Deletion, Insertion, and Symmetrical Identity*

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> It is pointless to define evaluation measures until we know what kinds of phonological descriptions we want them to select.
>
> *Kiparsky (1968:151)*

1 Introduction

The facts concerning the distribution of [ɹ] in Eastern Massachusetts and other dialects of English have resisted explanatorily adequate analysis primarily because they involve the insertion of [ɹ], a generally unexpected epenthetic consonant.[1] The fact that underlying [ɹ] is also deleted in a complementary set of environments is clearly relevant, as originally noted by Vennemann (1972), but no synchronic analysis of these facts to date has satisfactorily explained this connection. I present here an analysis of the facts of Eastern Massachusetts English within Optimality Theory (OT; Prince & Smolensky 1993) that establishes the relevant connection in an explanatory way. Crucial aspects of the proposed analysis provide support for the view that featural faithfulness constraints are symmetrical IDENT[*f*] constraints, as originally proposed by McCarthy & Prince (1995).

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[1] I employ the IPA symbol [ɹ] (coronal approximant) for perspicuity, but assume (following Delattre & Freeman 1968) that this segment involves both a coronal gesture and a pharyngeal constriction. See §3.2.

2 The Distribution of [ɹ] in Eastern Massachusetts English

Many are by now quite familiar with the facts concerning the distribution of [ɹ] in Eastern Massachusetts English, which has figured prominently in a number of generative works (e.g. Vennemann 1972, Kahn 1976, McCarthy 1991, 1993, Blevins 1997, Halle & Idsardi 1997).[2] To review, preconsonantal (and/or utterance-final) [ɹ] deletes.

(1) [ɹ]-deletion (McCarthy 1991:193, (2a))
   a. The spa [ɑ] seems to be broken. = The spar [ɑ] seems to be broken.
   b. He put the tuna [ə] near the table. = He put the tuner [ə] near the table.
   c. The boat tends to yaw [ɔ] some. = You're [ɔ] somewhat older.

We focus here, as most authors on the subject do, on word-final [ɹ]. The examples on the right in (1) exhibit words that etymologically (and for our purposes underlyingly) have a final [ɹ]; the underlyingly [ɹ]-less words on the left are provided for comparison.[3] Since the words following the [ɹ]-final words of interest begin with a consonant, the [ɹ] is deleted. Before following vowel-initial words, [ɹ] is not only retained but also inserted.

(2) [ɹ]-insertion/retention (McCarthy 1991:193, (2b))
   a. The spa [ɑɹ] is broken. = The spar [ɑɹ] is broken.
   b. He put the tuna [əɹ] on the table. = He put the tuner [əɹ] on the table.
   c. The boat tends to yaw [ɔɹ] a little. = You're [ɔɹ] a little older.

The above generalizations hold only when the vowel preceding the [ɹ] (whether deleted, inserted, or retained) is one of the vowels [ɑ,ə,ɔ]. The only other permissible word-final "vowels" of this dialect of English are the redundant diphthongs [ij,ej,uw,ow], which pattern with the distinctive diphthongs [ɑj,ɔj,ɑw].[4] Such diphthong-final words surface identically in the preconsonantal and prevocalic environments, as illustrated in (3). (Examples on the left are preconsonantal, those on the right are prevocalic.)

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[2] Other dialects of English (mostly British) with a similar distribution of [ɹ] are discussed in Chapter 5 of Harris 1994 and references therein. I focus here on Eastern Massachusetts English, an early description of which may be found in Whorf 1943.

[3] See McCarthy 1991, 1993 for extensive empirical arguments that the presupposed underlying distinction is real and necessary. These arguments are not in significant dispute in the literature (though see Pullum 1976 for an interesting objection), and discussion of them here would take us too far afield.

[4] The remaining monophthongs [ɪ,ɛ,ʊ,æ] are prohibited in word-final position. It may be that potential instances of such final vowels are diphthongized: observe the alternation between *says*, with a nonfinal monophthong [ɛ], and *say*, with a final diphthong [ej] (cf. *pays* and *pay*, both with diphthongs) — but see Kahn 1976:108, fn. 28.

(3) Diphthong-final words

a.	Do you see [ij] the problem?	=	I see [ij] it.
b.	Who will pay [ej] the bill?	=	I'll pay [ej] it.
c.	Who will shoe [uw] the horse?	=	I'll shoe [uw] it.
d.	Who will mow [ow] the lawn?	=	I'll mow [ow] it.
e.	Who will fly [ɑj] the plane?	=	I'll fly [ɑj] it.
f.	Where is the boy [ɔj] today?	=	The boy [ɔj] is not here.
g.	Where is the cow [ɑw] today?	=	The cow [ɑw] is not here.

Gick (1997a) offers a number of arguments (seven, to be exact) for categorizing the post-vocalic glides of the distinctive diphthongs [ɑj,ɔj,ɑw] of English as coda consonants. The fact that the redundantly diphthongal vowels [ij,ej,uw,ow] pattern with these distinctive diphthongs with respect to (the lack of) [ɹ]-insertion is a strong argument for their final consonantality as well (McCarthy 1991:193, 1993:176). Words ending in either distinctive or redundant diphthongs thus really end in consonants, and [ɹ]-insertion in (2) can safely be said to apply to all distinctively vowel-final words.

The result of the phonological processes in (1) and (2) is thus that the underlying distinction between [ɹ]-final words on the one hand and vowel-final words on the other is obliterated on the surface. Specifically, the grammar performs the following input-output mappings (A = [ɑ,ə,ɔ], C = any consonant, V = any vowel). Note the neutralization of the contrast between (4a) and (4b) and between (4c) and (4d).

(4) Input-output mappings in Eastern Massachusetts English

a.	/… Aɹ # C …/	↦	[… A # C …]	=	[ɹ]-deletion
b.	/… A # C …/	↦	[… A # C …]		
c.	/… Aɹ # V …/	↦	[… Aɹ # V …]	=	[ɹ]-retention
d.	/… A # V …/	↦	[… Aɹ # V …]	=	[ɹ]-insertion

Not only must any descriptively adequate analysis perform these mappings, but it is generally agreed among analysts of these facts that an explanatorily adequate analysis must also somehow connect [ɹ]-insertion on the one hand with [ɹ]-deletion and [ɹ]-retention on the other to explain why it is [ɹ] rather than some other consonant that is inserted in dialects that exhibit [ɹ]-deletion and [ɹ]-retention. In what follows I lay out what I believe to be such a descriptively and explanatorily adequate analysis.

Following up on a proposal originally made by Kahn (1976:69-70), I analyze [ɹ]-insertion as the diphthongization of a vowel, where diphthongization is here understood as a Correspondence relation (McCarthy & Prince 1995, to appear) between one segment in the input (e.g., /ə$_1$/) and two segments in the output ([ə$_1$ɹ$_1$]). This imperfect

correspondence violates some IDENT[*f*] constraint(s), where *f* is a feature or features not shared between [ɹ] and the vowel it forms a diphthong with. Similarly, [ɹ]-deletion is analyzed as the coalescence of [ɹ] with a preceding vowel, where coalescence is a relation between two segments in the input (e.g., /ə$_1$ɹ$_2$/) and one segment in the output ([ə$_{1,2}$]). This equally imperfect correspondence violates the same IDENT[*f*] constraint(s) that [ɹ]-insertion violates, and it is this connection between the two processes that explains why [ɹ] and not some other consonant is inserted in Eastern Massachusetts English speech.[5]

3 Analysis

3.1 Markedness

Following McCarthy (1993:180) and Harris (1994:248), I assume that [ɹ]-deletion and [ɹ]-retention are the result of a licensing condition, which I will refer to as LIC[ɹ], demanding that [ɹ] be linked to an onset.[6] Following McCarthy (1993), I assume that [ɹ]-insertion is due to a constraint that prosodic words may not end in a vowel, FINAL-C.[7] These two constraints conflict, and their violable interaction in a strict dominance hierarchy determines which wins out. In Eastern Massachusetts English, LIC[ɹ] dominates FINAL-C, demanding deletion of word-final [ɹ] unless it can be (ambisyllabically) linked as an onset to a following word-initial vowel, in which case [ɹ] is not only retained but also inserted.

(5) LIC[ɹ] » FINAL-C (McCarthy 1993, (17)/(18))

Candidates		LIC[ɹ]	FINAL-C
a. ☞	*Wanda left* [wɑn.də] [lɛft] *Homer left* [how.mə] [lɛft]		*
b.	*Wanda left* [wɑn.dəɹ] [lɛft] *Homer left* [how.məɹ] [lɛft]	* !	

[5] For an important precursor to the general idea of one-to-many and many-to-one correspondence, see Lamontagne & Rice 1995; see also (among others) Gnanadesikan 1995, 1997, Pater, to appear, Causley 1997, de Lacy 1999, McCarthy 1995, Kitto 1997, Smith 1998, Struijke 1998, and Urbanczyk 1998.

[6] I formulate this constraint as a licensing condition rather than as a coda condition (McCarthy 1993:172) to avoid unnecessary ambiguity in the interpretation of the latter (see Halle & Idsardi 1997:340-341). The low perceptibility of nonprevocalic [ɹ] (Blevins 1997:231-232) probably lies behind the ultimately correct statement of this constraint, though this point of detail is not germane here.

[7] For extensive arguments against an alternative anti-hiatus constraint, see McCarthy 1993:172-180.

(5) continued …

Candidates			LIC[ɹ]	FINAL-C
c.		*Wanda arrived* [wɑn.də] [ə.ɹɑjvd] *Homer arrived* [how.mə] [ə.ɹɑjvd]		* !
d.	☞	*Wanda arrived* [wɑn.dəɹ] [ɹə.ɹɑjvd] *Homer arrived* [how.məɹ] [ɹə.ɹɑjvd]		

Each candidate in the tableau in (5) consists of candidate pronunciations of two examples, one with an underlying word-final [ɹ] (*Homer*; cf. *Homeric*) and one presumably without (*Wanda*). Brackets indicate prosodic word edges and an ambisyllabic [ɹ] between two prosodic words is represented by two [ɹ]'s, one at the end of one prosodic word and one at the beginning of the next. The (b) and (d) examples are candidate pronunciations with an inserted or retained word-final [ɹ], and the (a) and (c) examples are ones without [ɹ] (deleted or simply not there to begin with). In the preconsonantal competition between (a) and (b), the [ɹ]-less pronunciations in (a) win, inevitably violating FINAL-C, because the alternative [ɹ]-ful pronunciations in (b) violate the higher-ranked LIC[ɹ]. In the prevocalic competition between (c) and (d), the [ɹ]-ful pronunciations in (d) win because both LIC[ɹ] and FINAL-C can be satisfied by an ambisyllabic word-final [ɹ] (either retained or inserted).

As McCarthy (1993:188*ff*) notes, the analysis of [ɹ]-insertion as the literal insertion of a consonant runs into a problem when it comes to explaining why it is that [ɹ] is inserted rather than some other consonant. The problem is that any inserted consonant will do to satisfy FINAL-C; given that an inserted consonant is precisely one that has nothing in the input to be (featurally) faithful to, the immediate prediction of this analysis is that it should surface as some least-marked consonant — perhaps [ʔ], but certainly not [ɹ]; see McCarthy (1993:189) for arguments that [ɹ] is "demonstrably not the default consonant of English."[8] Moreover, a consonant not subject to LIC[ɹ] would be ideal because FINAL-C, no longer encumbered by the higher-ranked constraint, could then force both preconsonantal and prevocalic insertion, as is its wont.

McCarthy's solution to this problem involves the postulation of an actual rule of [ɹ]-insertion — in McCarthy's words (1993:190), "a phonologically arbitrary stipulation […] that is outside the system of Optimality." The necessity of this (type of) solution has been defended by Blevins (1997) and criticized by Halle & Idsardi (1997); whether this type of solution is necessary in other cases and whether or not it spells imminent

[8] I assume for the sake of argument that [ʔ] is universally the least-marked consonant (for concrete proposals in this regard, see Alderete et al. 1997 and Lombardi 1997).

doom for OT is beside the point here. A solution that remains true to the fundamental principles of OT, that grammars are defined solely by ranked-and-violable conflicting universal constraints, is clearly preferable; it is to such a solution that we now turn.

3.2 Faithfulness

As noted in (3) above, underlyingly word-final "vowels" other than [ɑ,ə,ɔ] surface as word-final diphthongs regardless of the following environment. Of particular interest are the redundant diphthongs [ij,ej,uw,ow] as opposed to the distinctive diphthongs [ɑj,ɔj,ɑw]: whatever constraint motivates the redundant off-glide, these diphthongs can be said to be unfaithful surface manifestations of their (underlying) monophthongal counterparts /i,e,u,o/.[9] Since off-glides copy features from the vowels that precede them ([j] is front and occurs after the front vowels [i,e], [w] is back/round and occurs after the back/round vowels [u,o]), it is plausible to analyze the off-glides as copies of the vowels themselves — that is, as being in correspondence with them: $/o_1/ \mapsto [o_1 w_1]$. The "insertion" of an off-glide can thus be properly viewed as a diphthongization, which violates featural faithfulness constraints due to the imperfection of vowel/glide identity.[10]

Now Kahn (1976:69-70), Broadbent (1991), and Gnanadesikan (1997:159-162) have each suggested that [ɹ]-insertion is also a diphthongization. For Gnanadesikan, the vocalic pharyngeal constriction of [ɹ] (Delattre & Freeman 1968) is the result of the same feature [PHAR] responsible for the relative lowness of the vowels [ɑ,ə,ɔ] (McCarthy 1994b), making [ɹ] a featurally more suitable off-glide for these vowels than something like [j] or [w]. This pharyngeal constriction of [ɹ] is of course also accompanied by a coronal gesture not shared by [ɑ,ə,ɔ]; a gesture due to the feature [COR].[11] The imperfect

[9] They could of course also be faithful surface manifestations of underlying diphthongs. The choice of analysis is clearly arbitrary here, since there are only diphthongs on the surface; either there is a process changing underlying monophthongs to diphthongs or there are no underlying monophthongs to begin with. Either way, the language-particular grammar must contain machinery — a process or an inventory restriction — that rules out surface monophthongs. Under the hypothesis that there are no language-particular inventory restrictions (the Richness of the Base hypothesis; see Prince & Smolensky 1993:191*ff*), underlying monophthongs must be contended with by a grammatical process, and the uncontentious claim being made here is that they are diphthongized (see also footnote 4).

[10] And perhaps, though not necessarily, a constraint against diphthongization — McCarthy & Prince's (1995) INTEGRITY — or one against multiple correspondence in general — Lamontagne & Rice's (1995) *MC. See Keer 1998, forthcoming for arguments against the independent existence of such constraints.

[11] This is arguably the only feature not shared between [ɹ] and [ə] (see Appendix 1 of Kahn 1976); obviously, [ɑ,ɔ] must differ from [ɹ] with respect to more features than this. This is consistent with the historical fact that [ɹ] was inserted after [ə] prior to the period at which it was inserted after the other two vowels (Gick 1997b, citing Jones 1928:xvii). I use [COR] as a cover term for all of the relevant features.

correspondence between [ɹ] and [ɑ,ə,ɔ] thus violates (at least) IDENT[COR], a faithfulness constraint against corresponding segments that disagree in terms of the feature [COR].

In order for [ɹ]-insertion-as-diphthongization to be optimal, then, FINAL-C must dominate IDENT[COR], because the former forces violation of the latter. Because final vowel deletion or plain insertion of some unmarked consonant is not preferred to this imperfect correspondence, the faithfulness constraints MAX (no deletion) and DEP (no insertion) must also dominate IDENT[COR]. This is all shown in (6).

(6) FINAL-C, MAX, DEP » IDENT[COR]

Input: *Wanda* /ə$_1$/ *arrived*		FINAL-C	MAX	DEP	IDENT[COR]
a.	*Wanda* [ə$_1$] *arrived*	* !			
b. ☞	*Wanda* [ə$_1$ɹ$_1$] *arrived*				*
c.	*Wanda* [ə$_1$ʔ] *arrived*			* !	
d.	*Wanda* [ø] *arrived*		* !		

As first proposed by McCarthy & Prince (1995), constraints like IDENT[COR] are here interpreted symmetrically, such that an [ɹ] in correspondence with [ɑ,ə,ɔ] violates IDENT[COR] regardless of which is in the input and which is in the output. Thus, just as the correspondence of [ɑ,ə,ɔ] in the input with [ɹ] in the output violates IDENT[COR], so does the correspondence of [ɹ] in the input with [ɑ,ə,ɔ] in the output. This latter correspondence relation is necessary to analyze [ɹ]-deletion as coalescence.

In fact, the analysis of [ɹ]-deletion-as-coalescence follows straightforwardly from the ranking arguments already made. Since LIC[ɹ] dominates FINAL-C, as was shown in (5), it also dominates IDENT[COR] by transitivity of the domination relation. Since MAX and DEP also dominate IDENT[COR], then the optimal candidate is not one with literal [ɹ]-deletion (violating MAX) or with vowel insertion (violating DEP), but rather one with coalescence of [ɹ] and the final vowel, as shown in (7).

(7) {{LIC[ɹ] » FINAL-C}, MAX, DEP} » IDENT[COR]

Input: *Homer* /ə$_1$ɹ$_2$/ *left*		LIC[ɹ]	FINAL-C	MAX	DEP	ID[COR]
a.	*Homer* [ə$_1$ɹ$_2$] *left*	* !				
b. ☞	*Homer* [ə$_{1,2}$] *left*		*			*
c.	*Homer* [ə$_1$ø] *left*		*	* !		
d.	*Homer* [ə$_1$ɹ$_2$ə] *left*		*		* !	

Note that a candidate with deletion of *both* word-final [ɹ] and the preceding vowel would violate MAX twice but would avoid violation of FINAL-C, violated by the optimal candidate in (7b). To eliminate this candidate, MAX must also dominate FINAL-C. Similarly, a candidate with epenthesis of a vowel and some LIC[ɹ]-satisfying consonant would violate DEP twice but would also avoid the optimal candidate's violation of FINAL-C; therefore, DEP must also dominate FINAL-C.[12]

It should by now be clear why it is [ɹ], rather than some other consonant, that came to be inserted in Eastern Massachusetts English and other dialects like it with [ɹ]-deletion and [ɹ]-retention. Since IDENT[COR] is sensitive to the difference between [ɹ] and the vowels [ɑ,ə,ɔ] but not sensitive to the direction of change (from [ɹ] to [ɑ,ə,ɔ] or vice-versa), IDENT[COR] can be violated to satisfy FINAL-C as well as to satisfy LIC[ɹ]. Given that a grammar with [ɹ]-deletion-as-coalescence already acknowledges IDENT[COR] as the lowest-ranked among the relevant faithfulness constraints (the others being MAX and DEP), FINAL-C had no choice but to force violation of IDENT[COR] in the evolution from pre-[ɹ]-insertion Eastern Massachusetts English to this dialect's present state.

The symmetry of faithfulness violation crucial to this analysis resurrects McCarthy's (1991) proposal in which the symmetrical structural changes of [ɹ]-deletion and [ɹ]-insertion are separated from their respective contexts of application (whence the markedness constraints LIC[ɹ] and FINAL-C) and fused together as [ɹ] ~ Ø ("[ɹ] alternates with Ø"). This insight has proven difficult to formulate in both the standard rule-based theory (see McCarthy 1991, Halle & Idsardi 1997) and in OT (see McCarthy 1993, Blevins 1997); the concept of symmetrical identity within the Correspondence theory of faithfulness provides the key to the resolution of this dilemma within OT.

4 Conclusion

In the Correspondence theory of faithfulness as originally proposed by McCarthy & Prince (1995), faithfulness to a segment's feature specifications is regulated by symmetrical IDENT[*f*] constraints, by which a change within a segment from [–*f*] to [+*f*] or from [+*f*] to [–*f*] violates one and the same IDENT[*f*] constraint. This view of featural faithfulness, which deprives features of much of their autosegmental independence, has

[12] Another possibility is to dispense with MAX and DEP entirely, respectively reducing deletion and insertion to coalescence and diphthongization. I do not investigate this interesting possibility further here.

A candidate like (7d) but with diphthongization of [ɹ] to produce the "inserted" [ə] — *Homer* [ə$_{1}$ɹ$_{2}$ə$_{2}$] *left* — avoids a violation of DEP by violating IDENT[COR], thus tying on these constraints with the optimal candidate in (7b), *Homer* [ə$_{1,2}$] *left*. However, the additional segments of *Homer* [ə$_{1}$ɹ$_{2}$ə$_{2}$] *left* incur violations of markedness constraints that are avoided by *Homer* [ə$_{1,2}$] *left*, and so the diphthongization candidate could never be the optimal output for this input under any ranking of the constraints.

been argued against by a number of authors. For instance, Pater (to appear) gives an argument for asymmetrical IDENT[*f*] constraints, still binding featural faithfulness to segmental correspondence but partially recognizing the independence of opposite feature values (see also McCarthy & Prince 1995:§5.1, to appear:§5.4). More radically, Lombardi (1995 *et seq*.) and others (Causley 1997, Walker 1997) have argued for full-blown featural correspondence, freeing features completely from their segmental anchors.

I have brought here another set of facts to bear on the question of featural faithfulness, arguing in favor of symmetrical IDENT[*f*]. Specifically, I have argued that the markedness backbone of McCarthy's (1993) analysis of the distribution of [ɹ] in Eastern Massachusetts English is best supported by featural faithfulness constraints of the symmetrical IDENT[*f*] variety. The proposed analysis makes an explanatorily desirable connection between [ɹ]-insertion on the one hand and [ɹ]-deletion on the other; the two processes are compelled by distinct and competing markedness constraints but involve a violation of the same featural faithfulness constraint, IDENT[COR].

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