r-Intrusion in English Non-Rhotic Dialect: Misinterpretation and Coincidence with Phonetic Naturalness

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Cho, Hye-Sun. 2005. *r*-Intrusion in English Non-Rhotic Dialect: Misinterpretation and Coincidence with Phonetic Naturalness. *SNU Working Papers in English Linguistics and Language* 4, 216-235. This paper argues that the English non-rhotic dialect is triggered by misinterpretation of the ambiguous status of /r/ as UR or glide, and leads to sound change, for it coincides with the phonetically natural process of glide insertion, evidenced by gestural overlap (Gick 1999). English *r*-intrusion should be considered both synchronically (phonetic quality) and diachronically (historical origin). Previous studies have focused on only one side while this paper shows historical trigger and synchronic motivation that leads to sound change. Based on Ohala (1993)'s argument, my proposal traces the process of how the phonetic byproduct becomes a legitimate phonological segment. This study supports the view that sound change is not teleological, but subject to unintended events among speakers. (Seoul National University)

Keywords: *r*-Intrusion, Non-rhotic English, Articulatory Phonology, Misinterpretation, Sound Change, Phonetic Naturalness

1. Introduction: The phenomena and the problems

This paper demonstrates how the inserted /r/ takes place in some dialects of North East American English. British RP drops the word final *r* (*r*-deletion) while North East American English contains the *r*-insertion as well as the *r*-deletion. This phenomenon is mainly found in Boston, Massachusetts, in the southern part of New England. It is widely accepted that the *r*-insertion involves *r*-deletion and linking. Consider the following example sentences.

(1)   a. Etymological *r*

r Linking	*r*-deletion
The spar is broken.	The spar seems to be broken.
He put the tuner away.	He broke the spar.
	He put the tuner down.
You're a little late.	He bought a new tuner.
	You're somewhat late.

b. Unetymological *r*

r-intrusion	No *r*-intrusion
The spa̲r is broken.	The spa seems to be broken.
He put the tunar away.	He put the tuna down.
	The boat tends to yaw some.
The boat'll yawr a little.	Yeah, sure.
Yeahr, it is.	

These examples of *r*-deletion show that the underlying /r/ is not pronounced before a consonant and in the word final position, which is found in RP and the New England dialect. The same underlying etymological /r/ is pronounced when it is followed by a vowel. This phenomenon is referred to as *r*-linking. What puzzles phonologists is the unetymological /r/ which does not exist in the underlying representation as illustrated in (b). While RP has only *r*-linking and deletion, New England English has an unetymological *r* inserted before a vowel, the environment for *r*-linking. For example, the word tuna has no r at the word final, but the unetymological *r* is inserted when it is followed by a vowel. However, no intrusive *r* is found before a consonant. The unetymological *r* has the same distribution before a consonant and a vowel as *r*-linking and *r*-deletion of the etymological *r*. The problem is the question of why the *r*-linking and *r*-deletion is extended to the case where there is no underlying *r*. Rule based theory explains this with rule inversion (Vennemann 1972), and Optimality Theory explains it with constraint ranking that is specific for this dialect. The two phonological theories neglect to explain why, among other sounds, the inserted sound is /r/. Anttila and Cho (1998: 5) argue that

explanation of the motivation for the *r*-intrusion and deletion is a matter of syllable structure and can be separated from the quality of the epenthetic segments. However, what if this phenomenon is closely related to the very quality of the epenthetic segment? Anttila and Cho (1998) predict all the possible types in a given constraint set; however, these are the only logically and mathematically possible sets. Anttila and Cho (1998) cannot guarantee that those possible types really exist in languages. This lack of certainty is due to Anttila and Cho (1998)'s negligence of the quality of *r* and other influencing factors, which may play a decisive role in sifting out non existing patterns.

Some recent studies have succeeded in this respect, giving a phonetically based account for the insertion of *r* in an intervocalic environment. The phonetically based account (Gick 1999, Uffmann 2002) shows that the *r*-insertion can be explained synchronically. However, if phonetic markedness is universal, then why do rhotic and non-rhotic dialects both exist? As for the New England *r*-insertion, it is apparent that a historical development from *r*-deletion to *r*-insertion is involved. What triggers *r*-insertion in this dialect?

As far as we can observe, *r*-deletion always precedes *r*-insertion. Ohala (1993) helps us in this respect. He draws a fine line between the synchronic variation and diachronic variations. 'Hypercorrection' is the way through which synchronic phonological phenomena leads to a diachronic change. This paper argues that misinterpretation of this kind of hypercorrection and its coincidence with phonetic naturalness affect the development of sound change and variation such as the English non rhotic dialect. Furthermore, this explanation is in line with the non teleological viewpoint regarding sound change as mentioned by Ohala (1993).

2. Rule based approach

2.1 Rule inversion

The term 'Rule Inversion' was first used by Vennemann (1972) to illustrate English *r*-intrusion. Though it is still supported by Becker (2003), other studies such as Halle and Idsardi (1997) and McCarthy (1991) deny the plausibility of rule inversion. Rule inversion is a historical

replacement of a former rule by a later rule as defined below (Vennemann 1972, McCarthy 1991).

(2) **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 U D′ = U, D ∩ D′=∅, and D″ is "that subset of D′ in which B and A still alternate".

(3) **Stage I. Eastern Mass. phonology**
   Underlying representations

/spɑ/	'spa'	/spɑr/	'spar'
/tuwnə/	'tuna'	/tuwnər/	'tuner'
/ yɔ/	'yaw'	/yɔr/	'you're'

   Rule: r Deletion
   r→∅ / _____ {C,#}

Stage II. Eastern Mass. phonology
   Underlying Representations
   /spa/'spa' = 'spar'
   /tuwnə/'tuna' = 'tuner'
   /yɔ/'yaw' = 'you're'
   Rule: r Insertion
   ∅→r/V__V

Based on this definition, the Massachusetts r can be explained with the replacement of Stage I (r-deletion) by Stage II (r-insertion). The rule of r-deletion is inverted so as to the rule of r-insertion inserts r in coda positions between vowels. However, McCarthy (1991) criticizes that (3) cannot implement r-loss in word-final or preconsonantal position in case of new words such as Notre Dame University, palaver, Omar. r-deletion does not disappear, but rather co exists with r-insertion. Furthermore, r-insertion/deletion is a productive process because this phenomenon is also found in other languages such as in phrases like ganske[r] op in Danish. In summary, a theory with only r-deletion or with only r-insertion cannot explain this productive phenomenon. It is more plausible that the r-deletion rule emerged first, and subsequently had some effect on the later developed r-insertion rule.

2.2 Rule ordering

Halle and Idsardi (1999) admit co existence of the rules. If two related rules co exist, they should be correctly ordered under Generative rule based grammar. It is widely accepted that *r*-deletion precedes *r*-insertion historically. Halle and Idsardi (1999)'s rule ordering is as follows.

(4) *r*-deletion: r→∅/V_]σ
    r-insertion: ∅→r/V[-high]_]σ V

This rule ordering runs into problems because it makes no distinction between the linking *r* and the intrusive *r*. By the rule ordering (4) above, we get 'Duke of York derivation' /r/→∅→r for the linking *r* since the deleted *r* is repaired by the intrusive *r*. Admitting that linking *r* and coda *r* are phonetically identical, it is hard to view the linking *r* in Homer arrived as non etymologic intrusive *r* rather than etymological. To avoid 'Duke of York' gambit problem, Halle and Idsardi (1997) cite Elsewhere Condition (Kiparsky 1973) in order to enforce *r*-insertion to disjunctively apply with respect to *r*-deletion. However, this solution is not so convincing, as McCarthy (2000) criticizes. With regard to (a), the domain of *r*-insertions is not the subset of *r*-deletion. To avoid this problem, Halle and Idsardi (1997) further generalize the Elsewhere Condition: the less complex rule is blocked to the output string of a more complex rule. Without this tacit assumption, the rule ordering of Halle and Idsardi (1997) cannot work. Furthermore, admitting their proposal, it wrongly predicts that linking *r* should be impossible with function words since their theory does not make a distinction between the linking *r* and the intrusive *r*. McCarthy (2000) doubts that further explorations along these lines of rule ordering will prove any more successful.

3. OT approach

3.1 McCarthy (1993), Oostendorp (2000)

McCarthy (1993) is an attempt to explain *r*-insertion/deletion in an Optimality theoretic framework. This is a well motivated approach

since Optimality Theory is a theory of conspiracy. As previously demonstrated, the two rules of *r*-deletion and *r*-insertion should co-exist to achieve some effect coping with the later   developed *r*-insertion rule. In other words, the two rules 'conspire' synchronically. Halle and Idsardi (1999), a rule   based approach, criticize that OT cannot solve this issue since OT cannot deal with the distribution of the epenthetic *r* and the opaque interaction of *r*-insertion/deletion. Opacity of rule application is basically known as the Achilles' heel in OT since OT concerns with the surface forms only. However, there are several countermeasures with regard to opacity, one of which is Sympathy Theory (McCarthy 1998). Orgun (2001) argues against Halle and Idsardi (1997)'s such criticism showing that the distribution of the epenthetic *r* can be explained through the sonority   based markedness hierarchy, and that Sympathy Theory solves the opaque interaction of *r*-insertion/deletion. Therefore, we may hope that we can find a proper explanation in the OT framework.

According to McCarthy (1993), the *r*-insertion/deletion phenomena are due to the interaction between the two constraints below. The constraint Coda*r*-Cond requires *r* to be in onset and the constraint Final-C requires words not to end with short vowels.

(5)   a. Coda*r*-Cond   b. Final-C
          *VrX]σ   *V] PrWd

The ranking between the two constraints for *r*-deletion is Coda*r*-Cond ≫Final-C as we can see in the example, *Wanda left/*Wandar left*, in which Coda*r*-Cond dominates Final-C. The same ranking can apply to the *r*-insertion in *Wandar arrived* and the linking *r* in Homer arrived. Final C is the cause of the *r*-insertion and Coda*r*-Cond is the cause of the *r*-deletion.

What McCarthy cannot yet explain is the quality of the epenthetic consonant. In the appendix of McCarthy (1993), he indicates difficulties implementing /r/ as the epenthetic consonant. If there is a larger candidate set which includes other epenthesis besides /r/, the tableau cannot avoid choosing the candidates with epenthesis other than /r/ as the optimal winner. We cannot just fill the position with a default consonant because /r/ is not a default consonant in English. Thus, McCarthy (1993) suggests that a rule of *r*-insertion should exist outside

the system of OT in order to limit the candidate set. However, this is merely an ad hoc solution that severely undermines OT's basic assumptions.

Later in 1999, McCarthy (1999) implies that the epenthesis *r* might be phonetically based, mentioning that 'the distribution of *r* is robust and productive (McCarthy 1999: 2).' Although they have not implemented /r/ in the OT framework, both Oostendorp (2000) and Uffmann (2003) have demonstrated that the phonetic property of /r/ as the epenthetic consonant can be incorporated in the OT framework.

Oostendorp (2000) proposes that /r/ in non-rhotic dialect has only one feature [+sonorant], based on Giegerich (1999). Consider the constraint ranking below for both non-rhotic and rhotic dialect.

(6) Ranking
Non rhotic dialect:
　Ident-F >> CV >> Ident-[±sonorant] (=only relevant feature of [r])
Rhotic dialect:
　Ident-F (incl.features [r]) >> CV >> Ident-[±sonorant]

According to the ranking of the non-rhotic dialect, the consonants other than /r/ have the full status of consonant, and it is important to satisfy identity with the full consonants. Therefore, Ident-F (for consonants other than *r*) is ranked highest. Satisfying the constraint CV is more important than the identity with /r/. Ident-[±sonorant] means only the relevant feature for *r*, and requires identity with *r*, i.e. preservation of *r*. In non-rhotic dialect, preservation of *r* is ranked lowest. Thus, /r/ is dropped in word final position to satisfy the CV structure. In rhotic dialect, where there is no *r*-deletion or insertion, /r/ is the same as other consonants and not to be deleted. However, Oostendorp (2000) does not make clear what features are included in the full consonant /r/, which deteriorates the reliability of the theory.

3.2 Phonetic markedness scale for intervocalic segments (Uffmann 2003)

Unlike Oostendorp (2000) who uses identity constraints (faithfulness constraints), Uffmann (2003) introduces more specified phonetic

markedness scales for intervocalic segments, as below.

(7) Phonetic markedness scale for intervocalic segments
*V_V/lar ≫*V_V/obs≫*V_V/nas≫*V_V/l≫*V_V/r≫*V_V/V

The markedness constraints are known to be universal. The optimal output with glide insertion is thus obtained as the following tableaux show.

(8) Glide insertion after [+high] vowels

/kiːz/	ONSET	*G[-hi]	DEP(hi)	DEP	*V_V/lar	*V_V/r	*V_V/V
[kiːz]	*!						
☞ [kiːjz]					*		*

(9) Intrusive [r] after [-high] vowels

/lɔːz/	ONSET	*G[-hi]	DEP(hi)	DEP	*V_V/lar	*V_V/r	*V_V/V
[lɔːz]	*!						
[lɔwɪz]			*!	*			*
[lɔrɪz]		*!		*			*

[r] is the least marked possible epenthetic consonant after [-high] vowel and before a vowel. In prominent positions (onset), a maximally non sonorous consonant is inserted. When glide insertion is blocked, [r] is inserted instead since [r] is the second most sonorous consonant in the sonority scale.

Two problems arise. (i) Glide insertion is not limited in the intervocalic context. Glide means any sound that is naturally made when pronouncing from one sound to the other. For example, between consonants, [p] between [m] and [θ] in warmth is a glide. In the next section, Gick (1999) illustrates that word internal r-epenthesis of the American wa[r]sh is found in the non intervocalic environment /a(ɔ) _ ʃ. This epenthesis cannot be accounted as avoidance of hiatus, but as a case of "gestural overlap". (ii) If the markedness scale is well motivated as Uffmann (2003) argues, why do not all English dialects have r-insertion? Only some dialects of English have an intrusive r. Uffmann (2003) lacks explanation in this regard. For this understanding,

both synchronic motivation and diachronic motivation for intrusive *r* must be examined.

4. Synchronic motivation: phonetic naturalness of inserted [r]

This section introduces the phonetic properties of [r] and shows its naturalness in the intrusion environment. The best advantage in considering phonetic properties of [r] is that we do not need to depend upon arbitrariness of *r*-insertion. *r*-intrusion is productive because it is also found in new or foreign words and in interlanguage. For this reason, *r*-intrusion can be a phonetic process as frequently mentioned above (McCarthy 2000, Gick 1999, Uffmann 2003). It is not difficult to find acknowledgement of the properties of *r* as glide.

Giegerich (1999) argues that [r] is a glide of [-high] vowels, just as [j] and [w] are glides after [+high] vowels.
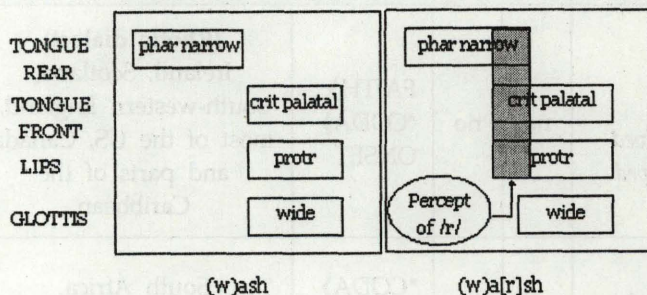
(10) I see - see[j]ing   glide of [+high, -back] vowels
     I do - do[w]ing   glide of [+high, +back] vowels

The most fundamental answer can be provided if we closely consider [r] in line with other glides, especially [l]. Gick (1999) provides the articulatory aspects of the phonemes in what is known as the Gesture based account or AP (Articulatory Phonology). He argues that the intrusive *r* should be examined with a wider perspective, namely, with other liquids and glides. In fact, the intrusive *l* is also widespread and closely related with the intrusive *r* phenomena. What the previous accounts are missing is discussion of related phenomena, which in turn prevents more fundamental consideration. These accounts also miss the word internal intrusive *r* such as *Wa[r]shington*, because they focus only on the intervocalic context.

In AP (Articulatory Phonology), the fundamental unit is articulatory gestures and they are mainly measured through two criteria, Final Reduction and Gestural Timing. Under the Gesture based view, /l/ consists of tongue tip raising and tongue dorsum backing gestures while /r/ consists of blade raising and pharynx constriction and lip constriction gestures. Among these composite segments, Gick (1999)'s experiment measures tongue tip positions because pharyngeal gestures are hard to

measure. Tongue tip raising is a kind of C-gesture (Consonantal gesture). C-gestures of composite segments in final positions are reduced in magnitude compared with initial allophones. Gick demonstrates that the magnitude of the C-gesture (tongue tip raising) in the intervocalic position is intermediate between those of initial and final allophones of /r/. This Gesture based account takes the upper hand in explaining the internal *r*-epenthesis as in *wa[r]sh, Wa[r]shington*. The *r*-epenthesis is just simple overlap of articulatory gestures as the following diagram illustrates.

(11) Internal epenthesis: gestural overlap

	(w)ash	(w)a[r]sh
TONGUE REAR	phar narrow	phar narrow
TONGUE FRONT	crit palatal	crit palatal
LIPS	protr	protr
GLOTTIS	wide	Percept of /r/ → wide

In summary, Gesture based account (Gick 1999) well explains the nature of *r* as an intrusive sound. The articulatory gestures of preceding and following sounds unintentionally produce a sound which people perceive as /r/. The sound which is perceived as /r/ is an unconscious phonetic byproduct that naturally arose in the process of articulation. Gick (1999)'s explanation can apply to the widest range of glide /r/ insertion (including non-rhotic dialect) while the markedness scale of intervocalic glide of Uffmann (2003) is restricted to the intervocalic context.

This phonetic aspect of *r* is the synchronic motivation of *r*-intrusion grammar in Non-rhotic dialect. To examine the diachronic motivation of the non-rhotic grammar, the question of the underlying/non underlying status of *r* must be addressed. This status is determined by the difference between linking *r* and intrusive *r*. For this understanding, we need to consider the historical development of the whole phenomena.

5. Synchronic variation and diachronic change

Anttila and Cho (1998) take the view that synchronic variation and diachronic change have the same pattern under a possible combination of related constraints. They have developed a model that predicts inventories of possible grammars. With the constraints set {Faith, *Coda, Onset}, they explain three invariable dialects of English.

(12)

Examples	DEL	INS	Ranking	Location
Wanda left *Homer left* *Wanda arrived* *Homer arrived*	no	no	FAITH⟩ *CODA⟩ ONSET	**(Rhotic dialect)** Ireland, Scotland, south-western England, most of the US, Canada and parts of the Caribbean
Wanda left *Home<r> left* *Wanda arrived* *Homer arrived*	yes	no	*CODA⟩ FAITH⟩ ONSET	South Africa, south-eastern US and formal RP
Wanda left *Home<r> left* *Wanda[r] arrived* *Homer arrived*	yes	yes	*CODA⟩ ONSET⟩ FAITH	**(Non-rhotic dialect)** non-rhotic England, parts of the eastern and southern US and the southern hemisphere

From these three rankings, Anttila and Cho determined the partial order of the *CODA ≫ ONSET. The three dialects are the possible sets from this partial ranking. However, they do not exclude the possibility that *CODA and ONSET are ranked freely. Anttila and Cho (1998) have made a complete lattice for {Faith, *Coda, Onset} (Anttila and Cho 1998:11), as shown below.

(13)

FCO	FOC	CFO	OFC	COF	OCF
Wanda left	Wanda left	Wanda left	Wanda left	Wanda left	Wanda left
Homer left	Homer left	Home<r> left	Homer left	Home<r> left	Home<r> left
Wanda arrived	Wanda arrived	Wanda arrived	Wanda[r] arrived	Wanda[r] arrived	Wanda[r] arrived
Homer arrived	Homer arrived	Homer arrived	Homer arrived	Homer arrived	Homer arrived
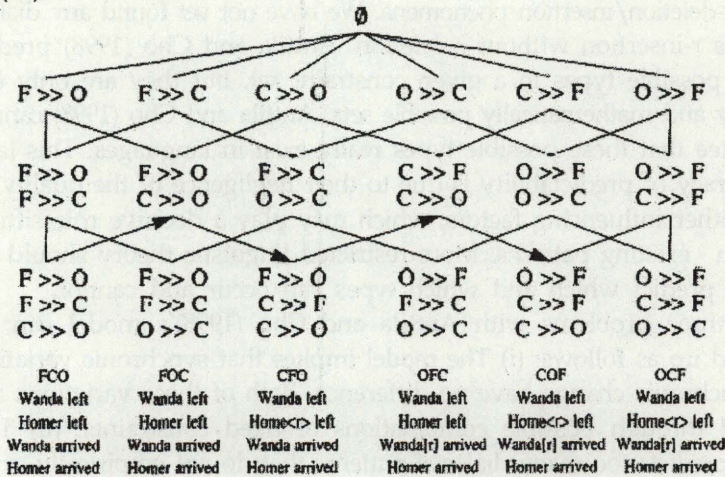
The leaves of the lattice show six invariant dialects that can possibly exist under the given constraints. The arrow means the diachronic path from one invariant dialect to another, with the variable dialect at the intermediate stage. English rhotic and non-rhotic dialects are the leaves connected with the partial ordering C≫O.

This grammar lattice is problematic in that it includes the following possibilities: (i) Dialects with intrusive *r* but no *r*-deletion, (ii) Dialects where intrusive *r* has a higher probability than *r*-deletion. Anttila and Cho (1998) argue that this is just an accidental gap possibly needing historical explanation. Anttila and Cho (1998) have a point in that they predict the diachronic path from invariant *r*-deletion dialect to *r*-insertion, with intermediate variable stages between them. However, Anttila and Cho (1998)'s model is overextended to the point that every typology can be possible under all the possible combinations of constraints. Anttila and Cho (1998)'s model predicts the dialects featuring insertion without deletion, but they argue that these are just accidental gaps, and possibly need a historical explanation. This explanation is flawed: Anttila and Cho (1998) cannot explain this gap historically when their model is already explaining the diachronic path. Such an explanation is no more than accepting that they are missing something and their diachronic path model is no more than a mathematical combination - it is not a linguistic model.

In fact, this 'gap' is too important to be ignored in explaining the nature of the r-deletion/insertion phenomena. We have not yet found any dialect that has r-insertion without r-deletion. Anttila and Cho (1998) predict all the possible types in a given constraint set, but they are only the logically and mathematically possible sets. Anttila and Cho (1998) cannot guarantee that these possible types really exist in languages. This lack of accuracy of predictability is due to their negligence of the quality of r and other influencing factors, which may play a decisive role sifting out non existing patterns. More restricted linguistic theory should be able to predict which and which types can occur and cannot.

The three problems with Anttila and Cho (1998)'s model can be summed up as follows: (i) The model implies that synchronic variation and diachronic change have no difference. Both of these variations are realized through possible combinations of fixed constraints. (ii) The model predicts too many dialectal patterns that do not empirically exist. From this phenomena only, 3 of 6 predicted dialects are empirically found. Considering there are an infinite number of phonological variables in language, the number of 'unreal' patterns this model predicts must be a burden of the theory. iii) Six possible dialects are predicted from only three constraints. Considering that usual phonological phenomena are involved with far more constraints, it is unthinkable how many patterns of dialects are predictable from the combination of more constraints, more than half of which may consist of 'unreal' dialects. If Anttila and Cho (1998) cannot answer how to separate empirically real dialects from unreal ones, the model is no more than a mathematical combination of possible sets: model construction becomes merely a matter of how to restrict the model.

6. Diachronic motivation: misinterpretation

The key to the solution can be found from a quite different angle. Ohala (1993) gives an insightful answer to the nature of sound change. According to Ohala (1993), sound changes arise from various factors, such as spelling pronunciation, paradigm regularization, and culture. Among them, phonetics plays a crucial role. He makes distinction between the listener's and the speaker's role in sound change. The language production of speakers has infinite phonetical variability. There

are synchronically infinite variations in speech production, and these variations are similar to sound change as evidenced by instrumental and perceptual studies of speech. Variation in the domain of production leads to sound change. Consider the Sanskrit spontaneous nasalization.

(14) Examples of spontaneous nasalization

Sanskrit	Prakrit	Old Hindi	Modern Hindi	Translation
paks	pakkha	pākh	paŋkhã	*a side*

It is often found in other languages that high airflow segments like voiceless fricatives [h] have a wide glottal opening, and result in assimilation in the adjacent vowels. These high airflow segments create an acoustic effect resembling nasalization, that is, pseudo-nasalization. This effect occurs because listeners misinterpret this pseudo-nasalization as actual nasalization.

Misinterpretation is common in the perception domain. [Θ] and [f] in English, e.g. [Θɪŋ] and [fɪŋ], are frequently confused. Labial velars and labials, e.g. [ku] and [bu], are also easily confused. Acoustically similar sounds are subject to confusion and cause variations, potentially leading to sound change. This phenomenon is referred to as a 'mini sound change'.

However, not all the mini sound changes lead to 'maxi sound change', which means the usual sense of sound change. Listeners normalize, or correct the speech signal including various phonetical perturbations in the process of speech production. Therefore, sound change from production variation is usually prevented. Misinterpretation can lead to sound change only if there is a change of norms, i.e. 'the listener forms a phonological norm that differs from that intended by the speaker (Ohala 244: 22).' What if the listener fails to 'correct' the perturbation of speech signal? This failure happens in the case of those listeners who do not have enough knowledge to correct the noise, such as children. They may accept the perturbation of speech signal at face value. This phenomenon is termed 'hypo-correction'.

There is another important class of sound change in which direction is reversed: Hyper-correction. Ohala (1993) illustrates that dissimilation is 'correction' erroneously implemented. In the case of Latin

/kwiŋkwē/>*/kiŋkwē/, a listener can be confused as to whether the lip rounding of the first syllable is distinctive or non distinctive perturbation of speech production which may have been caused by the lip rounding of the second syllable. Therefore, some listeners guessed wrong, and lost the lip rounding.

The secondary articulations, such as labialization, retroflexion, velarization, pharyngealization, glottalization, aspiration are acknowledged by slow cues (Ohala 1993: 252), which means they need comparatively long time to be perceived. That is, these secondary articulations are subject to loss unless a sufficient time window is given for them. This is why liquid /l/ and retroflexive /r/ are frequently synthesized or lost.

Summing up Ohala (1993), sound change is due to hypo-correction and hyper-correction, which comes from misinterpretation of speech production. As time passes, this information is lost, which in turn makes reconstruction of past events ambiguous. Sound change is non teleological because there is no intention between speaker and listener to misinterpret speech.

7. Proposal

I argue that there had been ambiguity in the status of /r/ at some point of historical development, and that this ambiguity caused misinterpretation, which led to extension of r-linking to those words without underlying r. This explanation is possible because glide /r/ insertion is phonetically natural. According to Gick (1999), r-epenthesis is the overlap of articulatory gestures. The /r/ is not the original underlying segment, but a byproduct that naturally arose in the process of articulation of phonetic gestures. The 'maxi' sound change is completed when this phonetic byproduct becomes a legitimate phonological segment.

I will now describe several steps in the historical development of r-insertion. As generally admitted, the first step is r-deletion. This step is phonetically natural because of the instability of /r/ as a coda and as a consonant. The sound /r/ is easy to drop. Deletion of r is in itself an independent process, as RP has only r deletion, not r-insertion. The recovered /r/ in linking r comes from underlying representation. These

two phenomena, *r*-deletion and *r*-linking posit little difficulty.

What needs to be considered is non historical *r*-insertion in the words previously without underlying /r/. Linking *r* itself is not a sound change since the phenomenon is that the underlying *r* is simply pronounced. The change to *r* insertion is triggered by reconstruction of the input, caused by the forms of which *r* is deleted. Look at the examples of *r*-deletion below again.

(15) The spaɼ seems to be broken.
     He broke the spaɼ.

For most speakers who know the spelling of spar, the underlying representation is still /spar/ even though they delete the underlying [*r*]. However, after some considerable time has passed, more and more speakers are exposed to the pronunciation of [spa] without [r]. Some of these speakers may be the illiterate or children who do not have knowledge of UR. For these speakers, the input is */spa/.

Consider what will happen when those people whose UR is */*spa*/ listen linking *r*, e.g. The [spar] (UR:/*spar*/) is broken. For them [*r*] is perceived as not underlying, but inserted. Because the resulting *r*-insertion is compatible with phonetic naturalness supported by the gestural overlap introduced by Gick (1999), [r] becomes ambiguous; it can be either a UR or a glide. Let us call the people whose UR is /spar/ Group 1, and others whose UR is */spa/ for /spar/ Group 2, in non rhotic dialect. A piece of evidence of UR restructuring can be found in the sentence *I pahked my cah in Havahd Yahd* (Halle and Idsardi 1999). Here in this sentence, the underlying *r* appears to have been lost. When the real input is /spar/ and pronounced as [spar] before a vowel, Group 1 regards it as linking *r* while Group 2 thinks of it as glide.

[Stage I] Misinterpretation

UR	"The spar is broken" Interpreted as	*r* as
Group 1 /spar/	*r*-linking	UR
Group 2 */spa/	*r*-insertion	glide (misinterpretation)

For Group 2 speakers, the phonetically natural process of glide insertion is now established as an active grammar. This is in fact a wrong interpretation, for this /r/ is etymological, not a glide. Misinterpretation triggers the change in the grammar of the Group 2 speakers.

This misinterpretation, however, leads only to a mini sound change since Group 1 does not have the *r*-insertion grammar yet. The articulatory gestures of preceding and following sounds unintentionally produce a sound which Group 2 perceives as /r/. The gestural overlap that sounds like /r/ is mere a phonetic perturbation before it is recognized as a legitimate phonological segment[1).

Since Group 2 has now the glide insertion grammar, when they pronounce, "The idea is fabulous", they will insert *r*.

[Stage II] Mini sound change

	UR	Pronouncing "The idea is fabulous"	r as
Group 1	/idea/	no *r* insertion	N/A
Group 2	/idea/	r-insertion "The idear is.."	glide

When listeners who have the UR /idea/, and have heard erroneous insertion of [r] after [idea] a sufficient number of times to make them suspect, they extend the glide insertion grammar in the entire environment, including instances where there is no underlying *r*. This acceptance marks the rise of *r*-insertion grammar. Mini sound change in Group 2 is extended into maxi sound change in both Groups. As a result, both Groups now have *r*-insertion grammar that is phonetically natural.

[Stage III] Maxi sound change

	UR	"The idea is fabulous" Interpreted as	r as
Group 1	/idea/	"The idearis.." r-insertion	glide

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1) In Probabilistic Phonology's terminology, this process corresponds to 'labeling' as a phoneme.

Group 2	/idea/	"The idearis.." r-insertion	glide

For both Groups, r is now automatically inserted as a glide. The change to r-intrusion has been completed. Note that the change would not have taken place if Group 1 had thought the change was phonologically unacceptable. Mini to maxi sound change would not have been possible unless the mini sound change is compatible with a phonetic naturalness [2].

8. Conclusion

In this paper, I have demonstrated how the phonetic byproduct evolves, solidifies, and develops into a legitimate phonological segment. The r-intrusion grammar of non rhotic dialect has two motivations: (i) Synchronically, phonetically natural process of glide insertion as a gestural overlap (ii) Diachronically, misinterpretation of the linking /r/ as the intrusive /r/.

r-deletion/insertion phenomena are productive in non-rhotic dialect and should be deemed in a phonetic perspective. McCarthy (1991) gave a constraint based account, but failed to explain why [r], among other sounds, should be inserted. Anttila and Cho (1998) predict dialects that do not exist because they disregarded the phonetic aspects of the quality of the epenthetic consonant [r].

As Ohala (1993) argues, sound change is triggered by misinterpretation in a certain historical stage. As for the English r-insertion, some groups of people wrongly constructed the underlying representation, which led to overapplication of r-linking. Coincidently, this phenomenon is compatible with the phonetically natural process of the glide insertion between vowels, supported by the gestural overlap (Gick 1999). Therefore, speakers who had a correct UR also begin to apply the glide insertion grammar. r-Intrusion is an instance that individuals' mini sound change develops into maxi sound change due to the phonetic naturalness

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2) I do not mean that the direction of sound change is toward phonetic naturalness. Rather, I agree with Ohala (1993)'s non-teleological view. Sound change against phonetic naturalness may well take place for various reasons, e.g. the purpose of maintaining lexical difference.

of the mini sound change.

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