

Synchronic Rule Inversion

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1. Introduction

Phonological rules are usually conceived of as expressions $A \rightarrow B / C$, specifying a context C , a unique input A , and a unique output B . This familiar theory, though, is not entirely satisfactory because of facts like those in (1), from the Australian language Lardil:

(1)	Underlying	Nominative	Accusative	
a.	/kela/	kela	kelan	'beach'
	/wiṭe/	wiṭe	wiṭen	'inside'
b.	/yalulu/	yalul	yalulun	'flame'
	/yukaɾpa/	yukaɾ	yukaɾpan	'husband'
	/muŋkumuŋku/	muŋkumu	muŋkumuŋkun	'stone axe'
c.	/wik/	wika	wikin	'shade'
	/maɾ/	maɾṭa	maɾin	'hand'

The accusative justifies the underlying form; the alternations of interest are in the nominative. The descriptive generalization is that the nominative is identical to the underlying form only for disyllabic words. Monosyllables are augmented in the nominative by adding a (1c); polysyllables are shortened by one syllable.

The analysis of these facts in Wilkinson (1988) relies on positing a disyllabic Minimal Word Constraint (McCarthy and Prince 1986) for Lardil. This constraint on phonological well-formedness stands apart from two context-free phonological rules, one of which deletes a final vowel and the other of which inserts final a . These rules apply under the aegis of the Minimal Word Constraint. Final vowel deletion applies only when its output would be well-formed under the constraint, therefore only in words of three or more syllables. Insertion of a applies only when it is required to satisfy the Minimal Word Constraint, therefore only in monosyllables.

This account of Lardil separates the contexts of the rules from the structural operations that the rules perform. A real generalization over the contexts of two different rules is thereby achieved: both are subject to the disyllabic minimum. Perhaps the earliest constraint-based approach of this type is Kisseberth's (1970) study of conspiracies, but there has been a burgeoning of interest in recent years, including among others Liberman (1975), Liberman and Prince (1977), Goldsmith (1976), McCarthy (1979), Cairns and Feinstein (1982), Prince (1983), Selkirk (1983), Kaye and Lowenstamm (1984), Kaye, Lowenstamm, & Vergnaud (1985), McCarthy (1986), Clements (1988), Yip (1988), and Prince (1991). Works that present specific theories of the mechanism and interplay of constraints and rules include Singh (1987), Paradis (1988), Myers (1991), and Goldsmith (1990).¹

There's a particular consequence of a constraint-based theory that has not previously been noted. In cases like Lardil, greater generality is achieved by relating the context of a rule to broader conditions on well-formedness. But a constraint-based theory provides another possible opportunity for generalization: the structural operation of the rule. Within the standard theory, the contexts of rules and their structural operations are inextricably linked. As a result of this, the structural operations of rules are necessarily directional: A becomes B . Once the context of the rule and its structural operation are separated, though, we can conceive of **some** rules as **nondirectional** statements: " A alternates with B ", expressing a generalization over the rules " A becomes B " and " B becomes A ". Whether A or B is the outcome is left up to the separately-stated constraints. This is what I mean by **synchronic rule inversion**.

2. Rule Inversion and Eastern Massachusetts r

The evidence of synchronic rule inversion comes from a close examination of the distribution of r in the English dialect spoken in Eastern Massachusetts. Insertion and deletion of r are classic shibboleths of this dialect, very familiar to other American English speakers. The data in (2) are typical contrasts and alternations in this dialect:²

(2)

a.

The spa seems to be broken.	=	The spar seems to be broken.
[spɑ]		[spɑ]
He put the tuna near the table	=	He put the tuner near the table.
[tuwnð]		[tuwnð]
The boat tends to yaw some.	=	You're somewhat older.
[yɔ]		[yɔ]

b. **Intrusive r**

The spa is broken.	=	The spar is broken.
[spɑr]		[spɑr]
He put the tuna on the table.	=	He put the tuner on the table.
[tuwnðr]		[tuwnðr]
The boat tends to yaw a little.	=	You're a little older.
[yɔr]		[yɔr]

Deletion of *r* before a consonant or pause is exemplified on the right in (2a), leading to merger of *spa* and *spar*. Merger in the opposite direction takes place in a prevocalic context, as (2b) shows. Traditional descriptions distinguish between the nonetymologic intrusive *r* on the left in (2b) and the etymologic linking *r* on the right in (2b).

We will soon examine the other facts surrounding (2) in great detail, but until then it will be helpful to establish some basic pretheoretic observations. Deletion of *r* takes place whenever an *r* would be expected to occur preconsonantly or utterance-finally. Conversely, linking *r* is preserved whenever a vowel follows within the same utterance. Intrusive *r* is found whenever one of the vowels *ɑ*, *ɔ*, or *ɔ* would otherwise be followed by a vowel in the same utterance. These conditions on the distribution of *r* have a straightforward syllabic basis that has been noted by many analysts (Vennemann 1972:216, Johansson 1973:60, Kahn 1976:109, Mohanan 1985:146). In the coda of a syllable, *r* is deleted. Resyllabification by the Onset Rule (Steriade 1982, Itô 1989) takes place within the utterance, so prevocalic *r* will be in onset position and hence not deleted. Intrusive *r* resolves hiatus within an utterance. The vowels that precede intrusive *r* (*ɑ*, *ɔ*, *ɔ*) are just exactly the non-diphthongal word-final vowels. With diphthongal final vowels (*seeing* [siyɪŋ] versus *sawing* [sɔrɪŋ]), there is no hiatus and therefore no intrusive *r*.

The use of the term "utterance" in describing the distribution of *r* is intentional; linking *r* and intrusive *r* are not sensitive to any syntactic distinctions (cf. Vogel (1986)). Thus, only pause, which delimits utterances, is relevant to the *r* alternations. It follows, then, that linking *r* and intrusive *r* are obligatory word-internally (*conferral*, *withdraw[r]al*), in various types of clitic groups (*Timor-is*, *Cuba[r] is*, *law[r] of the sea*), and in compounds and phrases (*canola[r] oil*, *far-away*, *saw[r] Ed yesterday*). So long as no pause intervenes, intrusive *r* and linking *r* are even obligatory across gaps (*What did the dog gnaw[r] after dinner?*), the boundaries of clauses or even sentences (*The man that I saw[r] appears to have left*), and between intonation phrases (*Melissa[r], aren't you coming?*).

The history of this phenomenon is not entirely clear, although the general picture is known. A general weakening of *r* in syllable codas occurred by the seventeenth century and this led to loss of *r* by the end of the eighteenth century in parts of Britain and coastal America (Kurath 1972: 70). At this stage, the phonology would have been roughly as in (3):

(3) Stage I Eastern Mass. Phonology

Underlying Representations

/spɑ/	'spa'	/spɑr/	'spar'
/tuwnð/	'tuna'	/tuwnðr/	'tuner'
/yɔ/	'yaw'	/yɔr/	'you're'

Rule

<i>r</i> Deletion	
<i>r</i> → ∅ / _____	{ c }
	{ # }

Speakers at this stage would be expected to have completed the merger in (2a) but not (2b). Intrusive *r* developed later, perhaps even in this century (Parslow 1967). Intrusive *r* in Britain and New England may very well be independent developments, which leads to a major historical (and synchronic) puzzle: why is intrusive *r* a natural next step from a phonology like (3)?

Vennemann (1972) makes a specific proposal about this historical development, identifying it as an instance of **rule inversion**. Rule inversion is a process of historical change defined as follows (Vennemann 1972: 211-2):

(4) Rule Inversion

Stage I. Phoneme type A taken as basic. Rule: A → B / D

Stage II. Phoneme type B taken as basic. Rule: B → A / D''

where U is the set of all possible contexts, D ∪ D' = U, D ∩ D' = ∅, and D'' is "that subset of D' in which B and A still alternate".

Put simply, rule inversion is reversal of the input and output of a rule and complementation of the environment.

For Eastern Massachusetts *r*, the rule inversion scenario means that the Stage I phonology in (3) is replaced by a Stage II phonology like that in (5).³

(5) Stage II Eastern Mass. Phonology

Underlying Representations

/spɑ/ 'spa' = 'spar'
 /tuwnð/ 'tuna' = 'tuner'
 /yɔ/ 'yaw' = 'you're'

Rule

r Insertion
 ∅ → r / V__V

At Stage II, the rhotic and non-rhotic underlying representations have been merged into non-rhotic ones. The rule of *r* Deletion has been inverted; instead of deleting *r* in coda position, the grammar now inserts *r* in hiatus. The phonology no longer contains a rule of *r* Deletion at all.

The question now is whether (5) is the correct synchronic analysis of the contemporary dialect, as the historical inversion account demands. Logically, we could imagine several other possible synchronic analyses, among them the historicizing analysis in (6) and the pure deletion analysis in (7):

(6) Historicizing Analysis

Underlying Representations

/spɑr/ 'spa' /spɑr/ 'spar'
 /tuwnðr/ 'tuna' /tuwnðr/ 'tuner'
 /yɔr/ 'yaw' /yɔr/ 'you're'

Rules

r Deletion $\left\{ \begin{matrix} c \\ \# \end{matrix} \right\}$ *r* Insertion
 r → ∅ / ____ ∅ → r / V__V

(7) Pure Deletion Analysis

Underlying Representations

/spɑr/ 'spa' = 'spar'
 /tuwnðr/ 'tuna' = 'tuner'
 /yɔr/ 'yaw' = 'you're'

Rule

r Deletion $\left\{ \begin{matrix} c \\ \# \end{matrix} \right\}$
 r → ∅ / ____

Both of these accounts deny historical inversion. The former sees *r* Insertion as just another rule added to the phonology, with the status quo maintained intact. The latter presupposes that the underlying representations were reanalyzed in the opposite direction and that the rule system did not change.

It seems clear that the absolutely historical analysis in (6) cannot be correct synchronically (cf. Johansson (1973), Pullum (1976), and Kahn (1976)). No internal evidence of the kind available to language learners would justify an underlying distinction between *spa* and *spar*, which are homophones in all contexts. There are two types of nominally external evidence that might conceivably be recruited by language learners, the orthography and pronunciations from other dialects. But this does not seem to happen. When speakers from Eastern Massachusetts attempt to accommodate to "Standard American", they frequently produce hypercorrections like the notorious [kyuwbðr] for *Cuba*. Orthography might play a minor role (Gimson 1970), as in Whorf's (1943) claimed distinction between *baahing of sheep* and *barring the door* ([bɑ?Iŋ] versus [bɑrIŋ]), though these are identical for me. Of course, the spelling of *r* in unfamiliar words is quite hopeless,

like *hussah* for *hussar*, *hyler* for *hyla* (from Joos's interpolations on Whorf (1943)), and *fanacula* for *vernacular* (from an undergraduate term paper).⁴

Johansson (1973) and Pullum (1976) present many arguments for the superiority of the *r* Insertion analysis in (5) over the *r* Deletion analysis in (7). Most are obviously defective or too aprioristic to still be relevant. Three, though, are worth scrutinizing:

! In more careful speech, there is an option to have ? in place of *r*: *far away* is [fɑr əweɪ] ~ [fɑ? əweɪ]. Under (5), this can be thought of as an alternative consonant insertion rule. But insertion of ? is needed independently, since it also occurs post-pausally, where *r* is impossible (*away* [?əweɪ], *[rəweɪ]). The glottal stop inserted by this rule would of course trigger deletion in /fɑr ?əweɪ/ under (7).

! Slower or more careful speech has fewer intrusive *r*'s. This means that the *r* Insertion rule applies more in faster speech, in conformity with the usual effect of speech rate on phonological rules. But it is unreasonable to assume that speech rate controls the application of *r* Insertion directly. Rather, speech rate and style have an obvious effect on phrasing and syllabification, and these determine either *r* Insertion or *r* Deletion.

! For RP, there are some reports of the absence of linking or intrusive *r* after another *r*: *emperor of Japan*. Under (5), this can be analyzed as a dissimilatory failure of *r* Insertion. This observation does not hold in Eastern Massachusetts nor is it widely reported in RP. If correct, it could just as well be a condition on Deletion as on Insertion.

Clearly, then, there are no empirical differences between (5) and (7). A feature-counting evaluation metric might prefer the shorter underlying representations of (5), but that is purely a matter of ink-saving. Both analyses have equally "long" underlying representations in the only way that counts: in both cases, there is massive redundancy in the shape of underlying forms. In (5), no underlying form ends in *r*; in (7), no underlying form ends in a vowel. We will now consider this problem in detail.

3. Analysis

We have established that there are no sound empirical reasons to prefer Insertion (5) over Deletion (7). In fact, there are very good empirical reasons to think that both (5) and (7) are really wrong -- wrong because they are incomplete characterizations of the competence of native speakers of this dialect.

The *r* Deletion analysis (7) is wrong because it does not explain why new words ending in *a*, *ɔ*, or *ɔ* **invariably** require intrusive *r* before a vowel: *Francois[r]* is coming, *rumba[r]*ing, *subpoena[r]*ing, *guffaw[r]*ing, *baah[r]*ing] of sheep, *blah[r]*er 'more mediocre', *schwa[r]* epenthesis, *The Beqaa[r]* in Lebanon. Nor does it explain why intrusive *r* is transferred to other languages, as in the following examples from Jespersen (1909): Danish *lukke[r]* op, German *hatte[r]* ich, *sagte[r]* er. In brief, (7) is wrong because it has no way of enforcing insertion of *r*; it simply takes it for granted that all underlying representations end in *r* rather than a short vowel.

The *r* Insertion analysis (5) is wrong for a very similar reason: it doesn't explain why new words that end in /r/ must lose that /r/ finally or before a consonant: *Notre Dame University*, *palavet*, *Omar*, *Ishtar*, *Kareem Abdul-Jabbar*. Nor does it explain why *r* deletion is transferred to other languages, as in Jespersen's (1909) example from Danish: *det brænder ganske[r]* op.⁵ In brief, (5) is wrong because it has no way of enforcing the loss of *r*; it simply takes it for granted that no underlying representations end in *r*.

To sum up, the evidence of productive language use (loan words, foreign accent, and the like) shows that an analysis with just an *r* Deletion rule or just an *r* Insertion rule is incorrect. Both Deletion and Insertion must coexist in any adequate analysis. In this respect, the historicizing account in (6) is the best one. It is still unreasonable to set up distinct underlying representations for *spa* and *spar*, so of course there has been some reanalysis, but both rules are required in any case. Indeed, the choice of underlying representations becomes relatively unimportant in the face of the coexisting Deletion and Insertion rules.⁶

Evidence for coexisting Deletion and Insertion has so far come from "external" sources. As it happens, though, there is a great deal of internal evidence pointing to the same conclusion. Three basic classes of arguments will be presented. The first consists of all the various *r/Ø* alternations in Level I morphology, which require both Insertion and Deletion. The second involves word-level or postlexical alternations in syllables with glide+liquid codas. This directly argues for Deletion and in a more indirect way for Insertion. Finally, the facts of function words will provide a completely distinct argument for Deletion.

Level I Morphology. The examples in (8) all involve alternations with Level I suffixes in English:

(8) *r* With Level I Suffixes

Homer [howmð]	Homeric	danger [deynjð]	dangerous
doctor [dɔktð]	doctoral	major [meyjð]	majority
tartar [tɔtð]	tartaric	mayor [meyð]	mayoral
sulfur [sɔlfð]	sulfuric	angular [æŋgɔðlð]	angularity
meter [miytð]	metric	cylinder [silɪndð]	cylindric
prior [prɔjð]	priority	satire [sætɔjð]	satiric

Compare:

algebra	algebraic
Inca	Incaic
orchestra	orchestral
idea	ideal
aroma	aromatic
anesthesia	anesthetic

Examples like *Homer/Homeric* or *doctor/doctoral* are a good source of *r/Ø* alternations with the expected distribution: *r* before a vowel, Ø finally. The real interest of these examples comes from comparison with *algebra/algebraic* or *orchestra/orchestral*, which do not have *r* before the suffix. The most straightforward account of this is to set up underlying representations like /howmðr/ versus /æljðbrð/, with a contrast between the presence and absence of final *r*.⁷ (Here and subsequently, underlying representations are abstract only in relevant aspects.) Thus, Level I suffixation provides limited evidence for an underlying etymologic contrast, though obviously this evidence won't be available for all or even most words. With these underlying representations, we need both *r* Deletion, to account for prepausal/preconsonantal *Homer*, and *r* Insertion, to account for intrusive *r* in *algebra[r]* *is my favorite subject*.

Some of the examples in (8) can be recruited to make a different sort of argument for underlying final *r* and *r* Deletion. Level I derivatives of sonorant-final stems differ in whether the sonorant is syllabic or not:⁸

(9)

a.	Homer	Homeric
	atom	atomic
	angel	angelic
b.	meter	metric
	cataclysm	cataclysmic
	cycle	cyclic

The standard account (Chomsky and Halle 1968:85) of this distinction is to set up underlying representations like /ætVm/ versus /kætðklɪzm/. Epenthesis (or sonorant syllabification) applies to the latter when the final sonorant is otherwise unsyllabifiable.

The data in (9) establish a parallelism between final *r* and other sonorants, since they show the same pattern of alternations. To make sense of this parallelism, we require contrasting underlying representations /howmVr/ and /miyr/. But these underlying representations presuppose *r* Deletion to get the prepausal surface forms of these words.

The strong verbs provide yet another kind of argument for coexisting Insertion and Deletion rules. The relevant examples appear in (10):

(10) Strong Verbs

a.	draw	draw[r]ing	drew
	saw	saw[r] a ...	see
	hear	[hiyð]	heard [hɪrd]
b.	swear, tear, bear	([sweyð])	
	swore, tore, bore	([swowð])	

The argument in (10a) hinges on the observation that the strong verbs alternate only in their vowels, not in their consonants. The *r*-less preterite *drew* indicates that *draw* does not have final *r*. Therefore the *r* of *draw[r]ing* must be inserted by rule. A parallel argument can be made for *see/saw*. Conversely, the preterite *heard* shows that *hear* has a final *r*, requiring a rule of *r* Deletion. The argument in (10b) is based on the observation that strong verbs are always monosyllabic (or iambic, with an unstressed prefix, like *beseech*). But *r*-less underlying representations of words like *swear* would necessarily be disyllabic and trochaic /sweyð/, like their prepausal surface forms, in violation of this exceptionless regularity. So this evidence requires *r* Deletion as well.

Another argument comes from syllabic *r*. Basically, we have to account for a consistent distributional regularity: syllabic *r* is possible only in stressed syllables. And we have to account for the alternations in (11): under Level I derivation which moves the stress or opens syllables, syllabic *r* alternates with a vowel or vowel-*r* sequence. The alternations in (11a) are between stressed *r* and unstressed *ɹ*. The alternations in (11b) occur when a syllable containing syllabic *r* is opened at Level I.

(11) Syllabic *r*

a. [r]/[ɹ] Alternations			
conserve	[kɔnsɹv]	conservation	[kɔnsəveɪʃən]
pervert _N	[pɹvɹt]	pervert _V	[pɔvɹt]
adverse	[ədvs]	adversary	[ədvsəri]
b. [r]/[Vr] Alternations			
err	[ɹ]	error	[ɛrɔ]
prefer	[prɔfɹ]	preference	[prɛfəɹəns]
deter	[dɔtɹ]	deterrence	[dɛtəɹəns]
concur	[kɔnkɹ]	concurrency	[kɔnkəɹəns]
defer	[dɔfɹ]	deference	[dɛfəɹəns]

These alternations are quite easy to understand if we assume that surface syllabic *r* is derived from an underlying vowel-*r* sequence. Specifically, the rules in (12), which are almost commonplace in English phonology, will account for the alternations:

(12)

a. Assimilation	
V	→ r / ___r]
	[-low]
b. Reduction	
V	→ ɹ
	[-stress]

The assimilation rule changes a non-low vowel to syllabic *r* before tautosyllabic consonantal *r*. The effects of this assimilation are neutralized by vowel reduction in unstressed syllables, whence the data on the right in (11a). These rules presuppose rhotic underlying representations like /pɔrvɔrt/, and this entails the existence of the *r* Deletion rule to account for the absence of rhotic quality in the initial syllable of *pervert_V*. The rules proposed in (12) are evidently productive; they are transferred in speaking other languages and they are respected by loan words like *Yassir* [yæsɹ] and *Sirhan* [sɹhæn].

In summary, the evidence of Level I alternations provides a variety of arguments for both *r* Deletion and *r* Insertion as well as a contrast between some rhotic and non-rhotic underlying representations. The *tartar/algebra* contrast requires both Deletion and Insertion. Syllabicity alternations in final sonorants (*Homeric/metric*) and syllabic *r* alternations establish the need for a Deletion rule. The strong verbs also require both Deletion and Insertion.

Before going on, it is proper to address one concern that is often raised about examples of this sort. Level I alternations are sometimes believed to be without evidentiary value. It makes no sense to deny them any usefulness as evidence, but certainly we should approach them with care. For example, as Kahn (1976) notes, there is irregular stem-allomorphy before some Level I suffixes (compare *algebraic* and *aromatic* in (8)). This irregularity obviously weakens the argument for a final *r* in *Homer*, since *Homeric* could be just another stem allomorph. But this argument is not presented in isolation; it is buttressed by other evidence from phenomena of great regularity, some at Level I and some to which we now turn.

Syllabification of Liquids. Up to this point, we have only looked at *r* after simple nuclei. The behavior of *r* after diphthongal nuclei provides a very different sort of argument for coexisting *r* Insertion and *r* Deletion rules. As a prerequisite to that argument, we need to establish some simple results involving *l*.

The data in (13) show the Eastern Massachusetts treatment of word-final *l* after a diphthongal nucleus. Before a consonant or pause, a disyllabic pronunciation is required, as in (13a). (13b) shows that these same stems are monosyllabic when the *l* precedes a vowel within the utterance.

(13) Final l With Diphthongal Nuclei

a. Preconsonantly and Prepausally			
feel	[fiyðl]	fool	[fuwðl]
fail	[feyðl]	foal	[fowðl]
file	[fɔyðl]	foul	[fɔwðl]
foil	[foyðl]		
b. Prevocally			
feeling	[fiylɪŋ]	feel it	[fiyl ɪt]
failing	[feylɪŋ]	fail it	[feyl ɪt]
filing	[fɔylɪŋ]	file it	[fɔyl ɪt]
fooling	[fuwliŋ]	fool it	[fuwl ɪt]
goalie	[gowliy]	goal of	[gowl ðv]

A trisyllabic pronunciation of *filing* [fɔyðlɪŋ] is possible in much more monitored speech.

The schwa in (13a) is not underlying; instead, it is derived by a rule of epenthesis. Compare the epenthetic schwa in (13) with the underlying schwa in (14), which does not delete (except in very casual speech):

(14)

a. Preconsonantly and Prepausally			
ideal	[ɑydiyðl]		
betrayal	[biytreyðl]		
trial	[trɔyðl]		
vial	[vɔyðl]		
Lowell	[lowðl]		
b. Prevocally			
idealize	[ɑydiyðlɔyz]	ideal of	[ɑydiyðl ðv]
betrayal of	[biytreyðl ðv]		
trial of	[trɔyðl ðv]		
vial of	[vɔyðl ðv]		
Lowell is	[lowðl ɪz]		

Because of this contrast between epenthetic and underlying schwa, *trail* = *betrayal* and *reel* = *real* are homophones, while *trail of* ≠ *betrayal of* and *reeling* ≠ *realist* are minimal pairs (mutatis mutandis).

These facts require an underlying distinction between monosyllabic forms like /riyl/ 'reel' and disyllabic ones like /riyðl/ 'real'. This distinction is neutralized in (13) by a rule of epenthesis that takes a final *VGl* sequence to *VGð*. Epenthesis does not apply to heterosyllabic sequences, as examples like (13b) and *doilie* [doyliy]/*[doyðliy] show. Nor does it apply when the final consonant is less sonorous than *l*, so *spine* [spɔyn] does not rhyme with disyllabic *iron* [ɑɪn]. The epenthesis is an effect of a minimal sonority distance constraint on tautosyllabic clusters (Steriade 1982). A glide+liquid sequence presents too small a sonority cline. The *l*, then, cannot be syllabified with the preceding diphthong and schwa epenthesis applies instead. If the *l* is an onset, as it is in (13b), then of course epenthesis will not apply. A final nasal, as in *spine*, offers a steeper sonority cline, and so it is tautosyllabic with the preceding glide.

These results about *l* lead directly to an argument for underlying final *r*. Compare the data in (15) with the data in (13):

(15)

a. Preconsonantly and Prepausally			
fear	[fiyð]	sure	[ʃuwð]
pare	[peyð]	four	[fowð]
fire	[fɔyð]	flour	[flɔwð]
b. Prevocally			
rearing	[riyrɪŋ]	rear of	[riyrðv]
paring	[peyrɪŋ]	pare it	[peyrɪt]
firing	[fɔyrɪŋ]	fire it	[fɔyrɪt]
assuring	[ðʃuwrɪŋ]	assure it	[ðʃuwrɪt]

As with *l*, a trisyllabic pronunciation of words like *firing* is possible in more monitored speech.

In previous analyses with *r*-less underlying forms (Johansson 1973, Kahn 1976), words like *fire* are represented as /fayð/. The prevocalic alternations in (15b) are derived either by a insertion of *r* in hiatus followed by schwa deletion (/fayð+Iŋ/ → fayðrIŋ → fayrIŋ) or by ð → *r* directly. Either way, the analysis of (15) is unrelated to the analysis of (13). In fact, this account is wrong, since it is unable to distinguish the schwa of *fire*, which disappears prevocalically, from the schwa that is preserved prevocalically in examples like (16b):

(16)

a. Preconsonantly and Prepausally

layer	[leyð]
power	[pɔwð]
rumba	[rðmbð]
Nashua	[næʃuwð]
Maria	[mðriyð]

b. Prevocalically

layering	[leyðrIŋ]	layer of	[leyðr ðv]
powering	[pɔwðrIŋ]	power of	[pɔwðr ðv]
rumbaing	[rðmbðrIŋ]	rumba away	[rðmbðr ðwey]
		Nashua is	[næʃuwðr Iz]
		Maria is	[mðriyðr Iz]

The examples in (16) closely parallel those with *l* in (14). As with *l*, we can exhibit homophones and minimal pairs like *Lear* = *Leah* versus *Lear* – *is* ≠ *Leah*[*r*] *is* or *rear* = *rhea* versus *the rear* – *is* ≠ *the rhea*[*r*] *is*, the latter essentially the same as *Maria*[*r*] *is*.

The evidence, then, indicates an underlying distinction between *rear* and *rhea*/*Maria*. Underlying monosyllabic *rear* cannot be /riy/, of course, since it is distinct from *Rhee* or *re*. The only other candidate monosyllabic underlying representation for *rear* is /riyr/, distinct from disyllabic *rhea* /riyð/ or trisyllabic *Maria* /mðriyð/. Underlying /riyr/ then undergoes schwa epenthesis, just as /fiyl/ does, in prepausal and preconsonantal position. In fact, the analysis of this epenthesis as an effect of minimal sonority distance entails precisely this generalization: *l* and *r* are identical in sonority and pattern alike in triggering epenthesis.

External evidence supports this account. Pig Latin forms respect the rules: *ear* [iyð] becomes *ear-ey* [iyrey], receiving the usual prevocalic treatment. New words like *Bashkir* are pronounced [baʃkiyð], with schwa and without *r*. My own experience with Arabic is that the rules are also readily transferred to a foreign language. In pronouncing ?*al-waziir*, I must guard against [waziyð], while I might misperceive Arabic *wazii9* as *waziir*.

This analysis leads us to an important conclusion about the structure of the phonology. The existence of underlying representations like /riyr/ entails that the grammar contain a rule of *r* Deletion, since otherwise surface [riyð] could not be derived. Unfortunately, this phenomenon does not provide a comparable argument for *r* Insertion. The (near-)minimal triplet *more*, *mower*, and *Samoa* illustrates the problem. These three words are identical in their prepausal/preconsonantal forms: [(sð)mowð]. Prevocalically, *more* is monosyllabic (*more of* [mowr ðv]) and the others are disyllabic (*mower is* ≡ *Samoa is* [(sð)mowðr Iz]). On this basis, we can justify an *r*-final underlying representation for *more*, but we cannot justify a distinction between, say, *mower* /mowðr/ and *Samoa* /sðmowð/. So, although there is proof of the need for *r* Deletion, there is no corresponding proof from these data of the need for *r* Insertion.

Function Words with *r*. The final argument for the underlying status of *r* in Eastern Massachusetts comes from the complex paradigm in (17) and (18), which involves *r* alternations in the vicinity of function words. The data in (17) show what happens to sequences where a function word follows a "real" word. All the examples involve a vowel-initial function word, either basic (17a, b) or derived by deletion of an initial consonant (17c, d). I have also distinguished between the etymologic linking *r* of (17b, d) and the nonetymologic intrusive *r* of (17a, c).

(17) Lexical Word + Function Word

Underlying Vowel-initial Function Word

a. Intrusive <i>r</i>	b. Linking <i>r</i>
Cuba[r] is ..	Timor is ...
Yemen and Cuba[r] are ...	Yemen and Timor are ..
Cuba[r] and Yemen ...	Timor and Yemen ...
...accused Cuba[r] of ...	accused Timor of ...
...put Cuba[r] on notice.	...put Timor on notice.
...put Cuba[r] input Timor in ...
...put Cuba[r] at odds withput Timor at odds with ...
I saw[r] it.	You're it .

Derived Vowel-initial Function Word

c. Cuba[r] has been ...	d. Timor has been ...
Cuba[r] had better ...	Timor had better ...
Cuba[r] was ... (faster speech)	Timor was ...
Cuba[r] will ...	Timor will ...
Cuba[r] would ...	Timor would ...
It's Cuba[r] he wants to win.	It's Timor he wants to win.
I saw[r] him.	
I saw[r] them.	
I saw[r] her.	
It's more blah[r] than that.	It's farther than that.

The deletion of initial consonants in the function words in (17c, d) is accomplished by various rules inventoried in Zwicky (1970) and Selkirk (1972).

The data in (17) show that, before a function word, intrusive *r* and linking *r* are not distinguished. This is hardly surprising, since our original discussion of *spa* and *spar* made exactly the same point. Now consider the paradigm in (18), which shows sequences of the form function word + "real" word. Remarkably, there is a complete absence of intrusive *r* (18a), although linking *r* appears as expected in (18b):

(18) Function Word + Lexical Word

a. No Intrusive <i>r</i>	b. Linking <i>r</i>
He shoulda eaten already.	They're eating .
[ʃʊdð iy?ðn]	Tom and I are eating .
*[ʃʊdɹ iy?ðn]	Tom and I were eating .
Likewise wanna, coulda,	
mighta, oughta, hafta.	
I'm gonna ask him.	
[ɑŋ gɔnd æskðm]	
*[ɑŋ gɔndɹ æskðm]	
Did you answer him?	Our answer was ...
[dɪjð ənsɔɹɪm]	Their answer was ...
*[dɪjɹ ənsɔɹɪm]	...give her any trouble...
Likewise should you,	
would you, could you.	
Quick to add to any problem.	...for any reason...
[tð əd tð enɪj]	neither apples nor oranges
*[tðɹ əd tðɹ enɪj]	either apples or oranges
Likewise reduced so, by.	
It was quarter of eight.	
[kwɔtɹ ɔ eyt]	
*[kwɔtɹɹ ɔɹ eyt]	
Why do Albert and you ...	
[dð əlbɔt]	
*[dðɹ əlbɔt]	
the apples	
[ðɪy æpɔlz] ~ [ðð æpɔlz]	
*[ððɹ æpɔlz]	

A minimal pair is provided by the contrast between *r*-less *fulla apples* ('full of apples') and *r*-full *fuller apples* = *Fulla[r] apples* ('apples from Fulla's orchard').

Now we can sum up the observations. **Before** a function word or a real word (17), linking *r* and intrusive *r* have exactly the same surface distribution. This is precisely what we expect. **But after** a function word (though not a real word) there is a split -- linking *r* (18b) but no intrusive *r* (18a). We would expect a schwa-final word like *shoulda* to take intrusive *r*, but it does not.

The surface contrast between (18a) and (18b) requires a parallel underlying contrast: underlying *r*-final function words like *for*, *are*, *our*, or *or* must be distinct from vowel-final

ones like *shoulda*, *wanna*, or *the*. Furthermore, the existence of some underlying *r*-final function words entails the existence of an *r* Deletion rule, since this *r* is obviously lost before a consonant or pause: *foʔ Tom*.

That completes the basic argument, but one detail remains: why, as in (18a), is intrusive *r* not found with function words? Later, we will attribute this to general properties of function words, but for now, we need to deal with an explanation suggested by Kahn (1976), who also first noted the facts in (18). Suppose that *wanna* is derived in the postlexical phonology from *want to*, which is underlying /wɔ̃nt tuw/ with a final glide. The sequence *want to eat*, underlying /wɔ̃nt tuw iyt/, would not undergo *r* Insertion because there is no hiatus between *to* and *eat* at this point in the derivation. Later, after *r* Insertion has applied, reduction of unstressed function words (Zwicky 1970, Selkirk 1972) will apply to shorten /tuw/ to [tə].

This ordering solution runs into three insuperable problems. First, as Kahn notes, the analysis requires that all reductions happening at the **beginning** of function words precede *r* Insertion, but all reductions happening at the **end** of function words follow *r* Insertion. The data in (18a) show that the final reductions, including vowel shortening in *wanna* and deletion of *v* in *coulda*, would need to follow *r* Insertion. The data in (17c, d), on the other hand, show that the initial reductions, including deletion of *h*, *w*, and *ð*, must all precede *r* Insertion. This is an improbable coincidence, that typologically similar rules, sorted only by the position in which they apply, should have very different order of application.

Another problem with the ordering solution is that it interpolates one rule of great generality, *r* Insertion, between two sets of highly lexicalized and idiosyncratic rules of reduction. Evidence that the reduction rules are lexically idiosyncratic includes the following:

- ! Vowel shortening applies to *you* but not to *I*, *he*, *she*.
- ! Shortening of only *the* is optionally sensitive to a following vowel. (Other dialects differ.)
- ! Reduction of *to* takes place in normal speech, but reduction of *so* or *by* is restricted to much more casual speech.
- ! Formation of portmanteaus like *wanna* is restricted to a small set of verbs.⁹
- ! Deletion of *ð* applies to *them*, *than* but not *they*, *then*.

Ordering these lexically governed processes after a regular phonological rule like *r* Insertion is implausible and in fact inconsistent with most views of rule typology.

The final argument against the ordering solution comes from non-native speaker intuition. A colleague who has lived for many years in Eastern Massachusetts but does not speak the dialect reports very sharp intuitions about the contrast in (18). There are two possible explanations for this: (i) he has learned this detail of *r* Insertion from long residence among natives; or (ii) the distinction in (18) follows from something shared by all dialects of English or even by all languages. The first explanation is unlikely to be correct, since this same person has very poor intuitions about much more conspicuous properties of *r* Insertion, like whether it applies word-internally. But the second explanation is incompatible with the ordering solution, since the contrast in (18) is pure stipulation.¹⁰

4. Conclusion

We have now examined all of the relevant data, drawn from throughout the phonology of this dialect. The external evidence of loan words and foreign language transfer shows that, whatever the shape of underlying representations, both *r* Deletion and *r* Insertion must coexist in the phonology. The internal evidence leads to the same conclusion. Arguments for *r* Insertion come from the Level I alternations in (8) and the strong verbs in (10). Arguments for *r* Deletion come from both of these plus sonorant syllabicity alternations at Level I (9), syllabic *r* (11), glide+liquid codas (15, 16), and function words (18). It is particularly striking that so many arguments point to the need for *r* Deletion, the rule that is rejected by previous analysts like Johansson (1973), Pullum (1976), and Kahn (1976).

We can now draw some morals, beginning with a diachronic one. The evidence shows that the historically prior process of *r* Deletion was not replaced by its inverse *r* Insertion,

but rather the two came to coexist in the synchronic phonology of this dialect. This means that there was no rule inversion in the sense of (4) because diachronic rule inversion is by definition **replacement** of the Stage I rule by the Stage II one, not coexistence.

In fact, scrutiny of the other examples of diachronic rule inversion in Vennemann (1972) and the subsequent literature casts doubt on the whole phenomenon. A recurring defect of these cases is that the inverse rule is nearly always morphologized. An example of this is Vennemann's account of inversion in the English *a/an* alternation. At Stage I, a rule of some generality deleted *n* preconsonantly. Inversion then took place, so at Stage II the rule inserts *n* prevocally, but only in the indefinite article. A rule that might have been phonological at Stage I is replaced by an undoubtedly morpholexical rule at Stage II. Klausenburger's (1978) account of inversion in the history of French liaison is very similar.

But the very definition of rule inversion in (4) is predicated on the assumption that the rules at both stages are phonological. Inversion is defined on the schema of phonological rules, statements of the form $A \rightarrow B / C$. It is unreasonable to suppose that morpholexical rules are constructed on this same schema, or, even if they are, that *A*, *B*, and *C* are units of the same type. For instance, Lieber (1980) proposes that allomorphs are listed in the lexicon and Vennemann (1974: 151, 153-4n) appears to adopt this view as well. If anything like this is correct, then rule inversion has nothing to do with rules at all -- it is just a matter of swapping one basic allomorph for another one and the entire definition in (4) is a category mistake. The problem is even more profound when the rule has been morphologized even before inversion, as in Vennemann's example of Sanskrit palatal/velar alternations or his vowel analysis of velar softening in English. Similar issues arise for other examples in the literature, including Feʔfeʔ Bamileke (Vennemann 1972), Chadic (Schuh 1972, Leben 1974), and Kamba (Hinnebusch 1974).¹¹

Certainly *r* Insertion is not a morphologized version of *r* Deletion, but neither is it the result of the inversion mechanism in (4), because the rules coexist at Stage II. The conclusion, then, is that (4) does not characterize any real mechanism of historical change.

Still, this leaves us with an important question: how do we get from Stage I with *r* Deletion to Stage II with coexisting Deletion and Insertion? Why is this such a natural change that it seems to have happened independently in Britain and New England? My proposal is that the Stage II situation is actually a historical **generalization** of the Stage I situation and that is why the two processes came to coexist at Stage II. The basis of this generalization is what I referred to in the introduction as synchronic rule inversion.

Constraint-based theories of rule application, because they separate the context of a rule from its structural change, give us a new opportunity to generalize over structural changes. With the structural change divorced from the context, we can state synchronically inverse rules with symmetric structural changes: $A \sim B$ ("A alternates with B") in addition to the familiar $A \rightarrow B$. Separate well-formedness constraints determine whether A or B is the output of the symmetric rule.

The claim here is that *r* Deletion/Insertion is just such a rule: $r \sim \emptyset$. The conditions on this rule are expressed by the constraints on syllabic well-formedness in (19):

- (19)
- a. Coda Condition
*VrX]_σ
 - b. Anti-hiatus Constraint
*V]_σ[_V

(19a) says that the output of $r \sim \emptyset$ is \emptyset in the coda of a syllable, where *r* is prohibited. (19b), on the other hand, expresses the condition under which the output of $r \sim \emptyset$ is *r*, to resolve hiatus. The choice between *r* or \emptyset is made straightforwardly, in satisfaction of the conditions in (19).¹²

This interpretation of the synchronic situation gives a quite different perspective on the history. Prior to Stage I, there was a pan-dialectal weakening of *r* in coda position. At Stage I in some dialects, this weakening led to *r* Deletion -- formally, $r \rightarrow \emptyset$ under the constraint in (19a). But already at Stage I, the grammar contained some form of the constraint (19b) as well. This is because (19b) is just a special case of the universal Onset Rule (Steriade 1982, Itô 1989), which restricts or prohibits onsetless syllables. There is abundant evidence

for the Onset Rule at Stage I. One obvious consequence is the resyllabification of linking *r* in *The spar—is*. Another, more subtle consequence (from Ross (1972: 258n.)) is the exceptionless rule of prevocalic tensing and gliding (VV → VGV), which has the effect of completely eliminating hiatus in the Level I morphology.¹³

It follows, then, that there was no real change in (19) between Stages I and II. The Stage I phonology already contains some form of the Onset Rule, the basis of (19b) and of the intrusive *r* phenomenon. Therefore the only innovation at Stage II is the generalization of the asymmetric rule *r* → ∅ to the symmetric rule *r* ~ ∅. This generalization is the only novel mechanism required to account for the diachronic problem of intrusive *r* and thus for the remaining case of rule inversion.

One matter remains, however, that leads to a refinement of the synchronic analysis. Recall the data in (18), which show that function words do not have intrusive *r*. Although the Anti-hiatus Constraint (19b) is surely the historical basis for intrusive *r*, it cannot explain why hiatus is allowed after a function word. This suggests that a prohibition on hiatus is not the best solution here.

I will briefly sketch an alternative to (19b) that solves the problem of function words, and then I will provide more detailed justification for it. The proposal is that, instead of a constraint on syllable structure (19b), the phonology contains the following constraint on word structure:

(20) Word Structure Constraint
 $*V]_{Wd}$

That is, vowel-final words are prohibited. This constraint is enforced when the category Wd first becomes available, at the end of Level I. It triggers insertion of *r* in all vowel-final words like *spa*, *tuna*, or *yaw*. (Glide-final words like *see* or *high* already respect (20).) In the postlexical phonology, this final *r* is subject to the Coda Condition (19a), so it must either be resyllabified as an onset (*spa[r]* *is*) or deleted (*spa*, *spa seems*). Underlying final *r*, required in a form like *rear*, receives exactly the same treatment in the postlexical phonology. Informal derivations proceed as follows:

(21)			
Underlying	/spα/		/rīr/
Level I Phonology and Morphology	↓		↓
Word Level	[spα] _{wd}		[riyr] _{wd}
(20), <i>r</i> ~ ∅	[spαr] _{wd}		"
Level II Morphology, other rules	↓		↓
	σ σ σ σ		σ
	σ σ σ σ		
(19a), <i>r</i> ~ ∅	spα spαr Iz		riy∅ riyr Iz

This approach may seem counterintuitive, since the Word Structure Constraint (20) is not surface-true and some *r*'s are inserted only to be deleted later (cf. Pullum (1976)). Still, there is a great deal of convergent evidence for the plausibility of this account.

The Word Structure Constraint (20) is paralleled by similar constraints in other languages and even other English dialects. In Arabic (McCarthy and Prince 1990), stems are subject to (20), which holds exceptionlessly at a relatively abstract level of representation but not at the surface. The closest analogue to (20) in an English dialect is the "Bristol *l*", which is added after all final schwas (whether in hiatus or not), so *area* and *aerial* are homophones. In Southampton, *r* serves a similar role. In both cases, a plausible interpretation is a prosodic requirement that all words end in a heavy syllable (assuming *α* and *∅* are long).¹⁴

Only real words are subject to (20), not function words. Function words are not of the category Wd, and so they do not receive intrusive *r*. There are abundant precedents for the immunity of function words to constraints on word structure. Similar to (20) are constraints on minimal word size, which notoriously do not apply to function words (McCarthy and Prince 1990). In fact, English is an instance of this: function words of the form C∅ are

possible, but real words are not, whence the idiosyncratic lengthening in CV monosyllables like *spa* (cf. Chomsky and Halle (1968: 214-6)). Function words can also differ from real words segmentally: real words in English begin with θ , never δ ; function words begin with δ , never θ .

Nevertheless, there is one circumstance when function words are of the category Wd --- when they are phrase-final (Selkirk 1984: 366). Under the assumption that phonological constituency is hierarchical and is imposed exhaustively (Selkirk 1986: 384), the edge of a phonological phrase must always coincide with the edge of a phonological word. Under exactly this condition, intrusive *r* **does** follow function words:¹⁵

(22)
I said I was gonna[r] and I did.
Did you[r] or didn't you? [diʝɹ]
We oughta[r] if we're asked.
If you hafta[r], I'll help.

These cases, where the strict layering of phonological constituents demands that function words like *gonna* be analyzed as Wd, provide striking confirmation for the claim in (20) that intrusive *r* is a Wd-final phenomenon.

The derivation in (21) demands that the Coda Condition (19a) not apply until the postlexical phonology, since *r* is inserted and preserved throughout the lexical and word phonology. There is ample evidence in support of this. It is required by the analysis of words like *fear* in (15), which presupposes that *r* is a candidate coda, blocked by minimal sonority distance. Closed Syllable Shortening in the lexical phonology (Myers 1987) also requires syllabification of *r* as a coda to account for alternations like *hear/heard* or *sincere/sincerity*. Stress assignment indicates that *r* codas make syllables heavy at Level I, providing further evidence that the Coda Condition is not enforced lexically.¹⁶

In other respects, the analysis follows well-established properties of English phonology. Final consonant extrasyllabicity is a necessary part of the whole system of lexical syllabification in English (Borowsky 1986). The point at which the category Wd becomes available is the Word Level of Borowsky (1986, 1990). The Word Level is the domain of many other dialect-specific rules in English. The constraint (20) presupposes prior application of the various tensing and diphthongization rules (to prevent intrusive *r* in glide-final words like *see*), all of which are part of the Level I phonology exclusively.

This completes the argument. Two main results emerge from this close study of *r* in Eastern Massachusetts. One is diachronic: rule inversion is not a mechanism of historical change. The other is synchronic: within a constraint-based theory, symmetric rules of the form $A \sim B$ are possible. In fact, the whole of the *r* phenomenon for the fundamental role of prosodic well-formedness conditions in phonological structure.

Notes

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1. Thanks to Alan Prince for bibliographic consultation.
2. Although I have consulted my own intuitions and observations throughout this work, most of what I say can be confirmed in other studies, including Whorf (1943), Trager (1943), Carlson (1973), Kahn (1976), Kurath and McDavid (1961), Thomas (1961), and Parslow (1967).
3. Vennemann (1972:216) actually proposes that there are three stages in the inversion of *r*

Deletion:

Stage I.	$r \rightarrow \emptyset / V_ \#C$
Stage IIa.	$\emptyset \rightarrow r / V_ \#V$ <i>in certain words</i>
Stage IIb.	$\emptyset \rightarrow r / V_ \#V$

I disregard this complication, since it does not make sense. Stage I and Stage IIa have different grammars but produce exactly the same surface representations. It follows, then, that the next generation of language learners is no closer to Stage IIb for having parents at Stage IIa whose utterances are identical to those of grandparents still at Stage I. Therefore we might as well dispense with Stage IIa entirely. This has the additional advantage of eliminating the need for an otherwise unprecedented type of historical change, the generalization of a completely lexicalized rule (insert *r* in certain words) to a completely phonological one (insert *r* everywhere).

4. Vogel (1986: 58) presents a different kind of argument against the historicizing analysis in (6). In a phonology with both Insertion and Deletion, it is an accident that both rules specify the utterance as their domain. This argument is based on the assumption that any rule can specify any domain, which seems unduly pessimistic. In any case, the problem is easily resolved if Deletion and Insertion are syllabically conditioned and syllabification takes the utterance as its domain.

5. Transfer of *r* Deletion to other languages is an obvious feature of my accent when speaking German or Arabic. I have not noticed any transfer of *r* Insertion, perhaps because it requires greater fluency, which I lack, and because I take great care to use glottal stop instead.

6. Kahn (1976:115) concludes for very different reasons (having to do with lexically governed variation) that *r* Deletion and Insertion coexist in New York City speech. He sees the historical development as a result of external influence.

7. The significance of these examples has been noted previously by Johansson (1973), Pullum (1976), and Mohanan (1985).

8. Rubach (1977:23ff.) and Borowsky (1986) are recent treatments of the phenomenon. Lightner (1983:93f.) gives a more than exhaustive list of morphemes showing the syllabicity alternation.

9. The parallel between contracted *wanna* and simple *to* in resisting intrusive *r* supports Pullum and Postal's (1979: 696n.) position against a treatment of *wanna* as a relexicalized verb of some kind.

10. Although the evidence from the Eastern Massachusetts dialect is unambiguous, there is a report from Sivertsen (1960: 138) that Cockney has intrusive *r* with the indefinite article, which can be *a* prevocally in this dialect. But the same report also shows intrusive *r* in phrases like *high[r]* house or *how[r]* old, where intrusive *r* would be impossible in New England or RP. So the intrusive *r* in Cockney may be a profoundly different phenomenon.

11. Vennemann (1972) presents another example of inversion where the Stage II rule is arguably phonological: vowel/zero alternations in English plurals, genitives, preterites, and so on. The proposed inversion here is from a syncope rule at Stage I to an epenthesis rule at Stage II. This case bears interesting similarities to the *r*/ \emptyset alternation discussed in the text, but it has one major defect: there is no solid evidence for epenthesis over syncope in the synchronic phonology. Zwicky (1974) reviews the problem thoroughly; Borowsky (1987) is one recent treatment.

12. One might imagine an account of Eastern Massachusetts *r* based on something like an empty C with default *r*. This is not a viable alternative, as evidenced by phenomena like (12) and (15), which show that *r* has specified phonological properties even in the lexical phonology.

13. Ross (1972) refers to a paper "English Vowel Non-sequences" that evidently deals precisely with the topic of avoidance of hiatus in English. Apparently this paper was never published and I have been unable to obtain a copy.

14. Information on these dialects comes from Wells (1982: 344) and Hughes and Trudgill (1979: 32). The Bristol *l* is heavily stigmatized, hardly surprising since all linguists feel compelled to repeat the jokes about a man with three daughters named Idle, Evil, and Normal, and about a dancer who said "I can rumble but I can't tangle".
15. Thanks to Lisa Selkirk for eliciting these examples from me.
16. Another indication that *r* codas are found lexically comes from pre-*r* vowel quality. In Eastern Massachusetts, there is a three-way contrast among *hoarse* [hos], *loss* [lɔs], and *horse* [hos] ~ [hɔs] (Laferriere 1979). The words *hoarse* and *loss* can have underlying representations identical to their surface representations; the problem lies in accounting for the variation in *horse*. If it is underlying /hɔrs/, then the variation can be expressed by a rule sensitive to postvocalic *r*. But this account presupposes an *r* coda in a position where it could not be extrasyllabic, before a syllabified final consonant.

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