Underlyingly Nonmoraic Coda Consonants, Faithfulness, and Sympathy[1]

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As currently formulated, the faithfulness constraints DEPμ and DEPLINKμ can debar underlyingly nonmoraic consonants from the rhyme by blocking weight by position or adjunction to a mora. This generates a range of unattested phonological phenomena, including lexical syllabification contrasts such as *ak.la* / *a.kla*. Therefore, DEPμ and DEPLINKμ must not penalize positional μ-licensing, defined as a relationship obtaining between a nonsyllabic segment α and a mora μ when α is underlyingly nonmoraic and μ is α's only licenser. The finding that positional μ-licensing does not violate faithfulness contradicts McCarthy's hypothesis that opaque outputs copy the unfaithful mappings of sympathetic cocandidates.

Keywords: mora, coda, syllabification, Optimality Theory, faithfulness, opacity

In recent years a great deal of attention has been devoted to the implementation of Mora Theory in an optimality-theoretic framework (e.g. Sherer 1994, Zec 1995b, Sprouse 1996, Broselow, Chen, and Huffman 1997, Lin 1997, Morén 1999, Rosenthall and van der Hulst 1999). Nonetheless, constraints on moraic structure are still surrounded by considerable uncertainty. Notably, McCarthy (to appear: sec. 6) has raised the question whether constraints demanding faithfulness to the moraic specifications of the input can

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generate unattested syllabification contrasts in tautomorphemic domains. Addressing one aspect of this problem, McCarthy shows that, given certain unproblematic assumptions about CON, syllabification oppositions involving single intervocalic consonants (e.g. *a.ta* versus *at.a*) need not arise.

This article addresses another aspect of the question: the behavior of faithfulness constraints penalizing the insertion of moras (DEPμ) or segment-mora links (DEPLINKμ). I shall prove that, as currently formulated, these constraints do give rise to illicit syllabification contrasts such as *a.kla* versus *ak.la*. Additionally, DEPμ and DEPLINKμ produce other aberrations: they create conditioned synchronic chain-shifts of the type geminate→singleton→∅, and they erroneously predict that word minimality requirements cannot block final consonant extrasyllabicity. These anomalies arise because, in their standard formulation, DEPμ and DEPLINKμ penalize weight by position, whilst DEPLINKμ also militates against the adjunction of weightless codas to a preceding mora. Thus, both constraints can prevent underlyingly nonmoraic consonants from being syllabified as codas. To rectify this situation, I shall define a relationship of *positional μ-licensing* as obtaining between a mora μ and a nonsyllabic segment α when α is nonmoraic in the input and μ is the sole prosodic licenser of α. The problems surrounding DEPμ and DEPLINKμ disappear if both constraints are reformulated so as to tolerate positional μ-licensing.

These results turn out to have severely adverse implications for McCarthy's (1999, to appear) proposal to deal with the problem of opacity in OT by means of the concept of cumulative sympathy. McCarthy claims that opacity is caused by the constraint ❁SYM, which requires the output to preserve the unfaithful mappings of a designated cocandidate (the sympathy candidate). However, phonological phenomena in which weight by position is rendered opaque, including various types of compensatory lengthening, only submit to a ❁SYM-based analysis on the premise that weight by position constitutes an unfaithful mapping. As noted above, however, the assumption that weight by position violates moraic faithfulness proves untenable.

1 Background

Since the appearance of McCarthy and Prince 1995, studies of mora structure in OT have unanimously relied on the templates of Correspondence Theory for the formulation of moraic faithfulness constraints. Thus, constraints against mora insertion and mora deletion are commonly stated as (1a) and (1b), respectively.

(1) a. *DEPμ*

A mora in the output has a correspondent in the input.

b. *MAXμ*

A mora in the input has a correspondent in the output.

Additionally, Correspondence Theory provides another constraint, IDENTμ, which prohibits altering the number of moraic attachments of individual segments. Morén (1999) splits IDENTμ into two separate constraints:

(2) a. *DEPLINKμ*

Let α be a segment in the input; let β be an output correspondent of α.

β is attached to no more moras than α.

b. *MAXLINKμ*

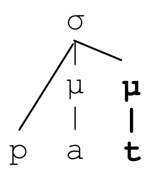
Let α be a segment in the input; let β be an output correspondent of α.

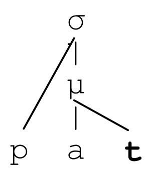
β is attached to no fewer moras than α.

Although the behavior of MAXμ and MAXLINKμ deserves scrutiny, this article will focus on questions concerning DEPμ and DEPLINKμ.

The general consensus regarding moraic faithfulness constraints stands in sharp contrast with persistent disagreements about key representational aspects of Mora Theory. The latter exists in several versions according to the treatment of onset consonants and of codas that do not contribute to weight. For my present purposes these issues can be largely ignored, as the problems surrounding DEPμ and DEPLINKμ affect all optimality-theoretic variants of moraic phonology to some extent. Nonetheless, choices must be made when carrying the argument through to the level of formal detail. Here I will espouse Hayes's first version of Mora Theory (Hayes 1989, Sprouse 1996, Broselow, Chen, and Huffman 1997). In this model, onset consonants are immediately dominated by the σ node (cf. Hyman 1985, Lin 1997). Weightless coda consonants are attached to a mora headed by a preceding segment;[2] rhymal segments are thus exhaustively parsed into moras (cf. McCarthy and Prince 1986, Sherer 1994, Zec 1995a,b, Morén 1999, Rosenthall and van der Hulst 1999):

(3) a. *weight-contributing coda* b. *weightless coda*





[2] Since rhyme structure is typically micro-trochaic (Prince 1990:377), a syllable will normally be headed by its leftmost mora (see also Zec 1995b:91), and a mora will be headed by the leftmost segment it dominates.

Whether or not coda consonants are weight-contributing depends on the relative ranking of the constraints *μ/C (Broselow, Chen, and Huffman 1997:65) and *BRANCHμ (Walker 1994:103, Sprouse 1996:398, 406, Broselow, Chen, and Huffman 1997:65):

(4) a. **μ/C*

A mora must not be headed by a consonant.[3]

b. **BRANCHμ*

A mora must dominate a single root-node.

This version of Mora Theory enjoys several advantages. First, the contrast between onset and rhyme segments is encoded representationally as a distinction between segments dominated by σ and segments dominated by μ (Hayes 1989:A1). Secondly, Broselow, Chen, and Huffman (1997) have shown that vowels are phonetically shortened when they precede a weightless coda; this fact follows directly from the representation of weightless codas as mora-sharing, on the assumption that moras function as timing units in the phonetic interpretation module. Finally, the assumption of mora-sharing makes it easy to capture the behavior of geminate consonants that fail to contribute to syllable weight (Sprouse 1996, Broselow, Chen, and Huffman 1997:sec. 5.2); see tableau 1.

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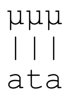
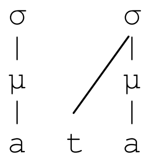
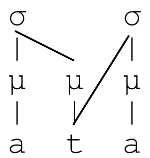
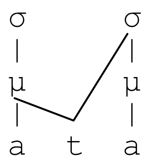
3 The ability to head a mora may be restricted to highly sonorous consonants (Zec 1988, 1995a). *μ/C is therefore to be interpreted as encompassing a set of sonority-sensitive constraints arranged in a fixed harmonic ordering (Sherer 1994:sec. 2.6.2.2).

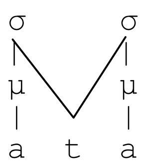
Tableau 1

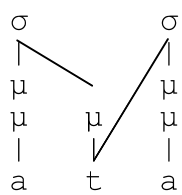
Derivation of weightless geminates in a mora-sharing model

	MAXLINKμ	*μ/C	MAXμ	*BRANCHμ
a. 	*!		*	
b. 		*!		
c. ☞ 			*	*

In a moraic model where weightless codas are attached to the σ node, in contrast, one would expect weightless geminates to be represented as in (5a), but there is no clear way of deriving such a structure from an input containing a moraic consonant. As Davis (1999:57) suggests, the only solution may be to appeal to different moraic projections, such as have been proposed to deal with failures of moraic consistency (see e.g. Hayes 1995:sec. 7.3). A weightless geminate would then be moraic only in the lowest projection, as shown in (5b).

(5) *Weightless geminates in moraic models without mora-sharing*

a. 

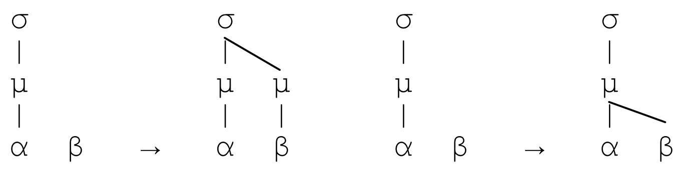
b. 

2 Anomalous implications of DEPμ and DEPLINKμ

2.1 Positional μ-licensing

In a rule-based framework, underlyingly nonmoraic consonants are syllabified in the rhyme through the operation of two rules: Weight by Position, which creates weight-contributing codas, and Adjunction, which generates weightless codas:

(6) a. *Weight by Position* b. *Adjunction*



Segments subject to these two rules form an interesting class. They become attached to a mora by virtue of their position in the string, rather than by lexical stipulation. Accordingly, they may be described as subject to *positional μ-licensing*. In OT, positionally μ-licensed segments can be identified as follows:

(7) *Positional μ-licensing*

A nonsyllabic segment α is positionally μ-licensed by a mora μ if, and only if,

(a) α does not have an input correspondent linked to a mora,

and (b) α is immediately dominated only by μ.

Positionally μ-licensed segments pose an interesting challenge to Correspondence Theory. In the standard approach to moraic faithfulness outlined above, such segments violate DEPLINKμ. If, in addition, they head a mora (i.e. in cases of weight by position), then they also violate DEPμ. This has counterintuitive implications:

syllabifying an underlyingly nonmoraic consonant in the rhyme appears to incur the same faithfulness penalties as lengthening a segment. In other words, DEPμ and DEPLINKμ fail to distinguish between basic syllabification and the neutralization of length contrasts. It therefore seems necessary to reformulate both constraints so that they will not penalize positionally μ-licensed segments. This intuition is confirmed by the fact that, as stated in (1a) and (2a), DEPμ and DEPLINKμ make a number of bizarre predictions.

2.2 *a.kla* versus *ak.la*

Consider a language in which coda consonants must contribute to syllable weight: that is, *BRANCHμ dominates *μ/C. Additionally, let *[$_σ$CC dominate CONTACT, so that intervocalic biconsonantal clusters are preferably heterosyllabic regardless of their sonority contour.

(8) a. **[$_σ$CC* (see e.g. Prince and Smolensky 1993:87)
The onset comprises no more than one segment.
b. *CONTACT* (Clements 1990, 1992, Vennemann 1988:40, Bat-El 1996: 304)
Given a syllable contact α.β, α must be more sonorous than β.

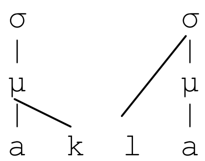
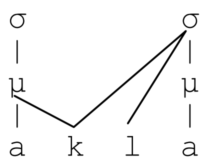
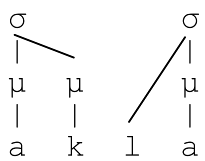
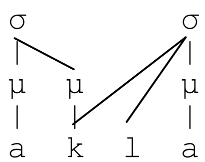
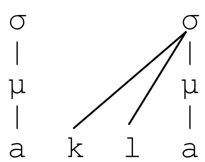
Finally, suppose that DEPμ and *BRANCHμ dominate *[$_σ$CC, yielding the following partial ranking:

(9) {DEPμ, *BRANCHμ} » *[$_σ$CC » {CONTACT, *μ/C}

Consider now two potential inputs /a^{μ}kla^μ/ and /a^{μ}k^{μ}la^μ/, opposed solely by the contrast between /k/ and /k^μ/. In an unwelcome result, hierarchy (9) transforms this moraic opposition into a syllabification contrast between output [a$^{\mu}$.kla$^{\mu}$] and [a$^{\mu}$k$^{\mu}$.la$^{\mu}$].[4] As shown in tableau 2, input /a$^{\mu}$k$^{\mu}$la$^{\mu}$/ does not require mora insertion to satisfy both *BRANCHμ and *[$_{\sigma}$CC, but the latter prevents underlying /k$^{\mu}$/ from attaching to the onset of the second syllable.

Tableau 2

/a$^{\mu}$k$^{\mu}$la$^{\mu}$/ → [a$^{\mu}$k$^{\mu}$.la$^{\mu}$]

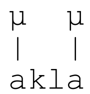
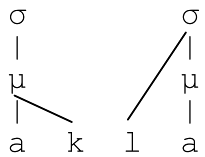
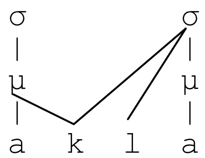
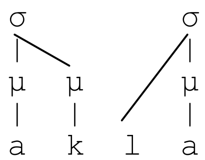
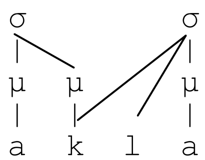
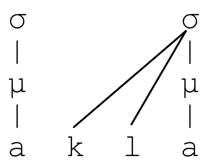
μμ μ || | akla	DEPμ	*BRANCHμ	*[$_{\sigma}$CC	CONTACT	*μ/C
a. 		*!		*	
b. 		*!	*		
c. ☞ 				*	*
d. 			*!		*
e. 			*!		

4 I use a superscript $^{\mu}$ to indicate that the immediately preceding segment heads a mora.

In the case of /a$^{\mu}$kla$^{\mu}$/, however, top-ranked DEPμ blocks weight by position, and nonmoraic /k/ is pushed into the onset of the second syllable to avoid a weightless coda; see tableau 3.

Tableau 3

/a$^{\mu}$kla$^{\mu}$/ → [a$^{\mu}$.kla$^{\mu}$]

	DEPμ	*BRANCHμ	*[$_{\sigma}$CC	CONTACT	*μ/C
a. 		*!		*	
b. 		*!	*		
c. 	*!			*	*
d. 	*!		*		*
e. ☞ 			*		

Syllabification contrasts such as *a.kla* versus *ak.la* are not attested (Hayes 1989:260). Hierarchy (9) must therefore contain one or more inadequately formulated constraints. Clearly, the culprit is DEPμ, under whose influence access to the coda is restricted to lexically moraic consonants. However, if DEPμ were reformulated so as not to penalize positional μ-licensing, input /a$^{\mu}$kla$^{\mu}$/ would be mapped onto output [a$^{\mu}$k$^{\mu}$.la$^{\mu}$], and the problematic syllabification contrast would disappear.

2.3 Geminate → Singleton → ∅

DEPμ and DEPLINKμ also predict the existence of strange synchronic chain-shifts whereby geminates surface as short coda consonants, and singletons delete, in environments where an onset slot is unavailable. To establish this point, consider a grammar where top-ranked markedness constraints rule out the onset cluster *kt-*. Assume, moreover, that in such a grammar the following ranking obtains:

(10) {DEPμ, *BRANCHμ} » MAXseg » *μ/C

Since *BRANCHμ outranks *μ/C, coda consonants are required to be weight-contributing. Consonants linked to their own mora in the input representation meet this condition without difficulty. In the case of input /a$^{\mu}$k$^{\mu}$ta$^{\mu}$/, for example, underlying /k$^{\mu}$/ is unproblematically syllabified in the coda of the first syllable and, being excluded from the onset of the second, surfaces as a singleton. Underlyingly nonmoraic consonants, however, are debarred from the rhyme, as top-ranked DEPμ blocks weight by position. With MAXseg low in the hierarchy, such consonants will undergo deletion if they cannot lodge in a syllable onset. As tableau 4 shows, this is the fate of nonmoraic /k/ in /a$^{\mu}$kta$^{\mu}$/.

Tableau 4

$/a^{\mu}kta^{\mu}/ \rightarrow [a^{\mu}.ta^{\mu}]$

$/a^{\mu}k^{\mu}ta^{\mu}/ \rightarrow [a^{\mu}k^{\mu}.ta^{\mu}]$

<table>
<tr><th>input</th><th>candidates</th><th>Depμ</th><th>*Branchμ</th><th>Maxseg</th><th>*μ/C</th></tr>
<tr><td rowspan="3"><pre>
μ μ
| |
akta
</pre></td><td><pre>
a.   σ   σ
     | /|
☞   μ   / μ
     | / |
     a t a
</pre></td><td></td><td></td><td>*</td><td></td></tr>
<tr><td><pre>
b.   σ   σ
     | /|
     μ   / μ
     |\   / |
     a k t   a
</pre></td><td></td><td>*!</td><td></td><td></td></tr>
<tr><td><pre>
c.   σ   σ
     |\   /|
     μ μ   / μ
     | | / |
     a k t   a
</pre></td><td>*!</td><td></td><td></td><td>*</td></tr>
<tr><td rowspan="3"><pre>
μμ μ
|| |
akta
</pre></td><td><pre>
d.   σ   σ
     | /|
     μ   / μ
     | / |
     a t a
</pre></td><td></td><td></td><td>*!</td><td></td></tr>
<tr><td><pre>
e.   σ   σ
     | /|
     μ   / μ
     |\   / |
     a k t   a
</pre></td><td></td><td>*!</td><td></td><td></td></tr>
<tr><td><pre>
f.   σ   σ
     |\   /|
☞   μ μ   / μ
     | | / |
     a k t   a
</pre></td><td></td><td></td><td></td><td>*</td></tr>
</table>

If, in addition to (10), Maxμ dominates *μ/C, intervocalic $/k^{\mu}/$ will surface as a geminate, whilst /k/ will surface as a short onset consonant. The result, therefore, is a synchronic chain-shift where, before *t*, long *k* shortens and short *k* deletes:

```
(11) a.   µ µ               µ   µ
          | |               |   |
        /aka/ → [a.ka]    /akta/ → [a.ta]

     b.   µµµ               µµ µ
          |||               || |
        /aka/ → [ak.ka]   /akta/ → [ak.ta]
```

I know of no actual instance of such a chain-shift. McCarthy (to appear) acknowledges in a footnote that the behavior illustrated in tableau 4 is odd, but he suggests that empirical applications are conceivable. Under the hierarchy in (10), input moraicity can be used to encode a contrast between fixed and latent segments, where the latter only surface in prevocalic position; a well-known case is that of final consonants in French (see e.g. Tranel 1995). Moreover, ranking (10) can describe a language with lexical exceptions to an otherwise general coda prohibition; the exceptional codas will be prespecified as moraic in the lexicon (see Inkelas and Cho 1993:554-556). However, although at first blush these applications are theoretically attractive, their appeal is lost when (10) is combined with the ranking MAXµ » *µ/C: bizarrely, this predicts that fixed (as opposed to latent) segments and exceptional coda consonants will lengthen in prevocalic environments.[5]

Note, again, that DEPµ is responsible for generating the anomalous chain-shift in (11) by blocking weight by position. If positional µ-licensing were not penalized, the results would be commonplace, with input /a$^{\mu}$kta$^{\mu}$/ mapped onto output [a$^{\mu}$k$^{\mu}$.ta$^{\mu}$].

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[5] There is an alternative approach to the fixed/latent contrast that does not incur this difficulty. Latent segments can be represented in the lexicon as bundles of features lacking a root-node. Under the ranking ONSET » DEProot-node » MAXfeature, such anchorless feature bundles will only surface in prevocalic position.

2.4 Final Consonant Extrasyllabicity

It is a well-known fact that minimal size requirements can cause extraprosodicity constraints to be violated (see Hayes 1995:110-113); this is true both of syllable extrametricality and of consonant extrasyllabicity. A good example of the cancellation of final consonant extrasyllabicity can be found in Turkish (Inkelas and Orgun 1995:sec. 5.2). In this language, stem-final plosives are usually voiced before a vowel-initial suffix and voiceless elsewhere. In contrast with exceptional nonalternating plosives, the alternating segments are underlyingly unspecified for voice; they receive [+voice] by default in the onset and [-voice] in the coda. However, this alternation only arises when the stem-final consonant is extrasyllabic prior to suffixation; if in the first cycle the plosive is syllabified as a coda, it undergoes default devoicing, which preempts voicing before vowel-initial suffixes. In CVC stems, final consonant extrasyllabicity is crucially blocked by a bimoraic minimality condition. In consequence, CVC stems never possess alternating final plosives.

Despite such empirical evidence, the standard formulation of DEPμ and DEPLINKμ predicts that a top-ranked minimality constraint cannot force a word-final consonant to violate extrasyllabicity by undergoing weight by position. Recall that DEPμ and DEPLINKμ fail to distinguish between weight by position and segmental lengthening. In this light, consider the treatment of a /$CV^{\mu}C$/ input under the following hierarchy:

(12) FTBIN » {WEAKEDGE, DEPμ}

Here, top-ranked FTBIN (Prince and Smolensky 1993:47) imposes minimal bimoraicity; this takes precedence over WEAKEDGE, which demands final consonant extrasyllabicity (Spaelti 1994), and over DEPμ. The results are shown in tableau 5: among the parses fulfilling the minimal size requirement, candidate (a), with vowel lengthening and extrasyllabicity, always wins over candidate (b), with weight by position, as the constraint violations of the former are a subset of those of the latter.

Tableau 5

Word minimality fails to cancel consonant extrasyllabicity

μ | CVC	FTBIN	WEAKEDGE	DEPμ
a. ☞ μ μ [ω[σ CV] C]			*
b. μμ | | [ω[σ CVC]]		*!	*
c. μ | [ω[σ CV] C]	*!		.
d. μ [ω[σ CVC]]	*!	*	

Thus, current formulations of DEPμ and DEPLINKμ cannot accommodate systems like Turkish, where $/CV^{\mu}C/$ inputs fulfil word minimality by suspending final consonant extrasyllabicity, rather than by lengthening the vowel. One might be tempted to solve this problem by appealing to a markedness constraint against long vowels: *LONGV;[6] lengthening could be prevented (and weight by position concomitantly enforced) by ranking *LONGV above WEAKEDGE. However, Middle English provides empirical evidence against this proposal:

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6 For an argument that such a constraint is unnecessary, see Morén (1999:sec. 5.1.2).

(13) *Middle English prosodification* (Bermúdez-Otero 1998, 1999:ch. 4)

a. *vat* /$va^{\mu}t$/ → [$_{\omega}$[$_{\sigma}$ $va^{\mu}t^{\mu}$]] 'vat'

b. *līf* /$li^{\mu\mu}f$/ → [$_{\omega}$[$_{\sigma}$ $li^{\mu\mu}$] f] 'life'

c. *tale* /$ta^{\mu}l\partial^{\mu}$/ → [$_{\omega}$[$_{\sigma}$ $ta^{\mu\mu}$] l] 'tale'

In Middle English lexical words were minimally bimoraic. At the same time, we know that final consonant extrasyllabicity was active because /$CV^{\mu\mu}C$/ words escaped a process of closed syllable shortening; see (13b). In the case of /$CV^{\mu}C$/ inputs, however, extrasyllabicity was suspended, as shown in (13a). One would therefore assume that *LONGV dominated WEAKEDGE. It turns out, however, that his ranking can be put to the test in forms subject to the loss of stem-final schwa, such as *tale* (13c). As tableau 6 indicates, the ranking *LONGV » WEAKEDGE predicts that the mora cast adrift by a deleted schwa should dock onto the preceding consonant: *[$_{\omega}$[$_{\sigma}$ $ta^{\mu}l^{\mu}$]]. But this prediction is incorrect: WEAKEDGE caused the floating mora to skip the preceding consonant and land on the root vowel, yielding output [$_{\omega}$[$_{\sigma}$ $ta^{\mu\mu}$] l]. Hence, *LONGV cannot have outranked WEAKEDGE in Middle English.

Tableau 6

Enforcing weight by position by means of *LONGV makes wrong predictions in Middle English

μ μ | | tal_ə	FTBIN	*LONGV	WEAKEDGE	DEPμ
a. wrong winner — μμ || [ω[σ tal]]			*	
b. wrong loser — μμ |/ [ω[σ ta] l]		*!		
c. — μ | [ω[σ ta] l]	*!			
d. — μ |\\ [ω[σ tal]]	*!		*	

The dilemma posed by the Middle English data disappears if DEPμ is reformulated so as not to block weight by position. Ranked over WEAKEDGE, such a revised version of DEPμ will prevent /CV$^{\mu}$C/ words (e.g. *vat*) from undergoing vowel lengthening, but will at the same time allow FTBIN to enforce weight by position. In items subject to schwa loss (e.g. *tale*), in contrast, final consonant extrasyllabicity will be free to apply: since the vowel lengthens by attracting a floating input mora, DEPμ is not violated.

2.5 DEPμ and DEPLINKμ reformulated

The anomalies diagnosed in the preceding sections stem from the fact that, as stated in (1a) and (2a), DEPμ and DEPLINKμ fail to distinguish between neutralization processes (such as vowel lengthening and glide vocalization) and basic operations of coda formation (namely, weight by position and adjunction). Among other problems, this creates the possibility of lexically specifying whether or not a consonant can be syllabified in the rhyme. To rectify this situation, one must reformulate DEPμ and DEPLINKμ so as to avoid penalizing weight by position and adjunction. This can be effected by reference to the relationship of positional μ-licensing defined in (7). More specifically, the insertion of moras or segment-mora links is to be treated as unfaithful except when it involves a positionally μ-licensed segment:

(14) *Revised formulation of DEPμ and DEPLINKμ*

a. DEPμ

Let μ be a mora in the output.

Either (i) μ has a correspondent in the input,

or (ii) μ is a positional μ-licenser.

b. DEPLINKμ

Let α be a segment in the input; let β be an output correspondent of α.

Either (i) β is attached to no more moras than α,

or (ii) β is positionally μ-licensed.

3 Opacity, Moraic Faithfulness, and Cumulative Sympathy

The finding that neither weight by position nor adjunction violates moraic faithfulness has unexpected repercussions upon the issue of opacity in OT, for it provides a counterexample to McCarthy's (1999, to appear) theory of cumulativity. McCarthy 1998 proposed that opaque phonological phenomena occur when a high-ranking sympathy constraint forces the optimal output to copy properties of a designated suboptimal cocandidate (the *sympathy candidate*). More recently, McCarthy (to appear) has argued that sympathetic correspondence is monitored by ❁SYM. This constraint demands that the output match all the unfaithful mappings of the sympathy candidate ─that is, all those properties in respect of which the sympathy candidate is unfaithful to the input. A parse that meets this requirement is said to be in a relationship of *cumulativity* with the sympathy candidate.[7] The theory of cumulativity is designed to prevent nonvacuous Duke-of-York gambits, in which an element α is mapped onto β, which crucially feeds or bleeds some other process, before changing back to α. McCarthy claims that this feature renders Sympathy Theory more restrictive than serial approaches to opacity such as interleaved OT (see e.g. Orgun 1996, Bermúdez-Otero 1999, Kiparsky forthcoming).

McCarthy's theory of cumulativity flounders upon lengthening phenomena where the output opaquely retains a mora inserted by weight by position at an intermediate stage in the derivation. In such cases, a sympathy-theoretic analysis presupposes that the opaque output copies the moraic content of a sympathetic candidate with transparent weight by position. Recall, however, that ❁SYM assesses sympathetic correspondence in terms of unfaithful mappings. Weight by position must therefore count as an unfaithful mapping if ❁SYM is to transfer moras inserted by weight by position from the sympathy candidate to the output. As the previous section has demonstrated, however, faithfulness constraints cannot penalize weight by position, for otherwise severe typological aberrations occur. I therefore conclude that cumulative sympathy cannot handle lengthening processes where weight by position is rendered opaque.

Hayes (1989) lists four types of compensatory lengthening in which weight by position can become opaque: classical compensatory lengthening (Hayes 1989:sec. 3.2, 5.1.1), total assimilation (Hayes 1989:sec. 5.1.2), double flop (Hayes 1989: sec. 4.1,

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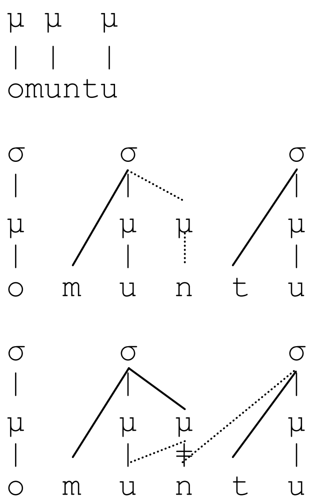
7 Noncumulative output candidates fail ❁SYM absolutely. Additionally, ❁SYM evaluates cumulative competitors gradiently: it favours that cumulative candidate whose unfaithful mappings exceed those of the sympathy candidate by the smallest amount. In an alternative implementation of cumulativity, the absolute and gradient components of ❁SYM are split between two constraints arranged in a fixed universal ranking: ❁CUMUL$_F$ » ❁DIFF$_F$ (McCarthy 1999:353).

5.1.5), and compensatory lengthening by prenasalization (Hayes 1989:sec. 5.1.4; see also Clements 1986, Maddieson 1993, Maddieson and Ladefoged 1993, Hubbard 1995a,b). McCarthy (to appear) discusses an instance of the latter in Luganda:

(15) Luganda /o-mu-ntu/ → [o.muː.ntu] 'person'



a. Underlying representation

b. Syllabification with Weight by Position

c. Prenasalization & Compensatory Lengthening

In the first round of syllabification the nasal consonant is in the rhyme, where it triggers Weight by Position. Subsequently, the nasal shifts into the onset of the following syllable, and the preceding vowel spreads to the vacant mora. In this process, Weight by Position becomes opaque, for neither the nasal nor the lengthened vowel meets its structural description on the surface. Thus, Prenasalization counterbleeds Weight by Position.

In an analysis based on cumulative sympathy, one would assume that ✿SYM forces the opaque winner [o$^{\mu}$.mu$^{\mu\mu}$.ntu$^{\mu}$] to copy the mora inserted by weight by position in the sympathy candidate [o$^{\mu}$.mu$^{\mu}$n$^{\mu}$.tu$^{\mu}$]; this would explain the failure of the transparent loser [o$^{\mu}$.mu$^{\mu}$.ntu$^{\mu}$]. However, ✿SYM can do no such thing, because, as I have demonstrated, weight by position does not constitute an unfaithful mapping. In

$[o^{\mu}.mu^{\mu}n^{\mu}.tu^{\mu}]$ the nasal consonant is positionally μ-licensed, and so the mora it projects satisfies DEPμ; see (14). Thus, the set of unfaithful mappings of the sympathy candidate turns out to be empty, and all other candidates are vacuously cumulative. Indeed, as table 1 shows, ❀SYM incorrectly favours the transparent loser over the opaque winner, for the unfaithful mappings of the former do not exceed those of the sympathy candidate (see footnote 7).

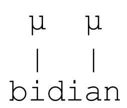
Table 1

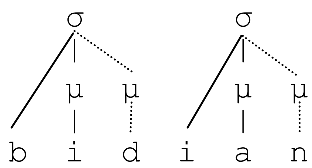
The failure of ❀SYM in Luganda

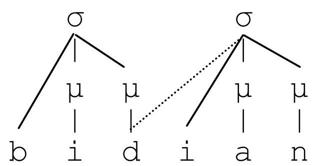
<table>
<tr><th>Status</th><th>Form</th><th>DEPμ</th><th>Unfaithful mappings</th><th>❀SYM</th></tr>
<tr><td>input</td><td><pre>μ μ μ
| | |
omuntu</pre></td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>sympathy candidate</td><td><pre>μ μμ μ
| || |
o.mun.tu</pre></td><td>✓
(positional μ-licensing)</td><td>0</td><td>not applicable</td></tr>
<tr><td>transparent loser</td><td><pre>μ μ   μ
| | |
o.mu.ntu</pre></td><td>✓</td><td>0</td><td>✓
(desired: *)</td></tr>
<tr><td>opaque winner</td><td><pre>μ μμ   μ
| |/ |
o.mu .ntu</pre></td><td>*</td><td>1</td><td>*
(desired: ✓)</td></tr>
</table>

West Germanic Gemination represents one further type of opaque weight by position, omitted in Hayes's 1989 taxonomy of mora-conserving lengthening processes (Bermúdez-Otero 1999:sec. 3.5). In West Germanic, C+[j] clusters were split in the first round of syllabification. This placed the first consonant in the coda, where it projected a mora by Weight by Position, as shown in (16b). Typically, however, the resulting syllable contact had a rising sonority profile, in violation of CONTACT; see (8b). This marked structure was subsequently repaired by adjoining the first member of the cluster to the onset of the following syllable. Nonetheless, the first consonant retained its moraic attachment and consequently surfaced as a geminate, despite no longer fulfilling the structural description of Weight by Position. Thus, the resyllabification of C[j] clusters counterbled Weight by Position:

(16) West Germanic /bid-j-an/ → [bid.djan] 'ask'

a.

Underlying representation

b.

Syllabification with Weight by Position

c.

Resyllabification

In West Germanic the theory of cumulative sympathy faces the same stumbling block as in Luganda. The sympathy candidate [bi$^{\mu}$d$^{\mu}$.ja$^{\mu}$n$^{\mu}$], which coincides with the intermediate representation in (16b), has no unfaithful mappings, as the mora assigned to the preyod consonant fulfils the criteria for positional µ-licensing. Every potential output candidate is accordingly vacuously cumulative in respect of the sympathy candidate, and ❁SYM cannot trigger the opaque violation of DEPµ incurred by the geminate in the output [bi$^{\mu}$d$^{\mu}$.dja$^{\mu}$n$^{\mu}$].

The implications of this result are profound. Sympathy Theory relies on two devices to rule out nonvacuous Duke-of-York gambits: cumulativity and the principle of Confinement to $\mathbb{C}_{<+F>}$, which asserts that sympathy candidates can only be selected by IO faithfulness constraints (McCarthy 1999:339). If either device fails, the theory's ability to block nonvacuous Duke-of-York gambits —and, with it, its claim to superiority over interleaved OT— collapses. I have presented one class of counterexample to cumulativity. Interestingly, the principle of Confinement to $\mathbb{C}_{<+F>}$ has proved untenable too (Bermúdez-Otero 1999:sec. 3.4.2.2, 3.5; see also Itô and Mester 1997, de Lacy 1998). Furthermore, Bermúdez-Otero 2001 provides evidence against the claim that nonvacuous Duke-of-York gambits are impossible: there, McCarthy's (1998:sec. 5) proposed reanalysis of a bleeding Duke-of-York gambit in Catalan (Harris 1993) is shown to be unworkable.

All in all, attempts to constrain opacity within Sympathy Theory have proved singularly unsuccessful. Interleaved OT offers a more promising approach. In this framework, the number of phonological strata and the depth of morphological and syntactic embedding in any given form impose limits on the complexity of potential opaque interactions (Bermúdez-Otero 1999:sec. 3.3.3.1). Other constraints on opacity emerge from the circumstances of language acquisition and change: notably, the tendency of innovative phonological regularities to percolate from lower to higher strata keeps divergence between levels at bay (Bermúdez-Otero 1999:sec. 3.3.3.2; cf. Benua 1997: sec. 3.5.4.2, McCarthy 1999:389).

4 Conclusion

The adaptation of Mora Theory to the constraint-based framework of OT raises subtle difficulties, arising particularly in connection with moraic faithfulness constraints. Notably, the standard formulation of DEPμ and DEPLINKμ produces severe anomalies.

These disappear if both constraints are reformulated in such a way as not to penalize positional μ-licensing. Further research should determine whether MAXμ and MAXLINKμ must also be revised and, if so, how.

Unexpectedly, the discovery that weight by position does not constitute an unfaithful mapping proves of relevance to the current debate about opacity in OT. McCarthy's theory of cumulative sympathy comes to grief over lengthening processes where a mora inserted through weight by position is opaquely preserved. This result adds to the mounting evidence for alternative approaches to opacity, such as interleaved OT.

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