable vowel raising

/gat [-low]u/ /kalder [-low]u/	PRESCONT (+/-low)	MAX FLT	IDENT (low)	IDENT (high)
a. ►getu kaldiru			*	*
b. gatu ~~[-low]~~ kalderu		*!		
c. getu kalderu	*!		*	

This does appear to work. However, it is not independently clear that contrast preservation is capable of providing a satisfactorily general theory of opacity. Most significantly, it (as well as local-conjunction theories) cannot adequately account for cases of counterfeeding on the environment like the opaque interaction of glide vocalization and vowel-raising in Bedouin Hijazi Arabic (Al-Mozainy 1981); see McCarthy (1999, to appear) for discussion.

5 The usefulness of vacuous docking

If NOVACDOC is a constraint in CON, then there must be some situation in at least one language where it is violated. In section 4.1, we saw one case where it might be analyzed as being violated, specifically the underapplication of height polarity under markedness pressures in Arabic. Section 5.1 will take the case for NOVACDOC's violability further:
I will argue that vacuous feature-docking plays a key role in analyzing mutation systems of the sort dubbed 'quirky' by Lieber (1987); that is, systems in which the various mutation-undergoing segments idiosyncratically differ as to what featural change(s) they exhibit. Section 5.2 will explore some other cases where NOVACDOC violation plays a role in allomorph selection.

5.1 'Quirky' mutation as violation of NOVACDOC

An illustrative example of a 'quirky' mutation system comes from Breton, where the 'mixed mutation', which is triggered by *e* "that", *ma* "that/if", and the progressive marker *o*, induces the following changes (Press 1986):

(51)

b	→	v	*spirantization*
d	→	t	***devoicing***
g	→	γ	*spirantization*
gw	→	w	*deletion*
m	→	v	*spirantization*

(other initials unchanged)

The descriptive generalization in (51)—setting aside until §9 the deletion of /g/ before /w/—is that coronal stops devoice but non-coronal stops and /m/ spirantize. This is quite odd; not only do the mutated segments undergo different featural changes, but spirantiztion takes place only in non-coronals, even though coronal fricatives would be less marked than non-coronal fricatives.

To illustrate how vacuous docking permits an analysis of this peculiar system, assume for the moment that the morphemes that trigger this mutation have two allomorphs, with different sets of floating features:

(52)
Allomorph 1: [-coronal, +continuant]
Allomorph 2: [+coronal, -voice]

Now suppose we have the ranking MAXFLT >> NOVACDOC. This forces the docking of every feature in the chosen allomorph, even if doing so will be vacuous. The ranking IDENT[coronal] >> NOVACDOC concomitantly forces selection of the allomorph that won't change the input's specification for [coronal]: vacuously docking a token of [coronal] is less serious than docking a [coronal] token of the opposite value and thereby changing a segment's specification for [coronal]. Together, these two rankings therefore drive correct allomorph selection by *compelling* vacuous docking.

Tableau (53) illustrates how spirantization wins with noncoronal targets:

(53) Breton: Selection of [-cor, +cont] allomorph

{[+cont, -cor], [-voi +cor]} + /b/ *Inputs:*		IDENT [cor]	MAX FLT	IDENT [cont]	IDENT [voi]	NO VAC DOC
[+cont]$_1$[-cor]$_2$ + b	a. ► v / \\ [+cont]$_1$[-cor]$_2$			*		[-cor]$_2$
[-voi]$_3$[+cor]$_4$ + b	b. t / \\ [-voi]$_3$[+cor]$_4$	*!			*	
[-voi]$_3$[+cor]$_4$ + b	c. p / [-voi]$_3$~~[+cor]~~$_4$		[+cor]$_4$!		*	

The winning candidate, (53a), docks both features in the chosen allomorph, and doesn't change the (non-)coronality of the targeted segment. Candidate (53b) docks both of the features in the other allomorph, and in so doing fatally violates IDENT[cor]. Candidate (53c) also chooses the 'wrong' allomorph, and attempts to avoid the IDENT[cor] violation by not docking the floating [+coronal], but this incurs a fatal violation of MAXFLT.

Tableau (54) illustrates selection of devoicing for coronal targets:

(54) Breton: Selection of [+cor, -voi] allomorph

{[+cont, -cor], [-voi +cor]} + /d/ *Inputs:*		IDENT [cor]	MAX FLT	IDENT [cont]	IDENT [voi]	NO VAC DOC
[-voi]$_3$[+cor]$_4$ + d	a. ► t / \\ [-voi]$_3$[+cor]$_4$				*	[+cor]$_4$
[+cont]$_1$[-cor]$_2$ + d	b. v / \\ [+cont]$_1$[-cor]$_2$	*!		*		
[+cont]$_1$[-cor]$_2$ + d	c. v / [+cont]$_1$~~[-cor]$_2$~~		[-cor]$_2$!	*		

The winning candidate, (54a), again docks both features of the allomorph whose [coronal] token matches the [coronal] specification of the targeted segment. In so doing, it violates IDENT[voi] and NOVACDOC, but these violations are less serious than violating IDENT[cor], as (54b) does in docking both features of the other allomorph, or violating MAXFLT, as in (54c)'s attempt to select the other allomorph without violating IDENT[cor].

A full account of the Breton facts will now require only a few adjustments to this picture. First, Breton has initial [z] and [ʒ] as well as [d]; why do the coronal fricatives not devoice, when the coronal stop does? We may suppose that there is a third allomorph, [+cor, +cont], and that IDENT[cont] >> IDENT[voi]. Coronal continuants will take the [+cor, +cont] allomorph, incurring two violations of NOVACDOC but violating no IDENT constraints.

(55) Breton: Selection of [+cont, +cor] allomorph

{[+cont, -cor], [-voi +cor], + /z/ [+cont, +cor]} *Inputs:*		IDENT [cor]	MAX FLT	IDENT [cont]	IDENT [voi]	NO VAC DOC
[-voi]$_3$[+cor]$_4$ + z	a. t / \\ [-voi]$_3$[+cor]$_4$			* !	*	[+cor]$_4$
[+cont]$_5$[+cor]$_6$ + z	b. ► z / \\ [+cont]$_5$[+cor]$_6$					[+cor]$_6$
[+cont]$_1$[-cor]$_2$ + z	c. v / \\ [+cont]$_1$[-cor]$_2$				*!	[+cont]$_1$

As before, candidates that fail to dock either or both floating features in the relevant allomorph are barred by the high-ranked status of *FLOAT and MAXFLT.

Meanwhile, the ranking IDENT[cont] >> IDENT[voi] assures that underlying /d/ will continue to take the [-voi, +cor] allomorph:

(56) Breton: Selection of [+cor, -voi] allomorph: Take 2

{[+cont, -cor], [-voi +cor], + /d/ [+cont, +cor]} *Inputs:*		IDENT [cor]	MAX FLT	IDENT [cont]	IDENT [voi]	NO VAC DOC
[-voi]$_3$[+cor]$_4$ + d	a. ► t / \\ [-voi]$_3$[+cor]$_4$				*	[+cor]$_4$
[+cont]$_5$[+cor]$_6$ + d	b. z / \\ [+cont]$_5$[+cor]$_6$			* !		[+cor]$_6$
[+cont]$_1$[-cor]$_2$ + d	b. v / \\ [+cont]$_5$[+cor]$_6$	*!		*		

The final outstanding question is what to do about root-initial sonorants. As shown in (51), /m/ spirantizes in the mixed mutation, but /n, ɲ, r, l, ʎ, w, j/ are unaffected. Among these, the non-coronals can take the [+cont, -cor] allomorph vacuously. For the coronals, the simplest move would seem to be to posit a fourth allomorph [+son, +cor], and to assume that IDENT[son] is dominated only by IDENT[cor] and MAXFLT. The argument is as before: coronal sonorants take the [+son, +cor] allomorphs, since this violates no faithfulness constraints other than the low-ranked NOVACDOC; coronal obstruents do not, since violating IDENT[son] is more serious than violating IDENT[voi], and /m/ takes [-cor, +cont], since taking any of the allomorphs with [+cor] fatally violates the undominated IDENT[cor]. Underlying /m/ loses its sonorancy in taking this allomorph, demonstrating the necessity of the ranking MAXFLT >> IDENT[son].

One may protest at the unwieldliness of an analysis that requires the existence of *four* allomorphs of each of the three Mixed Mutation-triggering morphemes. Nevertheless, the forgoing discussion does show that an autosegmental approach *is* capable of handling mutation systems that feature highly non-uniform sets of feature changes. Assuming the existence of four allomorphs for the closed class of morphemes that trigger the Mixed Mutation is considerably less unparsimonious than would be positing allomorphy over the open class of words in the Breton lexicon which can undergo the Mixed Mutation, as would be required in the proposal of Green (2005); see § 10.1 for further discussion of this proposal.

5.2 Further cases of vacuous docking in allomorph selection

Implicit in the analysis of Breton is the assumption that the floating features in the chosen allomorph can only dock at a designated edge of the targeted morpheme. The details of how floating features come to be aligned as they do is taken up in Section 9; for now it will suffice to say that the constraints responsible for this are undominated in Breton.

Factorial typology will, of course, continue to predict that these constraints could be low-ranked in other languages, raising the possibility that the selecting feature could be made to dock vacuously somewhere within (say) the root of an affixed word. This would mean that allomorphs of an affix could subcategorize according to whether or not the base of affixation (or host of a clitic) contained *anywhere* within it a segment bearing some feature.

Remarkably, this does happen. In Sibe, a Tungusic language spoken in the Xinjiang region of China, there are five suffixes whose initial consonant is uvular if the base contains a [+low] vowel anywhere, but which is velar otherwise (Data from Li (1996); the vowel alternations in the affixes are conditioned by a system of rounding harmony which is superfluous to the present discussion):

(57) (from Li (1996: 201))

diminutive of adjective:	-kɨn / -kun / -qɨn / -qun
comparative of adjective:	-kɨndi/ -kundi / -qɨndi / -qundi
self-perceived immediate past:	-xɨ / -xu / -χɨ / -χu
non-self-perceived past:	-xɤi/ -xui / -χɤi / -χui
self-perceived remote past:	-xɨŋ / -xuŋ / -χɨŋ / - χuŋ

The vowel system of Sibe, as reported by Li (1996: 189), is as follows:

(58)

	front		back	
	unrounded	rounded	unrounded[30]	rounded
high	i	ü	ɨ	u
low	ɛ	ö	a	ɔ

The presence of a low vowel in the root, even if a high vowel intervenes between it and one of the five affixes in (57), results in the appearance of the uvular version of the affix:

(59)
utu-xu 'dress.SELF-PERCEIVED IMMEDIATE PAST'
lavdu-χu 'become more.SELF-PERCEIVED IMMEDIATE PAST'

iɕi-xɨ 'be enough.SELF-PERCEIVED IMMEDIATE PAST'
ömi-χɨ 'drink. SELF-PERCEIVED IMMEDIATE PAST'

That the alternations in (57) are specific to the given affixes, and not a result of velars being disallowed anywhere after [+low] vowels, is indicated first of all by the fact that the /k/ of the imperative suffix /-kin/ does not alternate with [q]:

(60)
velar following high vowels:
bu-kin 'give.3rd.IMPERATIVE'
arɨ-kin 'make/write.3rd.IMPERATIVE'

velar following low vowels:
tɔ-kin 'curse.3rd.IMPERATIVE'
va-kin 'kill.3rd.IMPERATIVE'

cf.
tɔ-χu 'curse.SELF-PERCEIVED IMMEDIATE PAST'

Also, within roots, velars are allowed even if a [+low] vowel precedes:

(61)
jɔnuxun 'dog'
ɛdki 'neighbor'

[30] Li (1996: 191) describes [ɤ], as seen in the non-self-perceived past suffix in (1), as an allophone of /ɨ/ that appears word-initially or after a uvular or velar.

Li (1996: 192) also gives one example in which [χ] appears in a word with only high vowels, providing a further indication that velars and uvulars are not in complimentary distribution:

(62)
ufχu 'lungs'

cf.
fulxu 'root'

The vacuous-docking approach to quirky mutations makes the alternations in the five suffixes in (57) straightforward to analyze. For the self-percieved immediate past, assume that the allomorphs of the suffix are {[+low] χV, xV}, where V stands for the vowel that surfaces as either [ɨ] or [u] under rounding harmony.

An arbitrary preference between these allomorphs will be required. This is because the /[+low] χV/ allomorph fails to surface just in case the root contains no low vowels- that is, if MAXFLT cannot be satisfied without violating IDENT[low] or DEP. The uvular allomorph always appears unless dislodged by violation of one of these constraints. Following McCarthy & Prince (1993b: ch. 7) and McCarthy & Wolf (2005: §6.1), I assume that in cases of arbitrary preference among listed allomorphs, the allomorphs do not compete in a single tableau but that instead the higher-priority allomorph is 'tried first', and lower-priority allomorphs tried as inputs only if the input with the higher priority allomorph maps to the null output ⊙.[31] The required ranking for Sibe is:

(63)
MAXFLT, IDENT[low], DEP >> MPARSE[32] >> NOVACDOC, MORPH-O-CONTIG

(MORPH-O-CONTIG ≈ 'dock floating features adjacent to the rest of the affix.' See §9 for discussion.)
(MPARSE ≈ 'the output is non-null')

[31] For other proposals about arbitrary preference among allomorphs, see Picanço (2002) and Bonet, Lloret, & Mascaró (2003); see McCarthy & Wolf (2005: §6.1) for a critique of each of these.

[32] The MPARSE constraint relevant to this discussion is relativized to the self-perceived immediate past; see McCarthy & Wolf (2005: §5.1) for discussion of the morpheme-specificity of MPARSE constraints.

When the root contains a low vowel, the floating [+low] of the /[+low] χV/ allomorph docks to it vacuously:

(64) Sibe: 'drink. SELF-PERCEIVED IMMEDIATE PAST'

ömi + [+low]$_2$ χV | [+low]$_1$	MAX FLT	IDENT [low]	DEP	MPARSE	NOVAC DOC	MORPH-O-CONTIG
a.▶ ömiχɨ | [+low]$_{1,2}$					*	*
b. ömiχɨ | [+low]$_1$ ~~[+low]$_2$~~	*!					
c. ömεχɨ / \\ [+low]$_1$ [+low]$_2$		*!				
d. ömiaχɨ / \\ [+low]$_1$ [+low]$_2$			*!			
e. ⊙				*!		

In candidate (64a), the floating [+low] has docked to the underlyingly [+low] vowel [ö], incurring violations of NOVACDOC and MORPH-O-CONTIG. However, it still wins because candidates that satisfy these two constraints fatally violate higher-ranking constraints: (64b) deletes the floating [+low], violating MAXFLT; (64c) docks the [+low] to underlying /i/, turning it into [ε] and violating IDENT[low]; (64d) docks the [low] to an epenthetic vowel, violating DEP; and the null output (64e) violates MPARSE.

By contrast, when the root does not contain a low vowel, the floating [+low] has nowhere to vacuously dock, and so the null output wins:

(65) Sibe: 'be enough.SELF-PERCEIVED IMMEDIATE PAST'

iɕi + [+low]$_1$ χV	MAX FLT	IDENT [low]	DEP	MPARSE	NOVAC DOC	MORPH-O-CONTIG
a. iɕɛ χɨ | [+low]$_1$		*!				
b. iɕiχɨ ~~[+low]$_1$~~	*!					
c. iɕiaχɨ | [+low]$_1$			*!			
d. ► ⊙				*		

Candidate (65b) violates MAXFLT by failing to preserve the floating [+low] in the output. However, MAXFLT can only be satisfied by docking the floating feature to an underlyingly non-low vowel, as in (65a), which violates IDENT[low], or docking it to an epenthetic vowel, as in (65c), which violates Dep. MAXFLT, IDENT[low] and DEP all dominate MPARSE, so the null output (65d) is optimal.

The null output having won, the second-priority allomorph, /xV/, will then be fed to GEN as an input, producing the attested surface form:

(66) 'be enough.SELF-PERCEIVED IMMEDIATE PAST'

iɕi +xV	MAX FLT	IDENT [low]	DEP	MPARSE	NOVAC DOC	MORPH-O-CONTIG
a.► iɕixɨ						
b. ⊙				*!		

Having demonstrated the ability of the MAXFLT/NOVACDOC theory to account for the Sibe facts, it is worth considering whether any plausible alternative is available. The facts in (60-62) are problematic for the rule-based account of Sibe given in Vaux (1999) and Halle, Vaux, & Wolfe (2000), which is as follows:

(67) (=Halle, Vaux, & Wolfe's (52))
a. Spread marked [high] rightward to dorsal consonants.
b. [high] is only marked in [-high] segments.
c. Unmarked [high] specifications are not visible to the rule.
d. lavdu – Xu

[-high]

This account faces trouble, first of all, with the fact that the spreading of [-high] to dorsals must be restricted to dorsals appearing in a closed class of affixes, since velars do not become uvular in other affixes or in roots (60-61) and because velars and uvulars appear to contrast within roots (62).

Moreover, there does not appear to be any sensible way in which this analysis could be translated into an OT framework. Even if we grant Halle, Vaux, & Wolfe's construal of Sibe as an counterexample to Strict Locality in feature spreading,[33] the spreading of [-high] from a vowel to a nonlocal dorsal consonant would have to be motivated by a markedness constraint against potentially non-adjacent sequences of nonhigh vowels and velar consonants which would dominate whatever faithfulness constraints militate against the spreading. It is highly counter-intuitive that such a non-local markedness constraint should exist. The constraint would have to be violated even when high vowels intervened between the low vowel and the targeted consonant, so despite the known affinity between uvulars and low vowels, the constraint would seem to lack any sensible phonetic basis.

One possibly unsatisfying aspect of the analysis proposed here is the fact that the allomorphs that appear with low-vowel-containing roots all have uvular consonants. Given that there is an affinity between low vowels and uvulars, it would be tempting to describe this co-occurrence in markedness terms. However, the fact that low vowels can condition allomorphy non-locally, and the fact that the alternation is lexically restricted to five suffixes, suggests that a markedness-based account of these facts is unlikely to succeed.

The fact that the Sibe affixes in (57) subcategorize in a not-necessarily-local fashion for the presence of a certain feature-value in the base of affixation makes for particularly convincing evidence in favor of the NoVacDoc theory. This is because, as just mentioned, there is no plausible markedness reason why the distribution of the allomorphs to be as it is. There are a number of languages in which affixes, or allomorphs of a single affix, seem to subcategorize for the feature-values of an *adjacent* segments, but the fact of adjacency in these cases could make it possible to devise markedness-based accounts.

[33] On the theory of Strict Locality, see, among others, Ní Chiosáin & Padgett (2001), Flemming (1995), Gafos (1996), and Walker (1998).

For example, in English, the deadjectival verb-forming suffix *–en* (Siegel 1974, Halle 1973) can appear on obstruent-final but not sonorant-final roots (*redden, shorten* but **greenen, *tallen*). One could analyze this effect as the result of vacuous docking of [-son], but one could also appeal to the markedness of sonorant onsets to syllabic [n]. Although such onsets are normally permitted in English (e.g. *women*), there are numerous attested cased in which morphological gaps appear to result from violation of constraints whose violation is normally tolerated in the language. Within the MPARSE model of gaps, one could suppose that, although the markedness constraint against sonorant onsets is normally violated in English as a result of being dominated by faithfulness, this constraint is effectively inviolable in the morphological environment of *–en* as a result of being ranked above the MPARSE constraint associated with *–en*.[34] (See Raffelsiefen (2004) and McCarthy & Wolf (2005) for discussion of cases with this character.) In the Sibe case, however, the potentially non-local character of the subcategorization for [+low] makes it debatable whether any suitable markedness constraint could be found to drive the alternation.[35]

A somewhat different case of featural-subcategorization by vacuous docking comes from Nisgha, an Interior Tsimshianic language spoken in British Columbia (Tarpent 1983). Nisgha forms plurals in a variety of ways, but the most common is reduplication. Most verb roots have the shape CVC, and these reduplicate fully, giving the plural the form CVCCVC. There are longer roots, but for these the reduplicant is also restricted to being CVC, the reasons for which I will not go into here.

One interesting property of Nisgha reduplication for our purposes is that when the second (coda) consonant of the reduplicant is velar or uvular, it spirantizes, in spite of the fact that velar-consonant sequences are tolerated elsewhere in the language, and even in the bases of reduplicated forms where the spirantization has applied in the reduplicant:

(68) Nisgha plural reduplication

	singular	*plural*	*gloss*
a.	sqíksk^{w}	saχsqíksk^{w}	‘be injured’
b.	sqˀé:χk^{w}	saχsqˀé:χk^{w}	‘be in short supply’
c.	sáksaʔan	sixsáksaʔan	‘clean something’
d.	tákɬ	tixtákɬ	‘tie’
cf.:			
e.	táp	tiptáp	‘measure’
f.	qí:tk^{w}	qatqí:tk^{w}	‘be painful’

[34] Examples of allomorphic alternants that seem to subcategorize according to adjacent segment types include the postposed definite determiner in Haitian Creole (Klein 2003), the conjunctive particle in Korean (Lapointe 1999), and the ergative suffix in Yidiŋ (Hayes 1990).

[35] Though see Rose (2004) and Rose & Walker (2004) on the question of long-distance consonant/vowel interactions.

One could attempt to analyze this as a case of reduplicative Emergence of the Unmarked (McCarthy & Prince 1994), but the question that would pose itself is: just what constraint favors spirantization of only dorsals in a pre-consonantal context, but not of other stops? Velar fricatives are more marked than non-velar fricatives, as evidenced by languages like English that have fricatives and velar stops but not velar fricatives, so it is far from obvious that there exists any markedness constraint or combination of markedness constraints that could produce the observed effect.

Suppose instead, then, that the default allomorph of the Nisgha plural is /RED [+dors, +cont]/ - that is, the reduplication object, however one assumes that to be notated in the lexicon, plus two floating features. If MAXFLT and MORPHCONTIG dominate BR-IDENT(contin), then a reduplicant-final dorsal will surface as [+contin], as wanted:

(69) Nisgha: 'tie.PL'

RED [+dors]$_1$[+cont]$_2$ tákɬ	MAXFLT	MORPHCONTIG	BR-IDENT(contin)
a. ► tix$_3$ták$_3$ɬ /\\ [+dors]$_1$[+cont]$_2$			*
b. s$_4$ix$_3$t$_4$ák$_3$ɬ / \\ [+cont]$_2$ [+dors]$_1$		*!	
c. tik$_3$ták$_3$ɬ /\\ [+dors]$_1$~~[+cont]$_2$~~	[+cont]$_2$!		

However, if MAXFLT, MORPHCONTIG, and BR-IDENT(dors) all dominate MPARSE(plural), then the null output wins when the reduplicant ends in a non-dorsal:

(70) Nisgha: 'be painful.PL'

RED [+dors]$_1$[+cont]$_2$ qí:tk^w	MAXFLT	MORPH CONTIG	BR-IDENT (dors)	MPARSE (plural)
a. qax$_3$qí:t$_3$k^w /\\ [+dors]$_1$[+cont]$_2$			*!	
b. qas$_3$qí:t$_3$k^w / \\ [+dors]$_1$ [+cont]$_2$		*!		
c. qat$_3$qí:t$_3$k^w ~~[+dors]$_1$~~ ~~[+cont]$_2$~~	[+dors]$_1$!, [+cont]$_2$			
d. ►⊙				*

The grammar then attempts the elsewhere allomorph, which we may take as underlying /RED/, yielding reduplication without spirantization in the non-dorsal cases:

(71) Nisgha: 'be painful.PL'

RED qí:tk^w	MAXFLT	MORPH CONTIG	BR-IDENT (dors)	MPARSE (plural)
a. ► qat$_3$qí:t$_3$k^w				
b. ⊙				*!

6 The need to ban tautomorphemic docking

In all of the preceding analyses of cases in which a mutation-triggering morpheme contains segments as well as floating features, the tableaux have excluded candidates in which the floating features have docked onto those one of the segments belonging to the same morpheme as themselves. Something needs to rule these cases out.[36] This gap in the patterning of floating features is especially worrisome given the standard assumption that roots are universally subject to greater faithfulness protection than affixes (McCarthy & Prince 1995). If the markedness situation in some language would permit floating features to either dock heteromorphemically on a root segment or tautomorphemically on an affix segment, then we would expect them to dock on the affix segment, since this is less costly in faithfulness terms. It would also be easy to imagine examples in which docking a floating feature on an affix segment rather than a root segment would be preferred on markedness grounds.

A blunt but effective means to ruling out candidates where this happens is to simply posit the existence of a constraint that bans tautomorphemic docking:

(72) NOTAUMORDOC
$\forall F \in I$, where F is a feature: $[\neg[\exists S \in I$ such that S is a segment and F is attached to S$]] \rightarrow$
$[[\exists F' \in O$ such that $F \Re F'$ and F' is attached to a segment $\delta' \in O] \rightarrow$
$[[\exists \delta \in I$ s.t. $\delta \Re \delta'] \rightarrow [\neg$[F and δ are affiliated with the same morpheme]]]

Put less formally: if a feature was floating in the input and is docked to some segment in the output, then the feature and the segment are not exponents of the same morpheme.

NOTAUMORDOC is, in effect, a fully general version of the constraint *DOMAIN proposed in S. Myers & Carleton (1996), which forbids the realization of (floating) high tones within the AUX constituent defined by certain inflectional morphemes (in Chichewa, in the case of their specific analysis), and generalized by Revithiadou (1999) to ban realization of a lexically-listed accent within the segmental string of the morpheme that sponsors it. NOTAUMORDOC takes the next logical step, banning *any* floating element from being realized on bearing units belonging to the same morpheme.

[36] Thanks to Paul de Lacy for first pointing out this issue to me.

Another important property of NoTauMorDoc that distinguishes it from Revithiadou's version of *Domain is that the former bans tautomorphemic association only of underlyingly floating autosegments, while the latter encourages flopping of underlyingly associated accents off of their sponsoring morpheme onto another one. While this might be viable within an autosegmental theory of accent, it is almost certainly too powerful for the domain of mutations that affect segmental features: this would amount to a constraint that favored stripping the features off of every segment of every morpheme, and shifting them to another morpheme, and would doubtless add needless complications to featural phonology. See §10.2 for further discussion of Revithiadou's proposals.

Endowing NoTauMorDoc with sufficiently high rank will suffice to exclude candidates in which tautomorphemic docking. However, as with any other constraint in Con, we expect that this constraint will be violated in other languages where it is lower-ranked.

I do not know of any cases of tautomorphemic docking of segmental features[37], but there is at least one case of floating tones dock tautomorphemically if they cannot dock heteromorphemically. This example comes from San Agustín Mixtepec Zapotec (Beam de Azcona 2004), a language which contrasts three tones on the surface: high, low, and rising. In this language, the 1st person possessive pronominal enclitic in inserts an H on the final syllable of the possessed noun, if this syllable underlyingly has low tone. The result is a syllable with rising tone. In contrast, the 2nd person clitic has no such effect, despite the fact that both it and the 1st person clitic are low-toned:

(73) H docks on L-toned nouns with 1st person possessor

```
le            le le              le    na
 |             | |                |\    |
 L             L L                LH   L
'name'        'your name'        'my name'
```

However, when the possessed noun is underlyingly high or rising – that is, when it already bears an H – the 1st person clitic surfaces with rising tone. The second person clitic, however, remains low-toned in this environment:

(74) H docks on 1st person clitic when possessed noun already has an H

```
los           los  le              los   na
 |\            |\   |               |\    |\
LH            LH   L               LH    LH
'tongue'      'your tongue'       'my tongue'
```

[37] This statement excludes proposals that use tautomorphemic docking of floating features as a representational means of accounting for exceptions: see, e.g. Kim (2002) on Dakota ablaut.

These facts suggest an analysis in which the UR of the 1st person clitic contains a floating H. Normally, this H will dock onto the noun, since NoTauMorDoc dominates all constraints that would prefer that it dock onto the clitic:

(75) San Agustín Mixtepec Zapotec: 'my name'

le na | | L H L	MaxFlt	NoTau MorDoc	Ident(tone)	Ident(tone)$_{Root}$
a. ► le na |\ | L H L			*	*
b. le na | / | L H L		*!	*	
c. le na | | L ~~H~~ L	H!			

However, when the noun already bears an H, docking another H to its final TBU is ruled out by some constraint that dominates NoTauMorDoc; here we may attribute this to NoVacDoc (although a more traditional approach would be to assume that some version of the OCP is responsible for this effect):

(76) San Agustín Mixtepec Zapotec: 'my tongue'

los na |\ | L H_1 H_2 L	Max Flt	NoVac Doc	NoTau MorDoc	Ident (tone)	Ident(tone)$_{Root}$
a. ► los na |\ / | L H_1 L H_2			*	*	
b. los na |\ | L $H_{1,2}$ L		*!			
c. los na |\ | L H_1 ~~H_2~~ L	H_2!				

In the winning candidate, the clitic surfaces with an LH, rather than an HL, contour because, as mentioned, the language supports only a high/low/rising surface contrast.

Two small complications remain to be addressed. First, for a seemingly idiosyncratic group of nouns, the H appears on both the noun and the clitic: làd 'body' ~ làd lè 'your body' ~ làd nǎ̰'my body'. No semantic or phonological generalizations appear to distinguish the set of nouns that do this, so there may simply be two noun classes which take different 1st person possessive clitics, one whose UR has a floating H and linked L, and another with a floating H and linked LH.

Second, defining NOTAUMORDOC requires some subtleties when it comes to tone. Under Richness of the Base, it is possible that the UR of some morpheme may not contain any of the moras that it exhibits in the output. The moras exhibited in the output would then be epenthetic, and so would, like all epenthetic structure, lack morphological affiliation, meaning that to dock tones to them would be free in NOTAUMORDOC terms. In the case of San Agustín Mixtepec Zapotec, we could simply assume that the vowel of the 1st person clitic is underlyingly linked to a mora. This solution, though, would not be general. As a better approach, we can make use of the fact, noted by Campos-Astorkiza (2004), that not all epenthetic moras are equal: the insertion of moras onto positional μ-licensers like codas needs to be free in faithfulness cost, since otherwise we predict unattested languages that contrast moraic and non-moraic codas. Given that this asymmetry is already motivated, we can assume that these freely-inserted moras are treated as affiliates of the same morpheme as the structures that license them.[38]

An example of tautomorphemic docking of floating moras comes from Tiberian Hebrew (Prince 1975). A number of affixes in this language trigger gemination of the second consonant of the root, and some grammatical categories are marked only by such gemination. However, guttural geminates are disallowed, so when this consonant is a guttural, the preceding vowel is instead lengthened. The natural analysis would be to suppose that the gemination-triggering morphemes contain a floating mora, which preferentially docks to the 2nd root consonant, but when prevented from doing so by the markedness constraints banning guttural geminates, docks instead to the preceding vowel, lengthening it.[39]

Something similar happens following the definite article /ha-/. The definite article triggers gemination of the root-*initial* consonant. However, with a few complications (Prince 1975: 225-230), when this consonant is a guttural and therefore ungeminable, the article surfaces with a long vowel, i.e. [haː], meaning that the floating mora of the definite article docks tautomorphemically when the ban on guttural geminates prevents it from docking onto the root-initial consonant.[40]

[38] A related concern would arise in a theory that treated the syllable as the TBU, since, by universal assumption, there is no IO faithfulness to syllables (no language has contrastive syllabification), so all syllable nodes present in the output are (potentially) epenthetic. A σ-as-TBU theory could assume that syllables are treated by NOTAUMORDOC as affiliates of the morpheme (if any) of which their nucleus is an affiliate.

[39] However, see Beechey (2005) for a theory of geminate typology which is inconsistent with an account of morphological gemination as floating mora-docking.

[40] As a caveat, we may note that one could also pursue an analysis of the San Agustín Mixtepec Zapotec and Tiberan Hebrew facts in which the high tones and moras which we've just analyzed as

There is a second reason why NoTauMorDoc is a necessary component of an autosegmental theory of mutation. Many languages have mutations that give rise to phonotactic configurations that are not otherwise allowed. A well-known example is the Javanese elative (Dudas 1975) which is formed by tensing the last vowel in the adjective stem:

(77) Javanese

regular	*elative*	*gloss*
alʊs	alus	'refined, smooth'
aŋɛl	aŋil	'hard, difficult'

There is a theoretical issue here because Javanese does not allow tense vowels in closed syllables in any other context. This ban, like any other in OT, is the result of some ranking of markedness over faithfulness, call it $*V_{[+ATR]}C]_{\sigma}$ >> IDENT[ATR]. Something has to be able to overpower the markedness constraint in order for the elative to be realized as it is, and in the theory being pursued here, that something would be MAXFLT, with the UR of the elative morpheme taken to be /[+ATR]/.

This seems fine. However, there's a problem: under Richness of the Base, roots should be able to contain floating tokens of [+ATR] as well, which could dock tautomorphemically and thereby permit roots to support an [ATR] contrast in closed syllables[41]:

(78) Pseudo-Javanese with [ATR] contrast in closed σ

alʊs [+ATR]	MAXFLT	$*V_{[+ATR]}C]_{\sigma}$	IDENT[ATR]
a. ► alus | [+ATR]		*	*
b. alʊs ~~[+ATR]~~	*!		

Something further is needed to rule out (78a), and ranking NoTauMorDoc above MAXFLT will do the job.

7 Exceptions to strict base mutation

An important restrictive prediction of Alderete's (1999, 2001) version of anti-faithfulness is known as Strict Base Mutation. Alderete assumes, as discussed in section 4, that some surface member of every paradigm is selected as the base for all of the other members. In

underlyingly floating were treated as underlyingly linked tautomorphemically and flop onto the other morpheme when markedness permits.

[41] I am grateful to Shigeto Kawahara for pointing out this problem.

keeping with Benua's (1997) approach to OO-correspondence in derivational morphology, Alderete further assumes that only the phonological content of the morphemes that two forms have in common stand in OO-correspondence.[42] Because roots, but not affixes, are held in common by all members of a paradigm, only they can be subject to mutation induced by anti-faithfulness constraints, since, by assumption, such constraints only exist on the OO-dimension.

Similarly, the "make something different" version of MORPHREAL proposed in Kurisu (2001) can only induce changes to bases of affixation because it explicitly demands that an affixed form differ from the output of an unaffixed base. Therefore, segmentally contentful affixes cannot be mutated by this constraint because their mere presence ensures that the affixed and unaffixed forms are different, and therefore unfaithful renderings of affixes in the output are not necessary to satisfy MORPHREAL.

An autosegmental theory, however, does make it possible for mutation to occur other than between an affix and its base of affixation. Any morpheme may contain floating autosegments in its underlying form, and those autosegments can in principle dock on any other morpheme. Roots can, then, mutate their affixes, affixes can mutate other affixes, and one morpheme can mutate a neighbor in external sandhi. All three of these are attested.[43]

Chukchee is analyzed by Kenstowicz (1979) as having dominant-recessive [ATR] harmony: [-ATR] vowels are dominant and induce harmonization of [-ATR] throughout the word. Such harmony systems are far from unusual, but one striking quirk of the Chukchee system is that there are a number of affixes and roots that are dominant in the harmony system, despite being underlyingly vowelless. The following data from Krause (1979: 13) illustrate the contrast between dominant and recessive vowelless roots:

(79) Vowelless roots in Chukchee vowel harmony
vowelless roots behaving recessively:

ŋət-ək	ɣe-nt-ə-lin	"to cut off/he has cut off"
rəɣ-ək	ɣe-rɣ-ə-lin	"to dig, scratch/he has dug, scratched"

[42] The assumption that only the content of shared morphemes participates in the OO-correspondence relation between related forms is also argued for by McCarthy (2005); see also McCarthy & Wolf (2005: §5.3) for relevant discussion. This assumption is, however, challenged by Gouskova (2005), who lets affixes stand in the correspondence relation so as to use OO-DEP to restrict their size. If a proposal like Gouskova's is accepted, then strict base mutation would no longer be a property of anti-faithfulness. In such a version of anti-faithfulness, it would become conceivable that roots could mutate affixes, but mutation in external sandhi would still, presumably, be unobtainable.

[43] For a different sort of exception to Strict Base Mutation, see Apoussidou (2003) on post-accenting roots in Modern Greek.

(80)
vowelless roots behaving dominantly:

təm-ək	ɣa-nm-ə-len	"to kill/he has killed"
təm-ək	ɣa-tw-ə-len	"to say/he has said"
rəw-ək	ɣa-rw-ə-len	"to split/he has split"

If harmony is simply feature-spreading, then the analysis which suggests itself is one in which dominant vowelless roots contain a floating [-ATR] which docks to affixal vowels so as to satisfy MAXFLT, and which harmonizes under the pressure of whatever markedness constraints drive harmonization.

One minor point to address is the fact that [+ATR] /i, u/ alternate with the apparently also [+ATR] [e, o] in the context of dominant vowels. Kenstowicz (1979) gives this an rule-ordered analysis in which /i, u/ become /ɨ, ʉ/ through the spreading of [-ATR], and that these segments then lower to [e, o]—in the process becoming [+ATR] again—under application of a subsequent rule. Within OT, an analysis can presumably be given in terms of one's favorite theory of opacity. Regardless of the ultimate details of implementation, it is not clear how the Chukchee facts could be analyzed without floating features in roots. Why should prefixal /e/ become [a] before the initial [r] and [n] of some verbs but not others? If the Chukchee harmony system involves spreading of *some* feature, regardless of what exactly it is, it would seem that the most straightforward way to make vowelless morphemes trigger the harmony would be to have them underlyingly contain floating tokens of that feature.

Much more richly attested are cases in which one morpheme mutates a neighbor in external sandhi. Particularly rich in this regard are the Celtic languages. For instance, in Irish (Ó Siadhail 1989), the Lenition mutation is triggered on following verb by /maː/ 'if', /oː/ 'since', /ə/ (orthographic *a*), which is the 'preverbal particle in verbal noun complement.' Nouns are lenited by almost all preceding simple prepositions (e.g. [b]*ád* 'boat', *ar* [v]*ád* 'on a boat'). The conjunctions *agus/is* (i.e. 'and') lenite a following noun. The Eclipsis mutation is triggered on following nouns by the words for the numerals seven through ten, and in Dunquin dialects by *sa*, 'per' (e.g. [b]*liain* 'year', *sa* [m]*liain* 'per year').

In Welsh (Kibre 1997), the situation is much the same. Nouns are lenited by a seemingly unrelated set of prenominal adjectives, including *cryn* 'considerable', *hen* 'old', *gau* 'false', *gwir* 'true', and *hoff* 'favorite.' Lenition is also triggered on following nouns by the prepositions *gan* 'with', *heb* 'without', and *tan/dan* 'under' (among others), as well as determiners including *amryw* 'several' and *nail* 'either'.

Clearly, a theory of mutation in which affixes can only induce changes to their bases of affixation cannot account for cases like this. The Celtic mutations simply are not (generally) the result of affixational processes, but are induced by morpheme of an arbitrary set of triggers on a linearly following morpheme. That is to say, these mutations are external sandhi processes.[44] The generalization that mutation arises strictly on targets that are linearly following the trigger also falls out easily from an autosegmental analysis: the floating features dock, if at all, on the first segment of the following morpheme, something we can account for straightforwardly under the approach to governing the location of feature-docking presented in §9.

A final exception to strict base mutation comes from Chaha, whose labialization facts were introduced in §4.2. It is possible for affixes, such as the subject suffix /xä/, to intervene between the root and the 3rd.masc.obj. suffix, and the velar fricative of this affix is labialized in that case, e.g. [käfätx^{w}änɨm] 'you (masc.) opened it' (example from Piggott 2000). Such mutation of an affix by another affix is, again, out of reach to both anti-faithfulness and 'make something different' versions of MORPHREAL.

8 Length polarity with empty root nodes

Thusfar in this paper I have focused on the role of floating features, tones, and moras in morpho-phonological processes. However, a construal of Richness of the Base generous enough to permit floating autosegments in the input should also permit the input to contain empty root nodes which are unassociated to any features. Indeed, an empty root node is simply a segment that is underspecified for all features. Put another way, an input empty root node is a feature-bearing unit linked to no features; this should hardly seem like an odd thing to allow in the input given that inputs (and outputs) are uncontroversially taken to (potentially) contain TBUs that are not linked to any tones. This section presents an allomorphic analysis of length exchanges using such underlyingly featureless root nodes.

Under a theory of length that used a binary feature [long], the analysis of exchange processes between long and short vowels would be subsumable within the proposal about feature polarity given in §4: one would need only suppose that there were two allomorphs of the triggering morpheme: {[+long]; [-long]}. However, the advent of the moraic theory of weight makes the analysis of such cases becomes more difficult.

Subject to certain lexical restrictions, the plural form of verbs and nouns in the Yuman language Diegueño (Langdon 1970, D. Walker 1970) are formed, in part, by reversing the length of the stressed stem vowel (stress is usually final):

[44] That mutation is strictly local – the trigger linearly precedes the locus of mutation – is assumed in most analyses of Celtic, including Awbery (1975), Willis (1982), Tallerman (1990), Ball & Müller (1990), and Kibre (1997). However, see Green (2005) and Stump (1988) for some apparent exceptions; see §10.1 for discussion of how these might be dealt with. Kibre (1997) also makes the obersvation that no particular structural relationship need hold between triggers and undergoers of mutation, a principle which he dubs Astructuralism.

(81)

singular	*plural*	*gloss*
muɬ	muːɬ	'gather'
xiːnuʎp	xiːnuːʎp	'be cute'
saːw	saw	'eat'
kiːxaːr	kiːxarc	'complain'

To account for this reversal, suppose that the plural has two allomorphs:[45]

(82)
Allomorph 1: μ (i.e., a floating mora)
Allomorph 2: μ

Rt (i.e., an empty root node plus a floating mora)

Now, suppose that Allomorph 1, the floating mora, is the default allomorph. When the stressed vowel of the root is short, MAXFLT >> IDENT(length) will ensure docking of the floating mora without further ado:

(83) Diegueño: 'gather.PL'

muɬ + μ	MAXFLT	IDENT(length)
a. ► muːɬ		*
b. muɬ μ̶	*!	

When, however, the stressed vowel is long, we need the null output to win so as to gain access to the elsewhere allomorph. This will result from the following three constraints being ranked above MPARSE(plural):

(84)
MAXFLT: Don't delete the floating mora.

DEP: Don't epenthesize a segment for the floating mora to dock to.

*μμμ: A vowel cannot be linked to three moras.

Tableau (85) illustrates how ranking all of these above MPARSE(plural) results in the optimality of the null output:

[45] Thanks to Joe Pater for prompting me to pursue this extension of the proposal.

(85) Diegueño: ‘eat.PL’

saːw – μ	MAXFLT	DEP	*μμμ	MPARSE(plural)
a. saːw μ̶	*!			
b. saːwa | μ		*!		
c. saw /|\\ μμμ			*!	
d. ► ⊙				*

The victory of the null output when the stressed vowel is already long vowels now results in the second-priority allomorph being tried. What we now need to assure is that this allomorph, which consists of an empty root node plus a floating mora, supplants the root’s long vowel while acquiring all of its features and the floating mora, but not acquiring either of the two root moras.

Let’s deal with these goals one at a time. First: why does the empty root node supplant the root node of the base’s long vowel? Within the theory being pursued here, we may assume that a featureless root node counts as floating, and hence is subject to protection by (some version of) MAXFLT. Recall the definition of MAXFLT for features, repeated in (87):

(86)
MAXFLT
∀F∈I, where F is a feature:
[¬[∃S∈I such that S is a segment and F is attached to S]]→
[∃F′∈O such that F𝔑F′]

As so formulated, MAXFLT demands preservation of features that are linked to no root node in the input. To protect floating root nodes, we simply invert the definition: the output must preserve root nodes that are linked to no features in the input:

(87)
MAXFLT (for root nodes)
∀N∈I, where N is a root node:
[¬[∃F∈I such that F is a feature and F is attached to N]]→
[∃N′∈O such that N𝔑N′]

Ranking MAXFLT(root node) sufficiently high will then ensure that the floating root node is preserved in the output. Next, why does this root node replace the root node of the base’s long vowel? We can assume that to endow the floating root node with a complement of features is prevented by high-ranked DEP(feature) constraints, but that NOFLOP(feature) is dominated by MAXFLT(root node), causing the features of the long vowel to flop to the empty root node. Tableau (88) illustrates; 'F' denotes the features of the vowel /aː/:

(88) Diegueño: 'eat.PL'

saː$_3$w μ$_2$ | F$_1$ Rt$_4$	DEP(feature)	MAXFLT (root node)	NOFLOP(feature)	MAX
a. saːwa | \\ F$_1$ F$_2$	F$_2$!			
b. saː$_3$w ~~μ$_2$~~ | F$_1$ ~~Rt$_4$~~		Rt$_4$!		
c. ► sa$_4$w | F$_1$			*	aː$_3$

Lastly, we need to ensure that neither of the moras of the underlying long vowel are able to flop onto the floating root node. To explain this, we need only assume the ranking NOFLOP(μ) >> MAX(μ). However, the floating root node needs to acquire one mora, and we can assume under this analysis that it is the underlyingly floating one. NOFLOP constraints penalize both the insertion and removal of association lines, so docking of a floating mora onto a short vowel, as in (84), presumably also violates NOFLOP(μ). That means that Diegueño must have the ranking MAXFLT(μ) >> NOFLOP(μ) >> MAX(μ). This same ranking assures that the floating root node can acquire the floating mora that comes with it in the elsewhere allomorph of the plural affix, but that it cannot acquire either mora of the long root vowel that it overwrites: autosegmental linkages can be added for the sake of preserving floating moras, but not underlyingly linked moras.

Crucially, this analysis predicts that the plural would surface with a long vowel if there were some other affix present that also contained a floating mora: this second floating mora would be able to dock on the underlyingly-floating root node, thus creating a long vowel. This prediction is borne out by data from the Antipassive in Dinka (Andersen 1995). In the 'CVVC/H' class, the antipassive morpheme adds a floating mora to roots with a monomoraic vowel, but shortens roots with bimoraic vowels to being monomoraic, even though Dinka does have trimoraic vowels. This suggests an analysis just like the one given for Diegueño: MAXFLT and *μμμ dominate MPARSE(Antipassive), so when the root has a bimoraic vowel, the null output wins and forces access to the floating root node plus floating mora, which overwrites the bimoraic stem vowel. A key twist, though, is that the Non-Topical Subject, 1S, 2S, and Passive/Circumstantial Topic forms of the antipassive surface with bimoraic vowels. These morphemes could be analyzed as containing floating moras, whose docking on the floating root node is tolerated:

(89) Dinka: 'wash.AP.1S'

lɔ̀₁k Rt₂ /\ $\mu_3\mu_4$ μ_5 μ_6	MAXFLT (μ)	NOFLOP (μ)	MAX (μ)
a. ► lɔ̀₂k /\ $\mu_5\,\mu_6$ $\mu_3\,\mu_4$		μ_6	$\mu_3\mu_4$
b. lɔ̀₂k /\ $\mu_5\,\mu_3$ ~~μ_4 μ_6~~	μ_6!	μ_5	$\mu_4\mu_6$
c. lɔ̀₂k | μ_5	μ_6!		$\mu_3\mu_4\mu_6$

The fact that floating moras of another affix can dock onto the floating root node, when root moras cannot flop onto it, once again highlights the importance of MAXFLT's ability to induce faithfulness to floating but not non-floating elements.

Dinka is reported to have a second length exchange, as a plural marker in nouns (Anderson & Browne 1973). Length exchanges are also reported in the plural of another Yuman language, Jamul Tiipay (Miller 2001) and in diminutive formation in Czech (Anderson & Browne 1973), though the last of these processes may not by fully productive.

9 Locality of feature docking

One notable advantage which can be claimed by an autosegmental approach over both anti-faithfulness and MORPHREAL concerns the locality of mutation processes: why does the change take place where it does? Because mutation, in an autosegmental view, is simply the realization of particular pieces of *structure* in the output, the location of those structures can be regulated by the same kinds of alignment constraints that regulate the location of segmental affixes.

When a morpheme consists of just a single feature, as in the case of the Aka Class 5 marker, the locus of docking can be determined easily using MCat/PCat alignment (McCarthy & Prince 1993a). The Aka Class 5 morpheme is a prefix, so the relevant constraint is simply ALIGN(Class 5, L, PWd, L), or PREFIX(Class 5), in the categorical terminology of McCarthy (2003). In almost all cases of featural morphology, docking can only take place at the edge, and otherwise does not take place at all, so high-ranked categorical alignment constraints can easily account for the vast majority of cases. The two attested examples of a single-feature morpheme migrating away from its canonical docking location for markedness reasons involve the palatalization that marks 'uncontrolledness' in Japanese mimetics and the labialization seen the Chaha impersonal; these have already been analyzed using categorical alignment constraints by McCarthy (2003: §7.1).

The situation is more complicated when a morpheme consists of segmental material in addition to one or more floating features. The presence of a segmental suffix (prefix) at the right (left) edge of the PWd suffices to satisfy SUFFIX (or PREFIX), so what militates in favor of the floating features appearing adjacent to the suffix (prefix), or failing that, as close to it as possible, as we find? Pseudo-tableau (90) illustrates the problem:

(90) Nuer: 'overtake.1ST.PL.IND.PRES.ACT'

cob + [-voi]$_2$[+cont]$_3$ kɔ	SUFFIX(1ST.PL.IND.PRES.ACT)
a.►? cof kɔ /\\ [-voi]$_2$[+cont]$_3$	
b. ►? çopkɔ / \\ [-voi]$_2$[+cont]$_3$	
c. ►? çobkɔ |\\ [-voi]$_2$[+cont]$_3$	

In (90a-c), the rightmost material affiliated with the 1st. pl. ind. pres. act. morpheme, namely the vowel [ɔ] and all of its features, appears at the right edge of the word, so SUFFIX is satisfied in all of these candidates. Something else needs to be involved to break the tie in favor of the desired winner (1a) where the features are realized on the same segment.

What I propose is that the responsible constraint is as in (91):

(91) MORPH-O-CONTIG
The tokens of output structure affiliated with a given morpheme collectively span an uninterrupted interval.

This constraint is adapted from Landman (2002), who proposes it as a means of preventing morpheme-internal epenthesis and similar phenomena. In the case of Nuer, MORPH-O-CONTIG will get us the desired result:

(92) Nuer: 'overtake.1ST.PL.IND.PRES.ACT'

cob + [-voi]$_2$[+cont]$_3$ kɔ	SUFFIX(1ST.PL.IND.PRES.ACT)	MORPH-O-CONTIG
a.▶ cof kɔ /\\ [-voi]$_2$[+cont]$_3$		
b. çopkɔ / \\ [-voi]$_2$[+cont]$_3$		*!
c. çobkɔ [-voi]$_2$[+cont]$_3$		*!

The formerly-worrisome candidate (92b) is now eliminated because the root vowel [o] intervenes between two units of structure affiliated with the affix: the feature [-voi] and the feature [+cont].

In the Nuer case just considered, MORPH-O-CONTIG sufficed to force the two floating consonantal features to dock on the consonant adjacent to the affix, because there was only one such consonant. But what happens when there is a consonant cluster at the relevant edge of the mutated word? Recall that in the Breton mixed mutation, initial /gw/ becomes [w]. We may assume that this is due, in part, to the presumptive illegality of [ɣw] as an onset cluster in Breton – initial [ɣ] being 'rare' anyway, according to Press (1986). However, as tableau (93) illustrates, MORPH-O-CONTIG by itself does not produce the right result:

(93) Breton: 'see.PROGRESSIVE': Incorrect result with just MORPH-O-CONTIG

o[-cor, +cont] gwelout	MORPH-O-CONTIG	MAXFLT	* ɣw	MAX
a. o ɣwelout / \\ [-cor][+cont]			*!	
b. 💣 o gwelout / \\ [-cor] [+cont]				
c. o gwelout / \\ [-cor][+cont]	*!			
d.▶ o welout / \\ [-cor][+cont]				g!

Candidates (93b) and (93d), problematically, do equally well on MORPH-O-CONTIG, because in both cases the exponents of the progressive marker cover an uninterrupted interval, as (94) illustrates:

(94) *(Exponents of the progressive marker are in **bold**)*

Root tier:	**[o]**	[g]	[w]	
[coronal] tier:		**[-cor]**	[-cor]	
[continiuant] tier:		[ ]	**[+cont]**	*=(93b)*

Root tier:	**[o]**	[w]	
[coronal] tier:		**[-cor]**	
[continiuant] tier:		**[+cont]**	*=(93d)*

Because (93b,d) tie on MORPH-O-CONTIG, the desired winter (93d) incorrectly loses by virtue of violating MAX. We need something else to create a preference for (93d). The constraint in (95) will do this for us:

(95)
NOSPLITFLT
Let F_1, F_2 be any pair of features that are floating in the input and affiliated with the same morpheme M. If they have respective output correspondents F_1', F_2', and F_1' is docked to a bearing unit S_1, and F_2' is docked to a bearing unit S_2, then assign a violation-mark if $S_1 \neq S_2$.

Likewise, *mutatis mutandis*, for floating tones and moras.

This constraint will exercise the crucial preference in favor of (93d), where both of the floating features of the progressive marker have docked to a single segment, over (93b), where they have not.[46]

There is still one more case to consider, exemplified by the Chaha labialization discussed in §4.2. In Chaha, the 3rd person masculine singular object marker induces labialization of the rightmost non-coronal consonant in the stem; according to Rose (1997), this morpheme consists of a suffixal /-n/ as well as the floating feature [+round]. The floating feature will dock on the root-final consonant –satisfying MORPH-O-CONTIG- if that consonant is not a coronal:

[46] When is NOSPLITFLT violated? A possible segmental example comes from Texistepec Popoluca (Reilly 2005) where the inflectional prefix '$/^{N}$-/' induces nasalization/voicing of initial consonants plus an alternation of /i/→[ɛ] in the following vowel. With multitonal morphemes, there are plenty of examples where the floating tones dock onto different TBUs; one is the /L…H/ Igbo affirmative imperative marker (Clark 1990).

(96) Chaha: 'find.3rd.MASC.SG.OBJ'

näkäb [+round] n	MORPH-O-CONTIG
a. ► näkäb^{w}n	
b. näk^{w}äbn	*!

However, when the consonant adjacent to the suffix is coronal, and hence unlabializable, the [+round] will surface on the rightmost non-coronal. The loose intuition here is that the floating feature wants to be as close as possible to the /n/, which would be easy to express with gradient constraints. To capture this in categorical terms, we can posit a succession of constraints demanding that non-contiguous exponents of a single morpheme be realized in a single prosodic constituent:

(97)
GAP<X
Let α, β be consecutive noncontiguous exponents of a single morpheme M.
Assign a violation-mark if α and β are not dominated by a single prosodic constituent of level X.

When the second, but not the third, consonant of a triliteral root is labializable, GAP<σ will cause the [+round] to dock on the second consonant[47]:

(98) Chaha: 'lack.3rd.MASC.SG.OBJ'

bäkär [+round] n	MORPH-O-CONTIG	GAP<σ
a. ► bä.k^{w}ärn	*	
b. b^{w}ä.kärn	*	*!

In the case of quadriliteral roots, the facts are unclear. The impersonal in Chaha induces the same distribution of labialization as the 3rd masculine singular object marker, but apparently consists of just the [+round]. Based on the sparse data available, McCarthy (2003) concludes that SUFFIX/Ft may suffice to explain its distribution; if 3rd masculine singular object forms of quadriliterals also show a preference for docking their [+round] on the second rather than the first consonant, GAP<Ft will be able to explain this preference.

Another class of cases in which floating features do not dock on the nearest *segment* strictly adjacent to suffixal segments occurs when the floating features may only licitly dock on a vowel, as in the various phenomena traditionally called 'umlaut' or 'ablaut.' Here the relevant ranking would be GAP<σ >> MARK >> MORPH-O-CONTIG: markedness can force the floating vocalic features to skip over consonantal segments to

[47] Sprague (2005) proposes that floating moras in Zuni and Getxo Basque obligatorily dock root-finally due to the effect of CONTIGUITY, which is violated if, in the output, an underlying floating mora intervenes between underlyingly adjacent root moras. Such an approach will not generalize to floating *features*: in both (99a-b) the underlyingly floating [+round] supplants any underlying [-round] of the segment it docks to, and hence the tokens of [-round] flanking the locus of labialization were not contiguous in the input, and CONTIGUITY[round] is not violated.

get to a vowel, but to skip over a vowel (and thus a syllable) to dock on a more distant vowel would violate the undominated GAP<σ.

An additional desirable consequence of a representational theory of mutation is that we can regulate the location of *both* edges of a multi-part affix. For instance, in Lena Bable Spanish, the floating feature of the masculine singular suffix always docks on the nucleus of the stressed syllable, even if this means skipping over an unstressed vowel intervening between the stressed syllable and the suffixal /-u/:

(99) (from Hualde's (1989) (22))

masc. sg.	*masc. pl.*	*gloss*
burwíbanu	burwébanos	'wild strawberry'
silikútiku	silikótikos	'suffering from silicosis'
trwíbanu	trwébanos	'beehive'

We can assume that there are two categorical alignment constraints relevant to the patterning of the masc. sg. suffix: ALIGN(masc.sg., R, PWd, R), which forces the /-u/ to appear in suffixal position, and ALIGN(masc. sg., L, Δ_μPwd, L), which forces the leftmost unit of structure affiliated with the masc. sg. morpheme—the floating feature—to occur on the head mora of the Prosodic Word. If both of these constraints dominate all MorphContig constraints, then we obtain the 'infixation' of the floating features. Tableau (100) illustrates; for ease of exposition we abstract away from the multiple allomorphs of the input:

(100) Lena Bable Spanish: 'beehive.MASC.SG.'

trweban [+high]$_1$u	OO-IDENT (stress)	ALIGN (masc.sg., R, PWd, R)	ALIGN (masc. sg., L, Δ_μPwd, L)	MORPH-O-CONTIG	GAP<σ
a.► trwíbanu | [+high]$_1$				*	*
b. trwébinu | [+high]$_1$			*!	*	
c. trwíuban | [+high]$_1$			*!		
d. trwebínu | [+high]$_1$	*!			*	

The desired and actual winner is (100a), which violates GAP<σ and MORPH-O-CONTIG by virtue of skipping over the unstressed vowel. Trying to cut down on these violations, as in (100b-100d) by placing the floating feature or the affixal vowel elsewhere, or by shifting stress, violates higher-ranked constraints and hence is not observed.

A related case in which we can appeal to the effect of constraints on the alignment of both edges of an affix concerns non-automatic spreading of floating features. The best-known example of this comes from Terena, an Arawakan language spoken in Brazil, where the first person is marked by nasalization spanning from the left edge of the word up to the right edge, or, failing that, up to the leftmost obstruent (data from Bendor-Samuel (1960)):

(101) Terena first-person nasalization

ayo	'his brother'	ãỹõ	'my brother'
owoku	'his house'	õw̃õŋgũ	'my house'
piho	'he went'	mbiho	'I went'
emoʔu	'his word'	ẽmõʔũ	'my word'

To a first approximation, we can attribute this effect to two constraints: ALIGN(1P, L, PWd, L) and ALIGN(1P, R, PWd, R), plus the assumption that the UR of the 1P morpheme is /[+nasal]/[48]. If Alignment were still gradient, this would be all we'd need to say; however, characterizing the (sometimes violated) ALIGN-R constraints in Terena becomes more complicated under a categorical theory, especially given that Terena's elaborate stress system[49] makes it less than self-evident where the relevant edges of feet are located. To untangle the facts of Terena stress would take us well beyond the scope of this paper, but an analysis along the lines sketched here does not seem implausible.

An analysis like the one sketched for Terena also seems promising as an approach to affix-dominance in pitch accent systems. Many pitch-accent languages, Tokyo Japanese being a well-known example, have classes of affixes that have the effect of deleting any underlying accent on the base of affixation.[50] Alderete (1999, 2001) analyzes these in terms of an anti-faithfulness constraint ¬MAX(Accent):

(102) Tokyo Japanese: 'native of Kobe'

kóobe-kko	¬OO-MAX(Accent)	OO-MAX(Accent)	IO- MAX(Accent)
a. ► koobekko		*	*
b. kóobekko	*!		

To account for systems of this character we can hypothesize that affixes may have URs of the form /L kko/, i.e. a floating low tone plus the suffixal segments, and that both ALIGNR and ALIGNL for this affix are high-ranked. ALIGNR is satisfied by the presence of the segments [kko] at the right edge of the PWd, and ALIGNL is satisfied by extending the L tonal domain over the entire root, that is, all the way to the left edge of the PWd,

[48] Thanks to John McCarthy for suggesting this approach.

[49] On Terena stress and syllable structure, see Harden (1946), Bendor-Samuel (1962), Ekdahl & Grimes (1964), and Wilkinson (1976).

[50] For other examples, see Alderete (1999, 2001), McCawley (1968), and Poser (1984) on Japanese, Halle & Vergnaud (1987) and Blevins (1993) on Lithuanian, and Hualde & Bilbao (1992, 1993) on Getxo Basque.

which will have the effect of eliminating any H-containing accents in the root. Dominant affixes which themselves bear a lexical accent (e.g. the Tokyo Japanese adjective-forming suffix /-ppó/) will be protected from losing their accent to the L domain by NOTAUMORDOC. As a further measure, if the phonetic or phonological facts of some language with dominant affixes were inconsistent with having L specified across the root in cases where root accent had been deleted, we can look to a recent proposal by Key (2005) to the effect that TBUs with no tonal specification are parsed into ∅-tone spans; that is, that ∅-tone is an actual representational object which could also be forced to align with the left edge of the PWd in the manner described. Lastly, it should be noted that dominance effects of the kind described also exist in stress-accent systems; it is not so obvious how these would be handled within the theory proposed here, but it is not hard to imagine that they could be brought into the fold of a floating-feature theory.

An autosegmental theory, then, is capable of giving a satisfactory account of the loci of mutation because the changed features are actual objects, and as such alignment and contiguity constraints can directly refer to their locations. This makes for a considerably more coherent picture than the one offered in 'make something different' versions of MORPHREAL like that of Kurisu (2001). Kurisu suggests (pp. 210-211) that the unfaithful mappings in double morphemic exponence are realized adjacent to the triggering affix, and suggests (without defining it) that a MORPH-CONTIGUITY constraint is responsible. Because the affix-adjacent feature change in (say) the DhoLuo plural is, in a MORPHREAL system, not the manifestation of an object (like a floating feature) but instead the result of an IO-unfaithful mapping conditioned by faithfulness to a sympathetic candidate, it is unclear whether a sufficiently general contiguity constraint could be formulated to refer to its location. In any case, Kurisu makes no explicit proposal about how this would work, so we need not concern ourselves with it further.

An autosegmental theory also permits a much more satisfactory account of locality in mutation than does anti-faithfulness. Alderete (1999, 2001) proposes to account for the edge-tropic location of the unfaithful mappings compelled by anti-faithfulness constraints by locally conjoining anti-faithfulness with ANCHORING constraints. To illustrate, consider the DhoLuo plural: [bat] 'arm.NOM.SG', [bade] 'arm.NOM.PL'. The relevant conjoined constraint is [ANCHORR(Pwd) & ¬IDENT(voi)]$_{seg}$:

(103) DhoLuo : 'arm.NOM.PL' with anti-faithfulness

/bat-e/	[ANCHORR(Pwd) & ¬IDENT(voi)]$_{seg}$	¬IDENT(voi)	IDENT(voi)	ANCHORR(Pwd)
a. ► bade			*	*
b. bate	*(!)	*(!)		*
c. pate	*!		*	*

Failing to change the [voice] value of any segment, as in (103b), violates the undomianted anti-faithfulness constraint ¬IDENT(voi). The reasons for (103c)'s failure are a bit more complicated. ANCHORR(Pwd) is violated at [t]/[d] in all of the candidates illustrated because this segment was final in the input, but, due to the addition of the suffixal segment /e/, is no longer final in the output. Candidates (103b-c) therefore violate the local conjunction [ANCHORR(Pwd) & ¬IDENT(voi)]$_{seg}$ because they fail to be antifaithful at the same locus where ANCHORR(Pwd) is violated.

There are several reasons to be skeptical of this approach. First, it will only work when the affix to which the anti-faithfulness constraint is indexed has segmental content; as such, it will have nothing to say about the cases where a morpheme is realized only as featural change(s): Aka Class 5, the Javanese elative, the Chaha impersonal, and many more that we've discussed. Alderete (1999: p. 140) does suggest that a preference for mutating in initial position (as in Aka, for instance) could be driven by anti-*positional* faithfulness, but this will not suffice as a general solution, since there are plenty of mutations that take place reliably in weak, non-initial positions (Javanese, Chaha, DhoLuo, etc.). Another potential worry is that local conjunction can only localize anti-faithful mappings to the right edge if ANCHORRIGHT exists. Nelson (2003) has argued that it does not (though see Cohn (2004) for a counterargument); the local-conjunction approach to locality in anti-faithfulness requires one to stake out a disputed position in this debate, whereas an autosegmental approach permits one to remain agnostic as to the existence of ANCHORRIGHT.

10 Other alternative proposals

Thusfar in this paper I have argued for the favorability of the autosegmental approach proposed here relative to anti-faithfulness and MORPHREAL. These two, however, do not exhaust the range of competing proposals. Four further alternatives will be discussed and shown wanting in this section: the purely-suppletive model of Green (2005), high-ranked faithfulness to morphological heads (Revithiadou 1999, Ussishkin 2000a,b), Optimal Domains theory (Cole & Kisseberth 1994 *et seq*.) and morpheme-specific LAZY constraints (Kirchner 1998).

10.1 Mutation as pure suppletion

Green (2005) argues that the Celtic mutations are not the result of any kind of phonological process. Instead, he suggests, all words that undergo mutation have multiple lexically-listed allomorphs, each indexed for a particular mutation grade (radical, Lenited, Eclipsed, etc.), and that all morphosyntactic environments that trigger mutation do so by selecting for the relevant mutation grade. For instance, the Irish word for 'boat' will have the listed allomorphs {/bad/$_{radical}$, /vad/$_{lenition}$, /mad/$_{eclipsis}$}; the allomorph indexed to the appropriate mutation grade demanded by a particular morphosyntactic environment is the one that appears in that environment (unless prevented from doing so when markedness constraints preferring a different allomorph dominate MUTAGREE, the constraint that demands that the allomorph of the matching mutation grade be chosen.)

The most obvious objection to this proposal concerns the phonological regularity of alternations between mutated and unmutated forms. Given the initial consonant of an unmutated word, it is (with some exceptions) predictable what its initial consonant will be in a given mutation context. On the view that the Lenition-grade form is not computed from the radical by the phonological grammar, but is instead simply listed, the existence of any degree of phonological regularity in the mutations seems unexpected.

Green anticipates this objection (previously raised by Ball & Müller (1990) against a then-hypothetical non-phonological model of mutation)[51], and his response is to invoke the word-based morphological theory of Ford, Singh, & Martohardjono (1997). This model, in brief, denies the existence of morphological objects like 'root', 'affix' or 'stem', proposing instead that there are only whole words, belonging to distinct morphological categories. Speakers' knowledge of the phonological regularities holding between morphologically-related words is attributed to word-formation strategies (WFSs), which are not derivational rules, but, as the name implies, strategies by which a learner analogically posits the morphological relatives of some word, having already encountered certain lexical regularities.

This approach permits the Suppletive Model to have its cake and eat it too, by positing a parallel module of speakers' knowledge, outside of the phonological grammar but nevertheless containing phonological information. This invites, first of all, the objection of unfalsifiability: a phenomenon may be excised from the phonology while retaining an arbitrary degree of regularity statable in phonological terms. Such regularity would otherwise have been the primary—indeed only—justification for believing that the phonology had anything to do with the phenomenon in question in the first place.

A second objection to a word-based morphological theory, which Green also anticipates, concerns its restrictiveness. Being outside of the phonological grammar, WFSs are capable of stating any phonological alternation whatsoever, whether or not the grammar would be capable of computing it. Green's response here is to appeal to a diachronic explanation: morphophonological alternations descend from formerly phonologically-conditioned alternations, so the power of the phonological grammar indirectly restricts the range of possible morpho-phonological processes.

This, however, is not sufficient as a restrictive theory. There are many kinds of easily-described morpho-phonological alternations that are nevertheless unattested. In order to exclude them, a theory based on WFSs would have to find some way to show that no set of historical developments could ever give rise to such processes. It does not, however, seem promising to expect that this could, in general, be shown. First, there is as of yet no typological theory of possible diachronic changes. Second, we can construct quite plausible-sounding scenarios in which attested processes could give rise to WFSs for unattested ones.

For example, no language shows syllable-counting reduplication that copies the first three segments of the base, regardless of their prosodic affiliations. That is, we never see something like [pa.ta.ki] 'indict.SG' ~ [pat-pa.ta.ki] 'indict.PL', [a.ka.ti] 'bribe.SG'~ [a.ka-a.ka.ti] 'bribe.PL'. This fact can be captured by placing reduplication within the

[51] See also Boyce, Browman, & Goldstein (1987), who make a similar point in arguing against a purely suppletive model on psycholinguistic grounds.

purview of the grammar and appropriately defining the mechanisms governing it (e.g., assuming that templates are defined only in terms of prosodic structure, as in McCarthy & Prince (1986)). However, nothing in principle prevents speakers from forming a WFS reflecting such an alternation, and indeed we can well imagine a historical scenario that could produce one. Suppose, for example, that a language starts out marking the plural using initial reduplication in which the reduplicant is maximally one syllable: [pa.ta.ki]~[pat-pa.ta.ki], [a.ka.ti]~[ak-a.ka.ti]. Suppose further that words with onsets, like /pataki/, are far more frequent than those without, like /akati/. Since WFSs are the result of pattern-matching by the learner, we can easily imagine that learners could overgeneralize from the more frequent [pat-pa.ta.ki] pattern to pluralize [a.ka.ti] as [aka-a.ka.ti]. That is, having encountered the more frequent forms, the learner posits a WFS expressing the generalization 'copy the first three segments' (since this accurately describes what happens in words like [pataki]) and then applies it to forms without an initial onset, resulting in a general pattern of segment-counting reduplication.

Unless a convincing argument can be found that neither this nor any other set of historical contingencies could give rise to learners positing such a WFS, then the response of a model locating morpho-phonology outside of the phonological grammar would have to be to conclude that the non-existence of segment-counting reduplication is just not an interesting fact; linguistic theory would not be concerned with accounting for it.

Beyond its clear overgenerating potential, a word-based morphological theory runs into serious problems due to its denial of the existence of roots, affixes, etc., as real grammatical objects. How would one, for instance, account for the fact that many languages subject affixes to stricter markedness requirements than roots (the motivation for McCarthy & Prince (1995)'s fixed ranking $\text{F}\textsc{aith}_{\text{Root}}$ >> $\text{F}\textsc{aith}_{\text{Affix}}$)? In Navajo, for example (Alderete 2003), labials are permitted in roots but forbidden in affixes. Since WFSs are outside of the phonological grammar, there is no clear reason why otherwise-licit segments cannot be mentioned by them. Likewise, certain markedness restrictions appear to be root-bound, for instance the root-domain OCP in Semitic (Greenberg 1950, McCarthy 1979).

More challenging still, what about cases where an affix relocates from its default location- infixing or even switching between prefix- and suffix-hood (e.g., Noyer 1993), under the compulsion of markedness constraints? (That such things happen was discussed earlier in §9 with respect to Chaha labialization.) The classic example in OT is Prince & Smolensky's (2004) analysis of *-um-* infixation in Tagalog. To simplify the facts somewhat, the actor-focus morpheme /um/ is infixed after the initial onset of a verb, which Prince & Smolensky attribute to the fact that NoCoda dominates an Align-L constraint. Now, a WFS could of course be formulated to express the generalization 'the actor-focus form is identical to the basic form, but has [um] added after the first onset', but this obscures the fact that infixation is motivated by markedness. For example, we do not expect find languages that infix, say, /-mu-/ after the first onset of the root, since this violates Align-L without (in general) achieving any gain in markedness. However, such an infixation pattern could be modeled using a WFS formally identical to the one that would be required for Tagalog.

To return to the Celtic facts, it is not even clear that adopting the Suppletive Model would make it possible to eliminate floating-feature-induced mutation. The problem concerns Lenition of /f^j/ (the palatalized labiodental fricative) in Irish. Plain /f/ deletes in Lenition contexts (a fact whose apparent problems for an autosegmental theory will be taken up later in this section), but according to Ó Siadhail (1989: 113), when /f^j/ deletes, it leaves behind a palatal offglide that docks to a preceding consonant: /ən f^{j}oːl^j/ → [ən^j oːl^j], *an fheoil* 'the meat'. Within the Suppletive Model, this would have to be analyzed by assuming that the Lenition-grade allomorphs of words with initial /f^j/ in the radical contained a floating [-back] that docked onto the preceding consonant, thus granting the possibility of mutation through autosegmental processes.

The foregoing discussion makes it clear that there are significant empirical and conceptual costs to placing morpho-phonological processes outside of the phonological grammar. Now to consider the inverse question: are there disadvantages to placing them within it? Green (2005: 142) argues that '[t]o allow the phonology to be powerful enough to account for the quirkiest phoneme alternations is to weaken phonological theory to the point of being unfalsifiable.' Why this should of necessity be true is unclear. Since phonological theories, like theories in any other science, seek to avoid over-generation as well as under-generation, a phonological theory that handled all attested morpho-phonological processes would also, in order to be considered fully satisfactory, have to exclude all unattested phonological processes, morphologically-conditioned or not. It surely begs the question of whether or not morpho-phonology takes place within the phonological grammar to reason that no phonological theory could in principle give a fully restrictive account of both purely phonological and morphologically-conditioned alternations.[52]

Now we turn to considering the arguments offered by Green (2005) to motivate the Suppletive Model. First is the fact that mutation occasionally seems to be triggered other than by an immediately-preceding morpheme: for instance, by a non-adjacent morpheme or directly by the syntax rather than by any lexicalized trigger. Second, the reverse also occurs: mutation is sometimes blocked by morphosyntactic conditions. For instance, in Irish, the words for the numerals three through six cause Lenition of a following singular noun, but not a following plural noun.

Before turning to specific examples, we should be clear about what Green (2005) affirmatively proposes to be responsible for selecting the mutation allomorph. He suggests that selection of mutation grade operates in a manner analogical to Case assignment: mutation-triggering morphemes are marked with diacritic features, e.g.

[52] It is also worth noting that the 'purely phonological' phenomena of natural languages (stress, segmental inventories, etc.) are also highly intricate and diverse. To take the stance that a restrictive theory of these facts is in principle possible, but that one covering morpho-phonological phenomena as well is not, seems arbitrary.

[+Lenition]. Other morphemes in mutation-undergoing positions are required to agree with this via a constraint MUTAGREE, which compels selection of an allomorph bearing a matching diacritic. Mutation-triggering can therefore be non-local, again by analogy with Case-checking and other syntactic feature-matching phenomena which can be non-local.

A better move for cases of non-local triggering might be to suppose that the trigger and the target must agree in some (non-diacritic) morphological feature(s), with that agreement being marked on the target by an affix consisting of the floating autosegments responsible for the mutation. Space prevents a detailed re-analysis of all of the examples in Green (2005), but two examples concerning possessive pronouns will serve to illustrate the point.

In Irish, a possessive pronoun lenites a following noun, even if an English expletive intervenes between them: *Cá bhfuil mo fuckin' sheaicéad*, 'Where's my fuckin' jacket?' (Green 2005: 103, citing Stenson 1990a: 171); orthographic *sh* indicates lenition of radical /s/ to [h]. We can analyze this case by assuming that there is some sort of morphosyntactic agreement between the possessive pronoun and the possessed noun, and that, on the noun, the relevant morphosyntactic feature is spelled out as an prefix consisting of the floating features [+cont, -cor].[53] If any objections are raised to the syntactic plausibility of such an account, they crucially cannot decide between such a proposal and the Suppletive Model, since the latter also requires a feature-agreement relation between the possessive pronoun and the possessed noun, but with respect to a diacritic feature [Lenition]. An approach like the one suggested here would, thus, be equal to the Suppletive Model in the feature-agreement demands that it imposes on the morphosyntax, while keeping the phonological alternations seen in mutation within the phonological grammar.

A related but more complicated example concerns the interaction of possessive pronouns with the numeral *dhá* 'two.' Normally *dhá* triggers Lenition of a following noun, but if the noun is possessed, and the possessive pronoun selects for Eclipsis (or no mutation) of the noun, the selectional requirements of the pronoun win out:

(104) (from Green's (2005): (48), pp. 102-103)

a. *dhá* alone triggers Lenition:

dhá [h]*uil*	'two eyes'	*dhá* [h]*each*	'two houses'

b. *a* 'her' alone triggers no mutation; *bhur* 'your.PL' alone triggers eclipsis:

a [s]*úil*	'her eye'	*bhur* [d]*each* (radical [t]*each*)	'your.PL house'

c. *a dhá* and *a bhur* show same mutation (or lack of mutation) as *a/bhur* alone:

a dhá [s]*úil*	'her two eyes'	*bhur dhá* [d]*each*	'your.PL two houses'

[53] In Irish Lenition, stops and /m/ spirantize. Coronals become noncoronal: /t, s/ become [h] and /d/ becomes [γ]; /f/ deletes. See Ó Siadhail (1989) and Ní Chiosáin (1991) for more detailed discussion.

Green (2005) argues that if *dhá* is viewed as having floating features at its right edge, these facts are unexpected. We can, however, capture them in an autosegmental model if the mutation is not triggered by *dhá* or the possessive pronouns *per se*, with their floating features docking in external sandhi onto the initial segment of a following morpheme, but rather is the result of pressure for the noun to agree with both the possessive pronoun and the numeral in some pair of morphological features.

Merely for illustrative purposes, let's call one of these features [two] (the one for which the noun must agree with *dhá*) and the other [poss] (the one for which the noun must agree with the possessive pronoun). Now, to account for the interaction of *a* and *dhá*, imagine that we have the following affixes that the noun can take:

(105)

phonological content	*morphological features*
[+cont, -cor] *(i.e., Lenition)*	[+two, -poss]
∅	[+poss]

Under the assumption that, when there is competition between affixes, the one matching the greatest number of morphological features (without any mismatches) must be chosen (in Distributed Morphology, this is the Subset Principle of Halle (1997)), we then predict that unpossessed nouns that are complements of the numeral *dhá* will take the first affix; otherwise, as when the noun is possessed (and hence '[+poss]' in the naïve terms of our example), the second, phonologically null affix will be chosen, and hence no mutation occurs.

Obviously, a full account of all of the non-local mutation facts from the six Celtic languages will have to be considerably more sophisticated than what has just been sketched. However, it should be clear that non-local triggering of mutation is not *prima facie* incompatible with a theory that attributes the phonological changes that take place in mutation to the docking of floating autosegments.

A final difficulty to note concerning the MUTAGREE approach. Green (2005: §3.3.3.2) argues, following a number of sources cited therein, that Soft Mutation in Welsh is triggered on any word following a c-commanding XP. If this analysis proves correct, it is not obviously compatible with an autosegmental view of mutation, as Green argues. But it is not any clearer that MUTAGREE can accommodate these facts: if mutation is triggered on some word solely by its place in the syntactic tree, and not by any kind of lexicalized trigger, then what exactly is the source of the [+Soft Mutation] diacritic that the mutated word is pressured to agree with?[54]

[54] This said, we may also note that some alternatives to direct syntactic triggering have been proposed for these facts. Hannahs (1996; see also Kibre 1997: §8.3 for discussion) proposes that this mutation happens at the juncture of two prosodic phrases. The floating features that trigger mutation could, on such an account, be viewed as being inserted to satisfy constraints demanding the demarcation of prosodic constituents (Baker 1999). Kibre (1997) himself proposes that mutation occurs in these cases as a marker of non-topichood; the floating features might then be considered as exponents of a non-topic prefix.

Let's now turn to the more strictly phonological arguments that Green (2005) levies against an autosegmental account. Green notes that certain words idiosyncratically resist mutation, for instance personal names (in Welsh) and loanwords. This is hardly an argument against the mutations being a phonological process, since exceptions are well-attested in numerous clearly phonological domains[55]. Loanwords as well are known in many languages to resist full nativization, failing to undergo processes that would reliably occur in native vocabulary[56]. Green (2005: 117) argues that the loanword facts 'are… additional evidence against the mutations being phonological processes at all', but this is by no means the case: they are entirely indecisive in deciding between a suppletive account and one with phonological processes, since the resistance of loanwords to mutation can be easily explained in either theory (loanwords lack mutated allomorphs, or they are protected from the phonological process of mutation, however exactly it is triggered, by high-ranked faithfulness.)

Another argument concerns 'quirky' mutations of the sort that were considered in §5. Green's argument is that, given the non-uniformity of the featural changes in such cases, they cannot be attributed to floating autosegments. As we saw, however, listed allomorphy and vacuous docking gives us a means to analyze cases of this sort.

A final point of a phonological nature noted by Green (2005) is that an autosegmental theory cannot in any obvious way account for instances in which the Celtic mutations result in deletion of an initial segment, for instance of /f/ in Irish and Manx or /g/ in Welsh. It does seem possible, though, that these deletions could be given alternate explanations. For one, both are the second step of chain-shifts (p→f→∅ in Irish and Manx; k→g→∅ in Welsh); it might reasonably be hoped that an account could be given in terms of a more general theory of opacity. Moreover, truncation is attested as a productive morphological processes (see Horwood (2001) for examples and analysis in an anti-faithfulness framework), so an independent theory of these cases might also be expected to subsume the Celtic facts.

10.2 Faithfulness to morphological heads

Revithiadou (1999) argues for the following fixed ranking:

(106)
HEADFAITH >> OO-FAITH

That is, faithfulness to morphological heads (roots in inflectional morphology; derivational affixes in derivational morphology) are entitled to greatest faithfulness protection in computing the surface realization of a polymorphemic form. This proposal – presented to account for apparent exceptions to McCarthy & Prince's (1995) $\text{FAITH}_{\text{Root}}$ >>$\text{FAITH}_{\text{Affix}}$ metaconstraint – has been put to two uses in the literature. First, Revithiadou

[55] See, among many others, Inkelas, Orgun & Zoll (1997), Itô & Mester (1999), Pater (2000), and Anttila (2002) on phonological exceptions and various approaches to handling them in OT.

[56] Relevant references include Davidson & Noyer (1997) and Itô & Mester (1999).

herself uses it to account for cases where derivational affixes are dominant in accent systems. Second, Ussishkin (2000a,b) appeals to (106) in his analysis of Semitic root-and-pattern morphology.

In this paper, I have been pursuing the proposal that affixal features, tones, and moras can win out over faithfulness to roots if they are underlyingly floating, and hence eligible for the extra faithfulness protection afforded by MAXFLT. However, as we've seen, faithfulness to floating elements is equal-opportunity: root morphemes can mutate affixes, or indeed each other, if they contain floating autosegments in the input, and in Chukchee and the Celtic languages just this happens. Also, floating autosegments affiliated with inflectional affixes (in Chaha, Aka, DhoLuo, Dinka, Inor, Lena Bable Spanish, and many other languages) are able to mutate roots, something which (106) does not capture. A much more satisfactory generalization seems to be: any morpheme is in principle capable of being dominant in autosegmental-docking processes, and the thing that makes it so is its possession of floating elements in its UR, coupled with sufficiently high-ranking MAXFLT.

It would be beyond the scope of this paper to recast all of Revithiadou's examples in terms of the theory I am pursuing here, but the approach to suffix-dominance in languages like Tokyo Japanese sketched in the last section looks like a start. As for Ussishkin's extension of the proposal, it does not seem unlikely that faithfulness to floating root nodes, as applied to length exchanges in §8, could be relevant.

10.3 Optimal Domains

Although its motivating concern is harmony processes, Optimal Domains theory (Cole & Kisseberth 1994, 1995, Cassimjee & Kisserberth 1997, 1998, Cassimjee 1998) has also been suggested by its proponents as a possible tool for eliminating floating autosegments from underlying representations.

Cole & Kisseberth's (1994) argument is made with respect to the first-person singular nasalization in Terena (Bendor-Samuel 1960), some data from which was given in (102). Optimal Domains attributes feature spreading to the action of gradient "wide-scope" alignment constraints, which call for an edge of some feature domain to be aligned with the edges of prosodic or morphological constituents. In the case of morphological, non-automatic spreading such as is seen in Terena, Cole & Kisseberth (1994b) invoke morpheme-specific versions of these constraints:

(107) (=Cole & Kisseberth's (1994) (10))
a. Wide Scope Alignment-left: Align(1sg, L; N-domain, L)
b. Wide Scope Alignment-right: Align(1sg, R, N-domain, R)

Because the presence of nasal domains in 1st person singular forms are directly called for by these constraints, there is no need to assume the existence of floating tokens of [+nasal] in the input. One can well imagine that all cases of featural insertion could be handled this way, with morpheme-specific constraints demanding the existence of the relevant feature within some specified interval of the relevant form, possibly only a single segment in length.

However, there are serious difficulties with this proposal. First of all, Optimal Domains, at least in its original version, requires gradient alignment to drive spreading, and, as McCarthy (2003) argues, the admission of gradient constraints into OT is both undesirable and unnecessary. Another empirical problem related to the Terena data is that Wide-Scope Alignment can make nasal spreading not triggered by a sonorant stop go through that segment, as in [emoʔu] 'his word', [ẽmõʔũ] 'my word'. The problem is that the morpheme-specific wide-scope alignment constrains in (107) are formally no different from the alignment constraints that Optimal Domains uses to drive ordinary, non-morphologically conditioned spreading. This predicts the existence of languages in which sonorant stops do not trigger nasal harmony, but some other class of nasal segments do, and that such nasal spread should pass through sonorant stops. I am unaware of any language where this happens, and there is at least one language, Inor (Hetzron & Marcos 1965, Chamora & Hetzron 2000) where sonorant stops block nasal spreading triggered by nasal continuants. On the other hand, if we assume, as described in §9, that the Terena 1st.sg. morpheme has the UR /[+nasal]/, we can use morpheme-specific MCat/PCat alignment constraints to force the morpheme – and thus the [+nasal] feature, that being the morpheme's only exponent – to extend over a domain that possibly straddles a sonorant stop, and thus induce morphological 'spreading' via a mechanism that is not available for driving ordinary, phonologically-conditioned spreading.

The argument just made relies on the assumption that there are no alignment constraints demanding the alignment of feature-tokens with prosodic edges; see McCarthy (2004) on the incorrect typological predictions of such constraints.

10.4 Morpheme-Specific LAZY

A final possibility that has been advanced in the literature comes from Kirchner (1998). Kirchner seeks to provide a unified account of lenition, and so morphological lenition like that seen in the Celtic mutations would be attributed to morpheme-specific versions of the family of LAZY constraints that he proposes. These constraints drive lenition by penalizing configurations that involve levels of articulatory effort above a certain threshold.

For a critique of the general LAZY proposal, the reader is referred to McCarthy (2002: 222-225). Here, however, we will concern ourselves just with the adequacy of LAZY as a tool for analyzing morphological lenition. A first problem is that not all mutations have uniform effects in terms of increasing or decreasing articulatory effort. The Breton mixed mutation, for instance, lenites non-coronals (via spirantization) but fortites coronals (via devoicing). Worse, what would the LAZY proposal make of cases like the Dinka benefactive marker, with its combination of featural, tonal, and length changes? A floating-autosegment approach allows a straightforward account of such mutations, but it is far from obvious that a model based on restricting articulatory effort (or increasing perceptual salience) could. Second, there is no clear reason why neighbors in external sandhi should be able to impose special markedness conditions (i.e., morpheme-specific instantiations of LAZY) on each other. Affixes, as has come up repeatedly, can raise markedness standards in their morphological contexts via the action of MPARSE, but this is not available for mutations that arise in sandhi rather than through affixation, and MPARSE is in any case incapable of triggering repairs (see fn. 29).

11 Conclusion

If we grant the basic tenet of autosegmental phonology—that tones, features, and weight/length units (moras) are themselves representational objects and not simply attributes of other objects—then any reasonable construal of Richness of the Base will permit the existence of inputs where such objects are not associated to any bearing unit, and this invites the use of such inputs to account for mutation processes, as the autosegmental tradition has long assumed.

This paper has sought to demonstrate that a model of mutation based on floating autosegments offers the best available means of accounting for these processes. With relatively simple assumptions about the relevant constraints, it is quite straightforward for an autosegmental theory to produce multi-featural mutations (as in Nuer), feature polarity (as in DhoLuo), mutation in external sandhi (as in Celtic), affix-mutating roots (as in Chukchee), affixes mutating each other (as in Chaha), 'quirky' mutations (as in Breton), and non-automatic spreading of affixed features (as in Terena). All of these are problematic for at least some competing proposals. Moreover, a representational approach makes possible a coherent account of the localization of mutation processes, something which eludes both MORPHREAL and anti-faithfulness.

Before concluding, I should note that the present proposal does not (at least immediately) subsume all apparently nonconcatenative morphological processes, truncation (Horwood 2001) being a notable exception. For the time being, at least, some version of MORPHREAL or anti-faithfulness will have to be called upon to explain such phenomena. However, as this paper has sought to show, the elimination of floating autosegments from phonological theory cannot be used to motivate either of them.

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Department of Linguistics
University of Massachusetts Amherst
South College, Room 226
Amherst, MA 01003

mwolf@linguist.umass.edu