

# English schwa insertion before liquids and phonological opacity\*

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## 1. Introduction

The interaction between schwa insertion before tautosyllabic liquids and postvocalic *r* loss in Eastern Massachusetts English has been analysed as an opaque interaction of phonological processes by Halle and Idsardi (1997) as well as by Orgun (2001).<sup>1</sup> Halle and Idsardi claim that this kind of opaque rule interaction cannot be handled in parallelist Optimality Theory (OT, Prince & Smolensky 1993, McCarthy & Prince 1995, 1999). They criticise in particular the account of *r* loss and intrusion provided by McCarthy (1993). Orgun (2001) gives an account of this apparent opaque interaction in terms of Sympathy Theory (McCarthy 1999). In this paper, I examine the data from a broader perspective, looking in particular at the interaction of schwa and *r* in different non-rhotic varieties of English (in particular British English). It turns out that there are solid cross-varietal data supporting the claim that *r* is not deleted in coda position but rather weakened to a schwa or merges with the preceding non-high vowel (e.g., Kamińska 1995). On the basis of this I analyse *r* intrusion as glide formation, parallel to the insertion of high glides in hiatus position after high vowels (following, e.g., Kahn 1976, Broadbent 1991, Gnanadesikan 1997, Ortmann 1998, Baković 1999). If *r* loss is understood as weakening the issue of opacity disappears in this context. Finally, I provide an optimality theoretic account of the emergence of schwa and the loss and intrusion of post-vocalic *r* that obliterates the Sympathy account provided by Orgun and reflects the insights into the phenomenon sketched above. In conclusion, this paper does not solve the problem with opacity encountered in OT in general, it rather shows that for the development of phonological theory it is essential not to lose the connection to the linguistic facts.

The paper is organised as follows. Section 2 introduces first the basic facts of *r* loss and insertion and of schwa formation before liquids and discusses the analyses given by Halle and Idsardi (1997) and Orgun (2001). Section 3 provides arguments for an alternative account and implements this account in OT. Constraint reranking is then used in this section to explain microvariation in the pattern across speakers/accents. Section 4 concludes.

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<sup>1</sup> In this paper, the rhotic will be referred to as *r* in the text and as IPA [ɹ] in examples. The exact phonetic characteristics of the sound in the varieties to be discussed are not of major relevance.

## 2. The data and the problem

### 2.1 The data

The defining characteristic of non-rhotic varieties of English is the absence of *r* in postvocalic position in words which have *r* in this position historically (reflected by English orthography) or in other (rhotic) varieties as illustrated in (1a-d). In many non-rhotic varieties an *r* occurs after non-high, non-front vowels in hiatus position, at morpheme (1g,h) and word junctures (1i,j).

#### (1) English *r* neutralisation, linking and intrusive *r* (Eastern Mass. and BBC/RP)

a. [kɜ:l]	'curl'	f. [kɜ:lɪj]	'curly'
b. [sɔ:]	'soar'	g. [sɔ:ɹɪŋ]	'soaring'
c. [sɔ:]	'saw'	h. [sɔ:ɹɪŋ]	'sawing'
d. [kɑ:]	'car'	i. [kɑ:ɹɔ:bɑɪk]	'car or bike'
e. [aɪdɪə]	'idea'	j. [aɪdɪəɹɪz]	'idea is'

In the literature, a difference is made between linking *r* and intrusive *r*. Those postvocalic *rs* that are realised in hiatus position which have been lost historically are referred to as linking *r* (1g,i), while those *rs* that do not have an underlying or historical source are referred to as intrusive (1h,j). Schwa is inserted after the tense vowels /i:, eɪ, əʊ, u:/ before intersyllabic *r* and *l* (Wells 1982: 289). According to Halle and Idsardi (1997) and Orgun (2001) transitional schwa occurs in Eastern Massachusetts only if the liquid is in the same syllable, i.e., not in the cases in (2d). According to Wells (2000), the schwas in (2b,d) are optional. Hence, in Eastern Massachusetts the words in (2d) have no schwa, but for some speakers of Standard British English they have one.

#### (2) Schwa insertion before *l* and *r* in British English

a. [kɜ:l]	'curl'	c. [klɪə]	'clear'
b. [kuəl]	'cool'	[aɪələnd]	'Ireland'
[iəl]	'eel'	d. [ɪnfɪ(ə)ɹɪə]	'inferior'
[eɪəl]	'ale'	[paɪ(ə)ɹət]	'pirate'
		[baɪ(ə)ɹən]	'Byron'

Optionality combined with smoothing results in the alternative outputs in (3) in British English (Wells 1982).

#### (3) Alternatives in British English

[paɪəɹət]	/	[paɪrət]	/	[pa:ɹət]	/	[paɪrət]	'pirate'
[baɪəɹən]	/	[baɪrən]	/	[ba:ɹən]	/	[baɪrən]	'Byron'
[aɪələnd]	/	[aɪlənd]	/	[a:lənd]	/	[aɪlənd]	'Ireland'
[eɪəl]	/	[eəl]	/			[eɪl]	'ale'

Even though intervocalic *r* can be preceded by schwa for some speakers this is not possible for any speaker with *l* in the same context in mono-morphemic forms.

(4)	a.	[hi:ləm]	'helium'	*[hiələm]	b.	[iəri / i:ri]	'erie'
		[vi:ləm]	'velum'	*[viələm]		[pɪəriəd / pi:riəd]	'period'
		[dʒu:liən]	'Julian'	*[dʒuəliən]		[dʒʊəri / dʒu:ri]	'jury'
		[pɪkju:liə]	'peculiar'	*[pɪkjuəliə]			
		[paɪlət]	'pilot'	*[paɪələt]		[vaɪərəs / vaɪrəs]	'virus'
		[əsailəm]	'asylum'	*[əsaiələm]			

In morphologically complex forms, though, schwa can optionally be inserted before intervocalic *l* for some speakers of British English as well as American English (Wells 1982) (5a,b). Schwa is not optional in the same context before *r* (6). The morpheme class of the attached affix does not matter here as can be seen from comparing (5a) and (5b) as well as (6a) and (6b).

(5)	a.	[hɪ(ə)l]	'heal'	b.	[vaɪ(ə)l]	'vile'
		[hɪ(ə)liŋ]	'healing'		[vaɪ(ə)lə]	'viler'
		[hɪ(ə)lə]	'healer'		[vaɪ(ə)ləst]	'vilest'
(6)	a.	pjuə	'pure'	b.	hɪə	'hear'
		pjuərə	'purer'		hɪəriŋ	'hearing'
		pjuərəst	'purest'		hɪərə	'hearer'

We can conclude that *l* and *r* behave differently as triggers for schwa insertion. The former triggers the emergence of schwa only if it is tautosyllabic with the preceding vowel, while *r* triggers schwa in a wider context for some speakers.

The issue addressed by Halle and Idsardi and by Orgun is how schwa can emerge in forms such as those in the first row of (6). They assume that these schwas emerge because the underlying *r* triggers its appearance before itself is deleted. Under such an analysis this is an example of counterbleeding opacity (Kiparsky 1973a). I will first go through their analyses in the next section and then motivate an alternative analysis of the appearance of schwa in these contexts as a transparent phonological process.

## 1.2 Two opaque analyses

Halle and Idsardi provide an analysis in the derivational framework of Lexical Phonology (Kiparsky 1982, Mohanan 1986) and propose a revision of the Elsewhere Condition (Kiparsky 1973b). I will not go into the details of the latter.

In a nutshell, they assume that words like 'clear' have an underlying *r*. At an early stage of the derivation this *r* is in the same syllable as the preceding tense vowel, creating the context for schwa epenthesis. After the application of schwa insertion the *r* is deleted by a later rule. The Elsewhere Condition comes into play where the ordering of the two rules of *r* deletion and insertion is concerned. The two rules are ordered by the Elsewhere Condition and applied disjunctively, i.e., 4 does not apply to structures meeting the output conditions of 3 in (8).

(8) Derivational analysis (along the lines of Halle & Idsardi)

	Underlying	/klir/	/klir +ɪŋ/
1.	schwa insertion before liquids	klɪər	klɪər
2.	affixation	-/-	klɪərɪŋ
3.	<i>r</i> insertion	-/-	-/-
4.	<i>r</i> deletion	klɪə	-/-
	Output	klɪə	klɪərɪŋ

Since OT is an output-oriented parallelist theory and therefore cannot make reference to intermediate stages in a derivation Halle and Idsardi conclude that the theory is not capable of capturing these data and therefore should be rejected. Besides this, McCarthy (1993) rejects *r* as the unmarked consonant of English and has to assume a rule of *r* insertion, which he adds as a language-specific rule to GEN in English. Halle and Idsardi instead regard *r* intrusion as an unnatural process and maintain that this can be formulated without any problem as a language-specific insertion rule in a derivational rule-based theory.

Orgun (2001) reanalyzes the data in Sympathy Theory (McCarthy 1999). He assumes a shorthand constraint CODA-COND (9) which triggers schwa insertion.<sup>2</sup>

(9) CODA-COND: a syllable may not end with [jɪ], [jɪr]

Following McCarthy (1993) he also assumes a markedness constraint that requires *r* to be in onset position (see 23 below), which causes deletion of postvocalic *r*. FINAL-C is responsible for the emergence of *r* in hiatus position (see 17 below). Schwa insertion is illustrated in transparent environments in tableau (10), taken from Orgun (2001:745).

(10)	/fijl/	CODA-COND	ONSET- <i>r</i>	FINAL-C	MAX-C	DEP-V
a.	fijl	*!				
b.	fij				*!	
☞ c.	fijəl					*
d.	fijlə			*!		*

For the opaque form a sympathy relation between the optimal candidate and a failed candidate is assumed. The failed candidate fares best with respect to MAX, because *r* is not deleted, hence MAX-IO is the selector constraint. The sympathy faithfulness constraint that causes overapplication of schwa epenthesis has to be a

<sup>2</sup> Note that both Halle & Idsardi as well as Orgun transcribe the tense vowel as a diphthong [ij]. Since this phonetic detail of Eastern Massachusetts is not crucial I have omitted this and throughout this paper I use the transcriptions in Wells (2000).

MAX constraint guarding only the faithful mapping of vowels between sympathetic and optimal candidate. (11) is also taken from Orgun (2001:748).<sup>3</sup>

(11)	/klir/	*CODA-r	MAX <sub>o</sub> -O-V	MAX <sub>o</sub>	CODA-COND	DEP
Φ <sup>4</sup> a.	klɪj		*!	*		
b.	klɪjɹ	*!	*		*	
⊗ c.	klɪjəɹ	*!				*
☞ d.	klɪjə			*		*(!)

There are several problems with this account. First, it analyses the emergence of schwa here as an opaque phonological process. I will show below in section 3 that there are good reasons to assume that this is not the case. Furthermore, the difference in the behaviour of *l* and *r* as triggers of schwa emergence is neither detected nor accounted for. Last but not least, an account which uses less theoretical machinery and is more intuitive should be preferred on economic grounds.

The same criticism holds for Orgun's explanation of *r* as the emergent intrusive consonant after non-high vowels in non-rhotic varieties of English. Orgun proposes a markedness scale with negative markedness constraints that reflects the markedness situation in codas and one with positive markedness constraints that reflects preferences for nucleus position to explain the lack of *j* and *w* insertion after low vowels and the emergence of *r* in this context. This analysis does not capture the nature of these segments as offglides of the preceding vowel.

### 3. An alternative

In this section, I will first show that *r* alternates with schwa in English and then give a formal account of intrusive *r* as an offglide of low vowels (Kahn 1976, Broadbent 1991, Gnanadesikan 1997, Ortman 1998, Baković 1999) in satisfaction of the constraint FINAL-C (McCarthy 1993) in 3.2. In 3.3-3.5 I give a formal account of the emergence of schwa as a correspondent of underlying *r* and the interaction of linking *r* and schwa in morphologically complex forms. Finally, I account for the variation in the emergence of schwa before heterosyllabic *rs* shown above.

<sup>3</sup> In this tableau, Orgun has replaced ONSET-*r* by \*CODA-*r*, and having both constraints is important for his analysis of *r* insertion to work. Below, however, we will see that the assumption of a positive markedness or licensing constraint that demands *r* to be in onset position, rather than a negative one which bans *r* from coda position is crucial for the analysis of *r* loss and emergence, while the negative constraint is not necessary at all.

<sup>4</sup> Celtic cross just added to boost proliferation of unnecessary symbols - no theoretical status. It indicates the candidate that would be optimal without the specifics of the analysis, i.e., Sympathy, and which has to be excluded.

### 3.1 Schwa/r alternation

The central question here is whether the schwa in words such as 'hear' actually is a direct correspondent of underlying *r* or whether this schwa emerges as an effect of a constraint against tense high vowel plus liquid sequences. As we have seen above the distribution of schwa before liquids varies slightly. A first piece of evidence that schwa in this context is a reflex of underlying *r* comes from old RP speakers as cited in Kamińska (1995).

(12)	saw	sawing	sore	soring	call
Very old RP speakers	[sɔ:]	[sɔ:ɪŋ]	[sɔə]	[sɔəɪŋ]	[kɔ:l]
Young RP speakers	[sɔ:]	[sɔ:ɪŋ]	[sɔ:]	[sɔ:ɪŋ]	[kɔ:l]

For old RP speakers, /ɔ/ is treated like /ɛ/, i.e., the liquid /ɹ/ is not compatible with the feature specifications of these vowels, hence no lengthening occurs, but rather *r* is vocalised to a schwa, as can be seen from the very old RP speakers' realisation of 'sore'. Another interesting fact is that the schwa is realised as well in the morphologically complex form 'soring', which does definitely not provide the environment for transitional schwa at any conceivable level of analysis, since the back vowel in these words does not trigger transitional schwa before liquids in any accent. There is a parallel between *r* and /ɪ/, though, in that postvocalic /ɪ/ has a tendency to vocalise as well, resulting in a relatively high back vowel, as attested in Derby and Newcastle (Docherty & Foulkes 1999) or South East London (Tollfree 1999), for example. However, *r* vocalisation is independent of /ɪ/ vocalisation, since there are non-rhotic accents without /ɪ/ vocalisation, such as the Cardiff variety (Mees & Collins 1999), while Glaswegian is fully rhotic and has postvocalic /ɪ/ vocalisation (Stuart-Smith 1999).

In conclusion, surface schwa in words such as 'clear' is a surface correspondent of underlying *r* rather than the reflex of vowel-liquid transition at an abstract level. In consequence, *r* behaves just like the two glides *j* and *w* which alternate with vowels and which also emerge in hiatus positions. This will be used in the next section (3.2) to explain *r* insertion as a natural process, contrary to what McCarthy (1993), Halle & Idsardi (1997), or Hale & Reiss (2000) suggest, i.e., that *r* insertion is an unnatural process, because of the choice of epenthetic segment. Section 3.3 then provides a formal analysis of *r*/schwa alternation and gives an account of the emergence of schwa in morphologically complex contexts, as in 'fear-ing'. If we analyse final schwa in the monomorphemic words as a reflex of underlying *r*, the emergence of schwa in the above mentioned complex words becomes a mystery at first sight since the *r* is realised in onset position and there is no need for vocalisation.

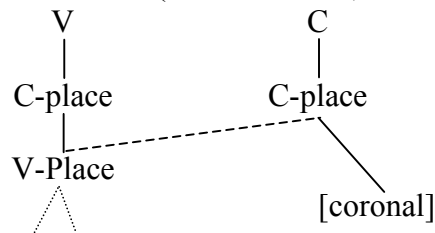
### 3.2 The source of intrusive r

Generally, intrusive *r* is assumed to occur as a resolution of vowel hiatus, i.e., two adjacent vowels in different syllables. I follow McCarthy (1993) here, assuming that *r* emerges in satisfaction of the constraint FINAL-C. This sounds a bit unjustified at first since intrusive *r* also occurs inside words, as in 'sawing'. I will respond to this in the course of this section. First, it should be noted that in many accents of English the high vowels are actually diphthongised as in (14). In (14), the affixes are in round brackets indicating that the vowels are diphthongised regardless of the presence of the affix.

- (14)      [sj(ɪŋ)]            'see(ing)'  
              [tʃuw(ɪŋ)]        'chew(ing)'

For many speakers, the tense high vowels are all diphthongised, for some there is diphthongisation only in hiatus contexts. Glide formation in avoidance of hiatus was analysed by Ortmann (1998) with an autosegmental rule. Ortmann includes English *r* insertion in the set of phenomena covered by this rule, i.e., *r* is a non-high glide in this account. He assumes that a segment position is inserted and filled with the features of the preceding vowel. The consonantal nature of the segment can then be derived by its syllable position, with onset position requiring a consonantal place feature, such as coronal as indicated in Bermúdez-Otero's (2005) analysis of *l* intrusion.<sup>5</sup>

- (15) Intrusion in hiatus context (Ortmann 1998, Bermudez-Otero 2005):

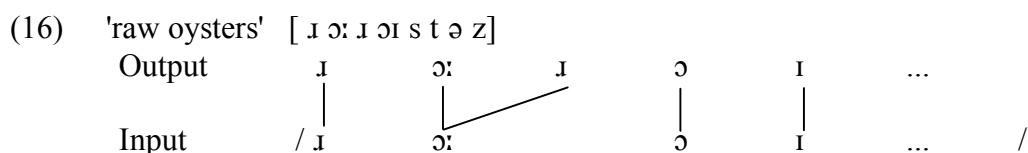


In OT, glide formation is formalised as multiple correspondence: The 'inserted' glide is determined in its quality by the preceding vowel since the whole segment originates in the latter, i.e. this is a case of copying or 'gemination' - rather than insertion (Baković 1999). I will follow this line of thought here.<sup>6</sup>

<sup>5</sup> In Bermudez Otero's analysis, the intrusive *l*, found in American English dialects (Gick 1999), has an additional specification for the feature [lateral] linked to the root node, as is the standard assumption for manner features. A detailed discussion of the differences between *l*-intrusion and *r*-intrusion and how a candidate with an *l* can ever be more optimal than a candidate with *r* is beyond the scope of this paper. In a nutshell, though, *r*-intrusion might be blocked in *l*-intrusion dialects by a high ranking constraint against nonhigh glides, which is violated by intrusive *r* but not by intrusive *l*.

<sup>6</sup> The idea that *r* insertion is parallel to high glide formation and that the rhotic acts as a nonhigh glide has been put forward several times in the literature (see references above). For a different

In OT, we can make a difference between insertion and glide formation by mapping one underlying segment to two surface segments, i.e., multiple correspondence. This analysis is graphically illustrated in (16). The underlying non-high vowel of 'raw' is mapped to two surface segments, of which the second one is realised as consonantal due to its syllabic position. The analysis is the same for high glides. In such an analysis, glide formation does not violate anti-insertion constraints, such as DEP-IO, but rather constraints responsible for the one-to-one mapping between input and output, such as INTEGRITY (McCarthy & Prince 1995) or \*MC (Lamontagne & Rice 1995, see below).



There has to be a constraint exerting pressure to choose the form with intrusion over conceivable competing candidates, such as one with glottal stop epenthesis and one without any change. Emergence of the consonant is triggered by the constraint FINAL-C as proposed in McCarthy (1993), (17). In words with an underlying final *r*, *r* is dropped in satisfaction of a markedness constraint requiring *r* to be in onset position (McCarthy 1993, see also Orgun's 2001 analysis). Hence, ONSET-*r* has to be ranked higher than FINAL-C, since otherwise we would get *r* intrusion for all words with word-final non-high vowels (as is attested in some so-called hyperrhotic American accents, where words like 'idea' end in an *r*).<sup>7</sup>

(17) FINAL-C: Every word ends with a consonant.

Glottal stop insertion would violate the anti-epenthesis constraint DEP-IO. However, the mapping of one segment to several violates the constraint No

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view see Uffmann (in press). Uffmann argues that *r* cannot be a glide, since, in his view, glide formation is an all-or-nothing choice; either all features are copied or none (i.e., no glide insertion). There are two major objections against this opinion. First we have seen above that *r* alternates with schwa. This puts this alternation on a par with high vowel - glide alternations. Second, phonetic measurements have shown that postvocalic *r* has much more vocalic qualities, such as greater intensity and clearer formant structures) than pre-vocalic *r* (Olive, Greenwood & Coleman 1993). Hence, the phonetics of *r* also suggest that it is a non-high glide in linking and intrusion contexts.

<sup>7</sup> In large parts of the literature it is assumed that *r* insertion happens to avoid vowel hiatus, while McCarthy argues *r* insertion to be triggered by a requirement on words to end in a consonant (as a sort of boundary marker). Even though McCarthy's (1993) arguments concerning the syntactic distribution of *r* insertion in Eastern Massachusetts are convincing there are some accents which defy this analysis. In South East London English, for example, *r* is inserted at the beginning of words, following a determiner, as in [ɜ:ɪæ:s] 'a house' (Tollfree 1999: 174) (not 'our house'). According to the analysis of English clitics in Selkirk (1995) the prosodic word boundaries should be before the determiner and after the noun. Thus, a full-blown account of the variation of *r* insertion across accents would have to utilise two triggering constraints, FINAL-C and NOHIATUS or ONSET.

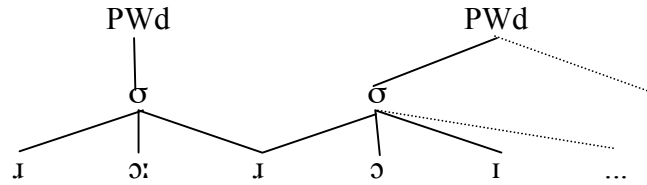


Multiple Correspondence (\*MC), proposed by Lamontagne & Rice (1995) to account for gemination and coalescence patterns.

(18) \*MC (Lamontagne & Rice 1995): No Multiple Correspondence. 'For every segment/feature in the input there is one correspondent segment/feature in the output. I.e., no coalescence and no gemination.'

A last ingredient we need for the analysis is a prosodic analysis of intervocalic *r* at the end of words. If *r* emerges in satisfaction of FINAL-C, then it has to be final in the first word in (16), but it also has to be word-initial in the following word to avoid violation of high ranking ONSET-*r*. Kahn (1976) proposed the overlapping structure in (19) for consonants at word juncture, which was adopted by McCarthy (1993) in his analysis of *r* insertion.

(19) Prosodic structure (Kahn 1976, McCarthy 1993)



Assuming this structure we can turn to the evaluation of potential candidates for word junctures with intrusive *r*. In tableau (20), the faithful mapping without any intrusive consonant is excluded for violation of high ranking FINAL-C. The choice between glottal stop epenthesis and low glide formation is made by the ranking of DEP-IO above \*MC.

(20)	/aɪdɪə ɪz/	FINAL-C	DEPIO	*MC	IDENT(cor)
a.	aɪdɪə ɪz	*!			
b.	aɪdɪəʔɪz		*!		
☞ c.	aɪdɪə.ɪz			*	*

To account for word-internal intrusive *r* we have to establish a word boundary between root and affix. Inkelas (1998) assumes a nested prosodic word structure for morphologically complex words in English, as in ((sɔ:l)<sub>PWd</sub>ɪŋ)<sub>PWd</sub>. In OT, such a prosodic word boundary between root and affix is enforced through alignment. The responsible alignment constraint is given in (21).

(21) ALIGNR(Root, PWd): 'The right edge of every root coincides with the right edge of a prosodic word.' (McCarthy and Prince 1993)

(22)	/ sɔ: -ɪŋ /	ALIGNR(R,PWd)	FINAL-C	DEPIO	*MC	IDENT(cor)
a.	(sɔ:ɪŋ)	*!				
b.	(sɔ:)ɪŋ)		*!			
☞ c.	((sɔ:ɪ)ɪŋ)				*	*

In form (22c), *r* is ambisyllabic, i.e., in onset and in coda position, just like the *r* at word junctures discussed above.

The final ingredient of the analysis of *r* phenomena is the exclusion of coda *r*. As said above FINAL-C and ONSET-*r* stand in direct conflict as far as word-final *r* is concerned. Tableau (24) shows that even underlying word-final *r* is not realised in surface forms due to high ranking ONSET-*r* and in violation of FINAL-C.

(23) ONSET *r*: *r* should be in a syllable onset.

(24)	/ sɔ:ɪ /	ONSET <i>r</i>	ALIGNR(R,PWd)	FINAL-C	*MC	IDENT(cor)
a.	sɔ:ɪ	*!				
☞ b.	sɔ:			*		

(25)	/ sɔ:ɪ -ɪŋ /	ONSET <i>r</i>	ALIGNR(R,PWd)	FINAL-C	*MC	IDENT(cor)
a.	(sɔ:ɪɪŋ)		*!			
b.	(sɔ:)ɪŋ)			*!		
☞ c.	((sɔ:ɪ)ɪŋ)				(*)	*

In 3.1, I have shown that schwa after high tense vowels is a surface reflex of underlying *r* rather than a transitional schwa. In 3.3, I implement this emergence of schwa in OT.

### 3.3 The source of schwa

Another argument against Halle & Idsardi's as well as Orgun's claim that schwa before deleted *r* stems from the same process as the schwa before tautosyllabic *l* comes from the observation that in some British English accents pre-rhotic schwa emerges in a wider context than pre-lateral schwa, as we find schwa for example in words like *pirate* (unlike in Eastern Massachusetts). Furthermore, all speakers seem to have a schwa before the rhotic in morphologically complex words such as *fearing*, but the schwa before the lateral in *feeling* is optional for some speakers and some don't produce a schwa in this context at all.

In the analysis of schwa/*r* alternations I do not go into the details of the featural analysis. For the current purpose it is sufficient to assume that *r* is incompatible with the vocalic feature [high] and has the place feature coronal, which schwa lacks. Thus, *r* vocalisation is the mapping of this consonant to the surface into a position where it is banned under minimal changes in its featural identity. This is reflected in tableau (26).

(26)	/ f <sub>1</sub> i <sub>2</sub> r <sub>3</sub> /	ONSET <i>J</i>	MAX	IDENT(hi)	IDENT(cor)
a.	f <sub>1</sub> i <sub>2</sub> r <sub>3</sub>	*!			
b.	f <sub>1</sub> i <sub>2</sub> : <sub>2</sub>		*!		
c.	f <sub>1</sub> i <sub>2</sub> : <sub>3</sub>			*!	*
☞ d.	f <sub>1</sub> i <sub>2</sub> ə <sub>3</sub>				*

In this analysis, the emergence of schwa in these forms is a completely transparent process. Hence, the criticism that OT cannot deal with this process has no basis and there is no need for a Sympathy analysis either.

There is a remaining question, however. Why is there a schwa in 'fearing'? There is no apparent need to vocalise the rhotic in such forms. Especially in the variety without schwa formation preceding hetero-syllabic *r*, i.e., with [paɪɹət] rather than [paɪ(ə)ɹət] 'pirate' the schwa in morphologically complex forms comes as a surprise in a surface-true analysis. English doesn't display the kind of alternation we find in German for example (27).

(27) German vowel/*r* alternation    /tir/    [tiə]    [ti:Rə]    'animal/animals'

The absence of this alternation could be taken as evidence that underlyingly there are no postvocalic *rs* in nonrhotic English accents with intrusion, and synchronically there is no such thing as linking *r* in these accents. That is, the underlying form of a word like 'fear' is /fiə/ rather than /fir/, and the *r* in the complex form 'fearing' emerges for the same reason as the *r* in historically *r*-less forms, such as 'drawing', and as the high glide in forms such as 'seeing', as developed in section 3.2. In this case, there is also no reason to assume an opaque interaction of phonological processes. However, the situation is not entirely clear, and the Richness of the Base (Prince and Smolensky 1993) forces us to consider inputs with postvocalic *r* and without schwa. For this reason, I give an account of pre-liquid schwa formation in the next two sections and combine this with the analysis of *r* loss and realisation. First, in section 3.4, I will give an account of 'conservative' speakers, i.e., those speakers with schwa before inter-syllabic *r* in mono-morphemic forms, and then discuss the varieties which do not have schwa in this context, such as the Eastern Massachusetts variety.

### 3.4 Conservative speakers

Orgun (2001) formulated a coda condition on tense vowels followed by liquids as a trigger for schwa formation in syllables with a tense vowel followed by a liquid. Given the different behaviour of *l* and *r* as triggers in this context we can split up the markedness constraint responsible for the emergence of schwa into one banning tautosyllabic tense vowel plus liquid sequences (28a) and one banning tense vowel plus rhotic sequences without reference to syllable structure (28b).

- (28) a.  $*V_{[+t]LIQU}_\sigma$ : 'No tautosyllabic nonlow tense vowels before *l* and *r*.'  
 b.  $*V_{[+t]I}$ : 'No nonlow tense vowels before *r*.'

For conservative speakers we can assume that both constraints are highly ranked. An input /paɪ.ɪət/ turns out with a schwa, but there is never any reason to insert a schwa into an input /hi:lɪəm/. Candidate (29d) is harmonically bounded.

(29)		$*V_{[+t]L}_\sigma$ $*V_{[+t]I}$	MAX IO	DEP IO	ONSET I	FINAL- C	*MC
a.	/paɪ.ɪət/ - paɪ.ɪət	*!					
☞ b.	/paɪ.ɪət/ - paɪə.ɪət			*			
☞ c.	/hi:lɪəm/ - hi:lɪəm						
d.	/hi:lɪəm/ - hɪəlɪəm			*!			

The situation is different, though, for morphologically complex forms. As established above, root final consonants are also in coda position when followed by a vowel-initial affix, due to high ranking ALIGNR. In this variety, schwa surfaces before *l* and *r* in morphologically complex forms. The analysis developed so far accounts for this, as shown in tableaux (30) and (31).

(30)	/ di:l + ɪŋ/	IDENT(hi)	$*V_{[+t]L}_\sigma$ $*V_{[+t]I}$	ALIGNR(R,P)	DEPIO
a.	(di:lɪŋ)			*!	
b.	((di:l)ɪŋ)		*!		
☞ c.	(diəlɪŋ)				*

Tableau (31) also shows a difference between schwa emergence before *l* and *r*. Since schwa and *r* have largely the same feature profile both could be correspondents of underlying *r*. Such a candidate avoids the DEPIO violation incurred by 'dealing' type words.

(31)	/ klɪr + ɪŋ/	IDENT (hi)	$*V_{[+t]L}_\sigma$ $*V_{[+t]I}$	MAX IO	ALIGNR (R,P)	DEP IO	FINAL C	*MC
a.	(kli.ɪŋ)		*!		*			
b.	((kliɪ)ɪŋ)		*!					
c.	(kli)ɪŋ			*!	*		*	
d.	((klɪə)ɪŋ)						*!	
☞ e.	((klɪəɪ)ɪŋ)							*

However, transitional schwa in non-derived environments is on the retreat. In the next subsection, I give an account of the lack of schwa before *r* in mono-morphemic forms ([paɪ.ɪət]) and absence or optionality of schwa before *l* in morphologically derived environments ([di(ə)lɪŋ]).

### 3.5 The progressive grammar

If the markedness constraint  $*V_{[+t]}\mathbf{I}$  is ranked below faithfulness, this instance of schwa formation is blocked in mono-morphemic environments.

(32)		MAXIO	$*V_{[+t]}\mathbf{L}_\sigma$	DEPIO	*MC	$*V_{[+t]}\mathbf{I}$
☞ a.	/paɪ.ɪət/ - paɪ.ɪət					*
b.	/paɪ.ɪət/ - paɪə.ɪət				*!	

In morphologically complex forms, the high ranking alignment constraints still favours candidates which have an ambisyllabic *r*, i.e., have to satisfy still high ranking  $*V_{[+t]}\mathbf{L}_\sigma$ .

(33)	/dɪl + ɪŋ/, /kliɪ + ɪŋ/	ALIGNR(R,P)	$*V_{[+t]}\mathbf{L}_\sigma$	DEPIO	*MC	$*V_{[+t]}\mathbf{I}$
a.	(dɪ:lɪŋ)	*!				
b.	((dɪ:l)ɪŋ)		*!			
☞ c.	(dɪəl)ɪŋ)			*		
d.	((kliɪ)ɪŋ)		*!			*
☞ e.	((kliə)ɪŋ)			*		

Speakers who have no ranking of  $*V_{[+t]}\mathbf{L}_\sigma$  and DEPIO, will show optional realisation of schwa before *l* in such forms. In such a grammar, forms with underlying *r* surface with schwa since the decision between candidates (d) and (e) is left to  $*V_{[+t]}\mathbf{I}$  if the two constraints above this one are unranked, as shown in (34).

(34)	/dɪl + ɪŋ/, /kliɪ + ɪŋ/	ALIGNR(R,P)	$*V_{[+t]}\mathbf{L}_\sigma$	DEPIO	*MC	$*V_{[+t]}\mathbf{I}$
a.	(dɪ:lɪŋ)	*!				
☞ b.	((dɪ:l)ɪŋ)		*			
☞ c.	(dɪəl)ɪŋ)			*		
d.	((kliɪ)ɪŋ)		*			*!
☞ e.	((kliə)ɪŋ)			*		

This completes the formal analysis of schwa/rhotic and schwa/lateral interaction in Eastern Massachusetts and Standard British English.<sup>8</sup>

<sup>8</sup> Ricardo Bermúdez-Otero (p.c.) points out to me that this analysis does not automatically generate accents that have a preference for breaking in forms followed by a vowel-initial clitic over breaking in forms closed by a vowel initial affix, as in the forms 'mail it' / 'mail-er', respectively (Hayes 2000). Hayes (2000) analyses this as a paradigm effect with two different rankable OO-faithfulness constraints, the lower ranked of which referring to morphologically complex forms and the higher ranked constraint referring to phrases. The same effect can be modelled with alignment constraints. For reasons of space, I have to leave this issue for future elaboration.

#### 4. Conclusion

The insertion of schwa between tense high vowels and liquids has been examined in detail in this paper, with particular attention to microvariation across different accents of English. I argued that schwa before liquids and schwa before *r* are in most instances not the result of the same phonological process. In OT terms, it was shown here that word-final schwas after high tense vowels are correspondents of underlying rhotics. This provides the basis for a transparent surface-true analysis of the pattern in OT. Furthermore, the choice of *r* as the inserted consonant to break up a hiatus was regarded as an unnatural arbitrary process (e.g., Hale and Reiss 2000; cf. also Uffmann, to appear, for an alternative proposal). However, if *r*-insertion is seen as glide formation, *r*-loss should be treated in the same fashion, i.e., as vocalisation. Gnanadesikan (1997) and Baković (1999) showed that *r* insertion is a natural process and therefore does not pose a challenge to OT. I showed that the other part of Halle & Idsardi's critique of OT in this connection does not hold either: The pattern of schwa/rhotic interaction can be analysed conveniently and insightfully in OT.

It was not the aim of this study to solve the problem of phonological opacity in OT. And even though we have seen here how an alleged case of opacity evaporates under scrutiny this does not imply that a closer look at the data necessarily has the same consequences for all cases of opacity discussed in the literature. Nevertheless, the current result confirms Itô & Mester's (2003) approach, according to which the uniformity of the phenomenon of opacity stems from the architecture of the theory in which it was dealt with (serialism), and, therefore, hitherto uniform phenomena might turn out to be attributable to diverse mechanisms if approached from a different point of view.

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