

Intrusive [r] and optimal epenthetic consonants

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Abstract

This paper argues against the view of intrusive [r] as a synchronically arbitrary insertion process. Instead, it is seen as a phonologically natural process, which can be modelled within the framework of Optimality Theory (OT). Insertion of [r] in phonologically restricted environments is a consequence of a more general theory of consonant epenthesis outlined here. This theory ties epenthesis in with the notion of prominence and strives to formalize a general theory of epenthesis which explains why glottal stops and glides are crosslinguistically frequently found epenthetic consonants, although in different prosodic contexts. I argue that glottal stops are optimal margin consonants and thus inserted in margin positions (e.g. word-initially) while glides are optimal peak consonants, inserted in peak positions (e.g. as hiatus breakers). This hypothesis is derived from sonority-based prominence scales [Prince, A., Smolensky, P., 1993. Optimality Theory: Constraint Interaction in Generative Grammar. Ms. Rutgers University and the University of Colorado at Boulder]. Intrusive [r] can then be understood as the optimal consonant in a peak position when glide formation is blocked, because [r] is the most sonorous possible element in this position. Spreading-based or perceptually grounded accounts of intrusive [r] are consequently rejected under this approach.
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1. Introduction

While intrusive [r] is a well-described phenomenon of English phonology (e.g. Sweet, 1908; Jespersen, 1913; Jones, 1917; Kenyon, 1924 for early accounts; for more recent descriptions, see Wells, 1982; Trudgill, 1986; Gutch, 1992, among others), it is still very

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much debated how it should be dealt with in phonological theory (see e.g. Vennemann, 1972; McCarthy, 1993; Harris, 1994; Gick, 1999; Orgun, 2001 for some recent analyses in different phonological frameworks). This paper aims to contribute to the ongoing debate by providing an Optimality-Theoretic account of intrusive [r] against the background of consonant epenthesis in general.

Intrusive [r] is an epenthetic non-etymological [r] which appears in hiatus position in a number of non-rhotic dialects of English, for example in Received Pronunciation (RP), across SE England and in E Massachusetts. Apart from hiatus position, there is a second condition on intrusive [r]: The preceding vowel must be non-high. In most dialects, possible triggers are thus [ə, ɑ:, ɔ:].¹ Examples of intrusive [r] (in bold typeface), with each of the three triggering vowels, are provided in (1):

- | | | |
|-----|--------------------|----------------------|
| (1) | India and Pakistan | [ɪndɪə r ənd] |
| | The Shah of Persia | [ʃɑ: r əv] |
| | law and order | [lɔ: r ənd] |

The diachronic path which led to intrusive [r] seems to be fairly clear (for an overview, see also Gutch, 1992; Gick, 1999, 2002b). In a first step, some dialects became non-rhotic, that is, coda-/r/² vocalised as schwa or deleted on the surface (after [ɑ:, ɔ:]).³ Consequently, the contrast between certain pairs such as *law–lore* (now both surfacing as [lɔ:]) and *spa–spar* (both realised as [spɑ:]) was neutralised in most environments. The only environment in which the contrast survived was intervocalically where /r/ could be syllabified into the onset of the consecutive syllable, as the examples in (2) demonstrate (so-called linking [r]).

- | | | | | | |
|-----|---------|--------------------|-----|--------|--------------------|
| (2) | spar is | [spɑ: r ɪz] | vs. | spa is | [spɑ: r ɪz] |
| | lore is | [lɔ: r ɪz] | vs. | law is | [lɔ: r ɪz] |

In a second step, reanalysis took place. Instead of deleting postvocalic /r/ everywhere except intervocalically, it is now inserted in this very context. In other words, the occurrence of [r] between vowels is overgeneralised to all contexts in which linking [r] can appear (that is, the set of non-high vowels). /r/ hence disappears as a distinctive segment from coda positions. Not only is the contrast lost in the *law–lore* pair in citation form; both words are realised identically also prevocalically, as shown by the examples in (3).

- | | | | | | |
|-----|---------|--------------------|---|--------|--------------------|
| (3) | spar is | [spɑ: r ɪz] | = | spa is | [spɑ: r ɪz] |
| | lore is | [lɔ: r ɪz] | = | law is | [lɔ: r ɪz] |

¹ This is the set of vowels in RP (Wells, 1982, among others) and in Eastern Massachusetts (McCarthy, 1993). Some British English dialects have a fourth vowel [ɛ:] or [æ:] (Wells, 1982), which corresponds to RP [aʊ] and also triggers intrusive [r].

² Following general convention, underlying representations are given between slashes /.../, surface forms are transcribed between square brackets [...].

³ It is not quite clear whether the appearance of schwa is due to vocalization of /r/ or the effect of breaking which occurred prior to deletion (for conflicting analyses, see e.g. Wells, 1982; Gick, 1999). In this paper, I am not going to take a position on this issue. It suffices to capture the generalization that there is no [r] in coda position; how exactly schwa appeared, is outside the scope of the present analysis.

In rule-based accounts, this path has been explained as a case of rule inversion (Vennemann, 1972). An original rule which deletes /r/ in one context is reinterpreted as a rule which inserts it in the inverse context. Thus, the rule in (4),

$$(4) \quad [r] \rightarrow \emptyset / V __ \{C, \#\}$$

is recast. Instead of having a deletion rule (delete [r] if it occurs postvocally and before a consonant or a pause), we now get epenthesis in the inverse context (insert [r] postvocally and before a vowel, i.e. not before a consonant or a pause), formulated in (5).

$$(5) \quad \emptyset \rightarrow [r] / V_{[-\text{high}]} __ V$$

While the diachronic path that led to intrusive [r] is thus fairly straightforward and can be modelled in a rule-based account, it seems harder to motivate this process also synchronically. The claim has been made that it is a synchronically arbitrary process that can only be understood diachronically (Harris, 1994; MacMahon, 2000, among others). In the remainder of this paper, I will try to provide a synchronic explanation, refuting the claim that intrusive [r] is synchronically arbitrary. The paper will be organised as follows: In Section 2 the problem of how intrusive [r] could be motivated synchronically will be stated. Section 3 will discuss consonant epenthesis from a more general perspective, and a new theory of consonant epenthesis, which is based on prominence scales, will be proposed in Section 4. Section 5 then applies these findings to the phenomenon of intrusive [r] and elaborates on the claim that [r] insertion occurs when glide insertion is blocked because [r] is the next most prominent segment which could be inserted. [r] epenthesis will thus be argued to be prominence-driven. In Section 6, alternative analyses will be evaluated, and Section 7 concludes the paper and provides an outlook at how the findings could contribute to phonological theory more generally.

2. Stating the problem

While the diachronic motivation for the appearance of intrusive [r] is clear (overgeneralisation and reanalysis), the same cannot be said for a potential synchronic motivation of this process. In fact, the very observation that intrusive [r] can receive a diachronic motivation, has led many researchers to assume that it is synchronically an arbitrary insertion process (e.g. Harris, 1994; Halle and Idsardi, 1997; Hale and Reiss, 2000; MacMahon, 2000). Why is [r] the epenthetic consonant? It seems problematic to stipulate a phonologically natural rule that can explain why [r] is inserted, of all possible epenthetic consonants. It would be hard to motivate why [r] could be the unmarked or underspecified segment of English.

This claim is especially problematic for the framework of Optimality Theory (Prince and Smolensky, 1993), which can, by definition, not deal with arbitrary processes. In Optimality Theory (henceforth OT), phonological processes follow from the interaction of surface constraints. More precisely, phonological alternations are triggered by markedness constraints (leaving aside alignment constraints); unfaithful input-to-output mappings can only occur if the resulting output structure is in a sense less marked than the input. How can epenthesis of [r] be motivated in this context as generating a less marked surface form? In fact, the phenomenon of intrusive [r] has been used as ammunition against OT: If epenthesis is triggered by markedness constraints but the epenthesized element cannot be

argued to be unmarked vis-à-vis other possible epenthetic segments, then the process cannot be modelled within OT (cf. [Hale and Reiss, 2000](#) and [MacMahon, 2000](#) for an elaboration of this argument). However, any theory of phonology which wants to be taken seriously should be capable of capturing all processes occurring in a language, not just a subset of phonologically natural processes, under exclusion of arbitrary/non-natural processes.

The problem that occurs when one tries to account for why [r] is selected as the epenthetic consonant is addressed in one of the first ever published papers written in the framework of OT. [McCarthy \(1993\)](#) shows how epenthesis in hiatus position can be formalised within OT, viz. as a strategy to satisfy the constraint FINAL-C. Similarly, [Anttila and Cho \(1998\)](#), who largely adopt McCarthy's analysis but replace FINAL-C with the ONSET constraint, can formalise the diachronic path outlined above by reranking the same set of constraints. Both, however, cannot explain why [r] is selected as the epenthetic consonant and not a segment which is typically considered unmarked, like the glottal stop. [McCarthy](#) concedes 'that *r* is demonstrably not the default consonant in English' (1993, p. 190) but that [r]-epenthesis instead seems to be unnatural. His solution to the problem is to stipulate an additional, phonologically arbitrary, postlexical rule which determines the quality of the epenthetic segment. It is this concession to rule-based derivational phonology that has provided opponents of OT with a powerful argument against the whole OT enterprise as such: If OT still needs rules to account for unnatural phonological processes, why do we need it in the first place? If a rule component is needed anyway, then any stipulation of other components is a clear violation of Occam's Razor. Consequently, several researchers (e.g. [Halle and Idsardi, 1997](#); [Hale and Reiss, 2000](#)) consider the potential inability to account for intrusive [r] – being an arbitrary process – a fundamental problem of OT.

These researchers do have a strong point against OT if their claim is correct. In this paper, however, I want to demonstrate that intrusive [r] is not synchronically arbitrary or unnatural but that it can receive an optimality-theoretic analysis which falls out from a more general typology of possible (and optimal) epenthetic consonants. In fact, it seems that McCarthy's problem is specific to early Containment-OT which has since been superseded by Correspondence Theory ([McCarthy and Prince, 1995](#)), where this problem disappears.⁴

2.1. *Against deletion accounts*

Before turning to the problem of intrusive [r] in the context of consonant epenthesis, I would like to briefly address a different issue that merits some discussion. The position has been taken that intrusive [r] is not due to epenthesis of [r] in a certain environment but that [r] is always underlyingly present in words that exhibit intrusive [r] (e.g. [Gutch, 1992](#); [Harris, 1994](#); [Gick, 1999](#)). According to this view, all words ending in [ə, ɪ, ɔ:] also contain an /r/ which is either floating ([Harris, 1994](#)) or deleted on the surface in all environments except prevocally. Hence, the overgeneralisation historically worked in a different direction – it is not rule inversion that takes place; instead, the occurrence of /r/ in under-

⁴ In Containment, it was impossible to specify the quality of an epenthetic segment, which was left to spell-out; only the locus of an epenthetic segment was indicated. In Correspondence Theory, this problem does not arise.

lying forms is overgeneralized: All forms ending in a non-high vowel are analysed as containing underlying /r/, not just some. The merger of the *law–lore* pair is thus not explained as the loss of final /r/ in the second member of the pair (such that both are underlyingly /lɔ:/) but as merger in the opposite direction such that both are underlyingly /lɔ:r/. Loss of surface [r] leads to overgeneralising underlying /r/, not to its loss.

Several arguments can be adduced against this view, both of the formal and of the empirical kind. The first argument that I would like to mention is entirely internal to OT, but it has implications that go beyond this specific phonological framework. This argument concerns a central tenet of OT, viz. Richness of The Base (Prince and Smolensky, 1993).

The principle of Richness of the Base states that no constraints hold on the level of underlying representations. The possible output forms of a language are determined by output constraints alone, never by additional constraints on input forms or by input pre-specifications. Whatever the input is, the constraint ranking alone should be able to transform it into a well-formed output. The claim that there is underlying /r/ in all forms that otherwise end in a non-high vowel is a gross violation of this principle, because it states that every form which is otherwise vowel-final must also have an /r/ in the input. Forms which do not contain /r/ are excluded from the set of possible input forms. In OT, however, the observed alternation between [r] and zero must fall out from the constraint ranking alone, independent of whether the input contains /r/ or not.

In fact, the data from English lend practical evidence to this rather theoretical claim. New inputs will always trigger intrusive [r], provided they end in a non-high vowel. We thus find intrusive [r] in new words, especially loanwords, such as *pasta*, *junta* or *UEFA* (Sebregts, 2001). A particularly striking example of this is from a recent best-selling pop song, Cornershop's *Brimful of Asha*, with its chorus, 'It's a brimful of Asha[r] on the 45' (Asha being the first name of a popular Bollywood musical singer). Similarly, Wells (1982, p. 226) observes that intrusive [r] is also an interlanguage phenomenon, which it should not be, if all /r/ were lexical. Wells cites examples from the French and German interlanguage of English learners, such as *j'étais déjà[r] ici* and *ich bin ja[r] auch fertig* to support his argument (see also Viëtor, 1914/5, p. 184, 258 for an earlier observation of the same phenomenon). In any case, proponents of the theory of underlying /r/ will have to explain how /r/ gets into new and foreign words; the process must be productive, which means that it also has to be able to deal with input material that does not contain /r/, but where /r/ is then added productively.⁵ In sum, Richness of the Base and the demonstrable productivity of the process form a powerful counterargument against deletion accounts of intrusive [r]. For further points and a more detailed discussion, the reader be referred to Sebregts (2001).

⁵ As a matter of fact, OT provides such a mechanism, i.e. Lexicon Optimisation. Under Lexicon Optimisation, it could be claimed that all inputs will receive an underlying /r/ when they are lexicalised. Still, the constraint ranking has to be able to deal with /r/-less forms, obeying Richness of the Base, even though these forms will almost immediately be lexicalised as /r/-ful forms. Under this view, the claim that /r/ is underlying is not really a counterargument to insertion accounts. It still must be established how /r/ gets there, even if this process applies only once.

3. Towards a typology of epenthetic consonants

In order to arrive at a novel analysis of intrusive [r], we first have to establish where its place is within the broader field of consonant epenthesis. Surprisingly, no attempt at a comprehensive typology of epenthetic consonants seems to have been made within OT so far. Crosslinguistically, two main processes of consonant epenthesis can be found, and I will take these as starting points for a more general analysis of consonant epenthesis, viz. glide insertion and glottal stop insertion. However, these two processes have hardly ever been systematically distinguished (but see [Rubach, 2000](#)); to motivate both processes, an onset requirement is usually adduced – a consonant is epenthised to satisfy the ONSET constraint; which consonant exactly is inserted, seems to fall out of the scope of most papers, though (but cf. [Lombardi, 1997](#)).

To illustrate this point, let me randomly cite two papers. [Smith \(2001\)](#) discusses hiatus resolution in Sinhala. Under certain (morphological) conditions, a glide will be inserted to resolve hiatus and to satisfy ONSET. However, Smith does not discuss why a glide is inserted and not any other consonant. [Alber \(2001\)](#) analyses glottal stop insertion in German, which she finds to occur either word- or foot-initially, again to satisfy ONSET. While she can predict correctly where epenthesis will occur, she does not discuss why a glottal stop is used for epenthesis. While a general theory of epenthetic segments is of course not a topic of the two papers, it is conspicuous that the same constraint can be responsible for different kinds of epenthesis, which shows that insertion of a specific segment is by no means self-evident.

[Lombardi \(1997\)](#) attempts to arrive at a more general typology of epenthetic consonants, although glide insertion is excluded from her paper. Lombardi finds that the glottal stop is the most frequent epenthetic consonant, that [t] is rarer and that other consonants occur only marginally. She translates this observation into a universal markedness hierarchy.

(6) *DORSAL, *LABIAL » *CORONAL » *PHARYNGEAL

This hierarchy is an extension of the well-known hierarchy that states that coronals are less marked than labials and dorsals. Lombardi proposes to add pharyngeals to this hierarchy as well and to place them at the bottom of the hierarchy. [pharyngeal] is thus the least marked place feature. If epenthesis occurs, then the epenthetic segment will be the least marked possible segment, normally the glottal stop [ʔ]. The fact that some languages have [t] rather than [ʔ] as the default epenthetic consonant (e.g. Axininca Campa) is explained by positing special-case constraints against individual sounds, like the glottal stop. A constraint *[ʔ] will prohibit a glottal stop from appearing in the output; the second-least marked segment, coronal [t], will then come to the rescue.

In short: Glottal stops are the most frequent epenthetic consonants because they only violate *PHARYNGEAL, which is the lowest-ranked of all constraints on place. This view poses two problems, though. First, Lombardi's analysis cannot explain glide insertion, which should be a marked process, according to her model. In any case, the model will have to be amended if it is to take into account epenthetic glides as well. Second, the view that pharyngeals are the least marked segments is not unproblematic. True pharyngeals are crosslinguistically rare. We would thus have to restrict the scope of the constraint *PHARYNGEAL to account for laryngeal segments only, under the exclusion of true pharyngeals which need to receive their status as marked segments from elsewhere.

The only paper that addresses the issue of glottal stop insertion versus glide insertion to my knowledge is Rubach (2000). Rubach notes that some languages employ both strategies. In Czech, for example, one finds both processes, glottal stop insertion word-initially and glide insertion intervocalically within the word. An input form /idiot/ ‘idiot’ will surface as [ʔidijot] in Czech. Rubach takes this as evidence for his theory of Derivational OT (DOT), which retains the idea of level ordering from Lexical Phonology. He assumes two constraints both of which militate against one of the two types of insertion. The constraint *[constricted glottis] bans insertion of the glottal stop by banning insertion of the feature [constricted glottis]. On the other hand, there is the constraint *MULT-LINK, a constraint against feature spreading. As glide formation results from vocalic spreading, high-ranked *MULT-LINK will block glide formation. Rubach now suggests that the ranking of these two constraints with respect to each other changes from one level of derivation to the next, such that gliding will occur on one level (due to lower-ranked *MULT-LINK) and glottal stop epenthesis on the other (because *[constricted glottis] is outranked by *MULT-LINK).

In the remainder of this section I want to show that it is not necessary to stipulate two levels of derivation in order to account for the selection of different epenthetic consonants. Neither is Lombardi’s markedness scale necessary to account for glottal stop insertion. In fact, I will demonstrate that both Lombardi’s and Rubach’s analyses miss important generalisations about types of consonant epenthesis. As I will try to show, [ʔ] and glides such as [j, w] are inserted in different prosodic positions and for different reasons. Hence, I will propose a model of consonant epenthesis which is sensitive to the position of the epenthetic segment. In order to get there, let us have a closer look at the two types of epenthesis (glottal stops versus glides) first.

3.1. Glottal stop epenthesis

Glottal stops are frequently found in the world’s languages (for an overview, see e.g. Lombardi, 1997) to satisfy an onset requirement. In addition, they are typically found word-initially to satisfy this requirement, less so intervocalically, as a hiatus breaker. This observation can be generalised to the statement that glottal stops are found initially with respect to prosodic categories, such as the word. Alber (2001), following Wiese (1996), finds that epenthetic glottal stops in Standard High German can be found in two different positions, namely at the beginning of words or at the beginning of a stressed syllable. Epenthesis is thus word- or foot-initial, as the examples in (7) show:

(7) Glottal stop epenthesis in German

- | | | | |
|---------------|------------|-------------|-----|
| (a) Orkan | [ʔɔR'ka:n] | ‘hurricane’ | |
| (b) Kloake | [kloʔa:kə] | ‘sewer’ | |
| (c) Oase | [ʔoʔa:zə] | ‘oasis’ | |
| (d) Chaos | [ˈkaɔs] | ‘chaos’ | |
| (e) chaotisch | [kaʔo:tɪʃ] | ‘chaotic’ | vs. |

(7a) gives an example of word-initial glottal stop epenthesis, while the example in (b) shows that epenthesis is not restricted to word-initial positions but also occurs to create an onset foot-initially. (c) has both, word- and foot-initial epenthesis, whereas (d) and (e) show that it really is an epenthesis process which triggers the occurrence of [ʔ] (and that it is not just hiatus which triggers epenthesis in (b) and (c)); while (d) does not have an

epenthetic consonant (the onsetless syllable being neither word-initial nor foot-initial), (e) has because the adjectival suffix *-isch* triggers stress shift; as stress moves to the second syllable, epenthesis becomes mandatory.

To sum up: Glottal stops are found epenthetically in onsets of initial or stressed syllables, that is, in prominent positions. They are, however, not found as hiatus breakers before an unstressed syllable.

3.2. *Glide insertion*

Glides, on the other hand, are typical hiatus breakers, occurring intervocally in a large number of languages (e.g. Dutch, Booij, 1995; Korean, Kang, 1999; Czech, Rubach, 2000; Sinhala, Smith, 2001; Japanese, Kawahara, 2002). Conversely, they seem to be rare as default epenthetic segments in word-initial position. In addition, several other things are worth noting about epenthetic glides. First of all, their featural content is determined by spreading from one of the two flanking vowels. [j] is commonly inserted in the context of a front vowel; [w] is inserted in the context of a back/round vowel. In (8), some examples of this are provided from Japanese where the sequence of two vowels the second of which is [a] triggers glide insertion (data from Kawahara, 2002):

- | | | |
|-----|-----------------------------|------------------------|
| (8) | Glide insertion in Japanese | |
| | [j] after a front vowel | [w] after a back vowel |
| | si[j]awase ‘happiness’ | gu[w]ai ‘condition’ |
| | mi[j]ai ‘blind date’ | hu[w]antai ‘unstable’ |
| | e[j]akon ‘A/C’ | ko[w]ara ‘koala’ |

In addition, glides are generally considered to have the same featural make-up as vowels, except for syllabicity (see e.g. Clements and Hume, 1995 for their treatment of vowels and glides as ‘vocoids’). In both place and manner of articulation glides are thus maximally similar to their vocalic environment. In other words, glides are minimally contrastive with their environment. This minimal contrastiveness is enhanced by a second factor: That the degree of phonetic realisation may vary; glide insertion is optional in a number of languages, e.g. in Shona (Pongweni, 1983) and in Japanese (Kawahara, 2002); alternatively, the degree of gliding (in terms of duration) may vary. Glottal stop epenthesis hardly ever shows this amount of variability.

3.3. *Prominence-driven epenthesis*

The comparison of glottal stops and glides now enables us to forward a new hypothesis: Their insertion occurs in different contexts, for different reasons. The proposal I would like to present now is that the choice of the epenthetic consonant depends on its prosodic position and on prominence contrast. Depending on the optimal degree of contrast, different epenthesis strategies will be employed, such that

- glottal stops are inserted to maximise the contrast to the following vowel,
- glides are inserted to minimise the contrast to the following or preceding vowel.

Under this view, there is thus not one invariably optimal epenthetic consonant or one ‘default’ consonant in a language. Instead, the choice of the epenthetic consonant is deter-

mined by the environment in which epenthesis occurs and the drive to either maximise or minimise the contrast of the epenthetic segment to its environment (I will detail below how contrast is to be understood in this theory). Consequently, the constraints that are responsible for the selection of the epenthetic consonant cannot simply be universal markedness constraints. Instead, these constraints have to be sensitive to the position where epenthesis occurs and to the relative prominence of the epenthetic segment. The solution that will be proposed here makes use of such context-sensitive constraints, using the theory of Prominence Alignment, which was first proposed by Prince and Smolensky (1993) to explain syllabification in Imdlawn Tashlhiyt Berber, but lay dormant for quite some time until it was recently rediscovered to model a number of different phonological phenomena (e.g. de Lacy, 2001; Walker, 2001; Crosswhite, 2004).

4. A prominence-based account of consonant epenthesis

Prince and Smolensky (1993) identify two different prominence scales, one with respect to the prominence of different syllable positions, one with respect to the prominence of the individual segment, where prominence is here defined as the sonority of a segment. The first scale distinguishes between peaks (typically nuclei) and margins (onsets, maybe codas) and is given in (9) – note that the symbol ‘>’ means ‘is more prominent than’, in line with Prince and Smolensky (1993, p. 149).

- (9) Syllabic prominence: Peak > Margin

The second scale captures the prominence of individual segments and should also be familiar to the reader as the sonority scale, used elsewhere in the literature. It states that vowels are the most prominent segments, followed by rhotics, laterals, nasals, obstruents and finally laryngeals.⁶

- (10) Segmental prominence: Vowels > r > l > nasals > obstruents > laryngeals

Prince and Smolensky propose to cross the two scales, thus yielding two sets of scalar markedness constraints, by aligning the members of both scales with respect to their relative prominence. Prominent segments align with prominent positions and vice versa. Peaks are thus preferably filled with prominent material (best: vowels); margins are preferably filled with non-prominent material (obstruents, laryngeals), as shown by the two markedness scales:

- (11) *Margin/V » *Margin/r » Margin/l » *Margin/nas » *Margin/obs » *Margin/lar
 (12) *Peak/lar » *Peak/obs » *Peak/nasal » *Peak/l » *Peak/r » *Peak/V

(11) states that a vowel in margin position is most marked, and that a laryngeal in margin position is least marked. (12) states the reverse for peaks: Here, laryngeals are most marked and vowels are least marked. As there is the drive for peaks to be maximally

⁶ The number of intermediate categories is, of course, open to discussion, and I am not assuming any theoretical position here; the important point is that the endpoints (vowels vs. laryngeals) are fixed.

prominent and for margins to be minimally prominent, optimal syllables thus display maximal prominence contrast. In the next section, I am going to show how this drive towards contrast maximisation explains glottal stop epenthesis as insertion of the least marked segment in a margin position.⁷

4.1. Glottal stop epenthesis revisited

Recall the facts from German, as outlined in Section 3.1 above. Glottal stops are inserted in otherwise onsetless initial or stressed syllables; an input /ɛlç/ (‘moose’) will be realised as [ʔɛlç]. Leaving aside the issue of non-initial stressed syllables for the sake of keeping the argument simple, this epenthesis process can be modelled as a case of constraint interaction, more precisely, as interaction of two basic constraints, one markedness constraints which demands that first syllables have an onset, and a faithfulness constraint which bans epenthesis. These constraints are ONSET and DEP-IO, formalised below.

- (13) ONSET Syllables have onsets (Prince and Smolensky, 1993)
- (14) DEP-IO Output segments have a correspondent in the input (no epenthesis; McCarthy and Prince, 1995)

If ONSET is ranked above DEP, epenthesis will ensue, because satisfaction of the markedness constraint (have an onset) is more important than satisfaction of the faithfulness constraint (do not add material). This basic ranking does not determine, however, which segment is inserted. This is determined by the prominence-based markedness scale for margins (onsets being margins), introduced in (11), which is shown in the tableau in (15):

(15) Example tableau for German *Elch* (‘moose’):

/ɛlç/	ONSET	DEP	*Margin/V	*Margin/nas	*Margin/obs	*Margin/lar
[ɛlç]	*!					
^{IO} [ʔɛlç]		*				*
[tɛlç]		*			*!	
[nɛlç]		*		*!		
[jɛlç]		*	*!			

The first, faithful, candidate is not selected because it fatally violates high-ranked ONSET, the demand that syllables have onsets. This constraint is satisfied by the four other candidates, at the expense of a violation of DEP. Which of the four candidates is selected as optimal, crucially depends on the markedness scale for margins. Working the way up the tableau, the bottom candidate [jɛlç] is ruled out because the epenthetic consonant is a glide, i.e. a non-nuclear vowel. Glides, however, are highly marked in margin positions. The next candidate, [nɛlç], is better but still fairly marked. Less marked is [tɛlç] but optimal is [ʔɛlç], because

⁷ Note that the notions of prominence and contrast used here are phonological in nature, based on syllable position and sonority, and are not to be confused with strictly perception-based notions, as in Steriade (2001), which will also be discussed below in Section 6.3.

laryngeals are the least marked segments in margin position. Note here an important difference to previous treatments of glottal stop insertion: The glottal stop is not inserted because it is the least marked segment per se. Only in a margin position it is the least marked consonant because it is least sonorous. This treatment offers a great conceptual advantage over the position-blind accounts à la Lombardi (1997) or Rubach (2000).

4.2. Glide insertion revisited

Coming to glide insertion now, we will see that the proposal has to be modified to a certain extent, because the drive to have minimally sonorous margins should prohibit glide insertion. So far, all onsets have been treated as margins, in line with Prince and Smolensky's original proposal. Hence, all epenthesis in onset position should prefer [ʔ]. However, the picture is more complex. In intervocalic contexts, glides are preferred, i.e. the most sonorous segments possible. Having said above that glides are inserted to minimise prominence contrast and to make the inserted element as similar to a vowel as possible, it seems reasonable to argue that intervocalic onsets are not treated as margins in many phonological systems but rather as peaks. Therefore, a maximally prominent segment is optimal in intervocalic position – the intervocalic position itself is prominent. The markedness hierarchy for intervocalic consonants is thus the one in (16), which repeats the peak hierarchy from (12), but with special reference to the intervocalic context.

$$(16) \quad *V_V/lar \gg *V_V/obs \gg *V_V/nas \gg *V_V/l \gg *V_V/r \gg *V_V/V$$

The tableau in (17), which assumes an abstract input /ia/ and a glide formation process as in (8), illustrates how insertion of a maximally sonorous segment now emerges as optimal. The basic ranking of ONSET and DEP-IO remains the same: Epenthesis occurs for the same structural reason, namely the requirement for syllables to have onsets. However, the selection of the optimal epenthetic segment functions differently because the markedness scale for this context is the reverse of the scale from the tableau in (15); intervocalically, prominence is maximised (and contrast is minimised) in epenthesis.

(17) Example tableau: Japanese-type glide insertion

/ia/	ONSET	DEP	*V_V/lar	*V_V/obs	*V_V/nas	*V_V/V
[ia]	*!					
[iʔa]		*	*!			
[ita]		*		*!		
[ina]		*			*!	
^{ESP} [ija]		*				*

In this tableau, insertion of a glottal stop is least optimal because the constraint against laryngeals is ranked highest intervocalically, followed by obstruents, nasals, and finally glides, which are optimal in this environment because they are the most sonorous (i.e.

prominent) segment which can be inserted. Hence, the epenthesis pattern is the reverse of what we find for initial epenthesis.

4.3. *Motivating the hierarchies further*

It is thus possible to explain the two principal strategies of consonant epenthesis, glottal stop insertion and glide formation, in a unified framework, by making reference to prominence scales which differ across prosodic positions. An in-depth investigation into crosslinguistically attested epenthetic consonants, including consonants which are not readily predicted by this model, is outside the scope of this paper and will have to be relegated to future research (cf. Lombardi, 1997; Vaux, 2002 for examples of such consonants). The two main types of epenthesis are captured, however, and the below discussion will show that intrusive [r] can also be explained by this model. Another point which also warrants further research concerns the question of which contexts exactly are prominent or non-prominent contexts (i.e. the question in which contexts exactly each of the two markedness scales applies), and whether there are crosslinguistic commonalities or whether there are language-dependent choices with respect to what is perceived as a prominent or non-prominent position. The present dichotomy probably simplifies matters to some degree.

Note, however, that the two markedness scales proposed here also have a surplus value in that they account not only for epenthesis patterns. Instead, they are independently justified by other phonological processes which are sensitive to prosodic positions and by the distributional properties of segments. A detailed discussion of such processes and distributional properties would go far beyond the scope of the present paper. Still, I would like to mention a few points here that can provide an independent justification of the proposed markedness scales.

First, there is a crosslinguistically common process of intervocalic lenition. By invoking the markedness scale for intervocalic segments, such processes can straightforwardly be described as the interplay of this scale with faithfulness constraints of the IDENT-IO(F) family. Depending on how low identity constraints are ranked with respect to this scale, different degrees of lenition can be predicted, from intervocalic voicing to more drastic types of lenition where e.g. voiceless stops become approximants (e.g. Campidanian Sardinian where /p/ → [β] intervocalically; Lubowicz, 1998), as the drive to maximize sonority in intervocalic position.

On the other hand, many languages display distributional restrictions on which segments can appear in certain prosodic positions. In English and German, for example, laryngeals are the only consonants banned from intervocalic position (provided that the second vowel is not stress-bearing, i.e. that there is no intervening foot boundary), a distributional constraint which falls out naturally from the intervocalic markedness scale. Similarly, in many Khoisan languages clicks are restricted to initial positions. A fairly dramatic example of this is !Xóǀ (Traill, 1985) where strong distributional constraints hold. !Xóǀ has 119 consonants, 80 of which are clicks. However, only the sonorants [β, j, m, n, l] are found intervocalically (obstruents are banned from this position). Conversely, a subset of these sonorants, [l, j, n], cannot occur in initial position.

While space does not permit to go into more detail here, it should be clear that the two markedness scales in (11–12) are not just stipulative or ad-hoc solutions for the problem at hand. They can find independent motivation in phonological processes involving lenition

or fortition, and they can explain distributional gaps. The pertinent question, however, is how the above findings relate to the phenomenon of intrusive [r]. In the next section, I want to argue that [r] insertion also follows from the markedness hierarchies proposed. More particularly, I want to show that epenthesis of [r] is the optimal strategy in environments where glide formation is blocked, [r] being the ‘next-best’ consonant in intervocalic positions (the most sonorous consonant after the glides).

5. A prominence-based account of intrusive [r]

If one wants to understand intrusive [r], it is misleading to look at this phenomenon in isolation. As has been observed by numerous researchers, [r] is not the only hiatus breaker in English. Instead, it interacts systematically with the glides [w] and [j] (see e.g. [Trudgill, 1986](#); [McCarthy, 1993](#)), such that [j] is inserted after high front vowels (after [i:, eɪ, aɪ, ɔ]) and [w] is inserted after high back vowels (after [u:, əʊ, aʊ]). [r] is inserted after all other potential final vowels, i.e. the set of non-high vowels [ə, au, ɔ:] discussed above.⁸

(18) Hiatus resolution in English

- | | | |
|-----|-------------|-----------|
| (a) | The key is | [ki:jɪz] |
| | The pay is | [peɪjɪz] |
| (b) | The zoo is | [zu:wɪz] |
| | The show is | [ʃəʊwɪz] |
| (c) | The law is | [lə:rɪz] |
| | The spa is | [spɑ:rɪz] |

The insertion of glides in (18a–b) can be straightforwardly explained, taking into account the findings of the previous section. Glide insertion occurs because a glide is the least marked epenthetic consonant in hiatus position. In the forms in (c), however, glide formation is apparently blocked because a different consonant is inserted. The question now is why glide formation is blocked.

The data in (18) show that glide formation only occurs if the preceding vowel is high. The glides [j, w] themselves are high. In addition, the glide also agrees in backness and roundness with the preceding vowel, such that [w] occurs after [u, ʊ] and [j] occurs after [i, ɪ]. In terms of the crucial vocalic features, height and backness, the glide is thus an exact copy of the preceding vowel. This can be captured as a spreading process, in the framework of Feature Geometry ([Sagey, 1986](#); [Clements, 1991](#)). In particular, I will assume the Unified Feature Geometry model of Feature Geometry ([Clements, 1991](#); [Clements and Hume, 1995](#)), in which the set of distinctive features is unified for consonants and vowels, such that front vowels are [coronal], back vowels are [dorsal] and round vowels are [labial]. In feature geometric terms, glide formation in English can be formalised as in [Fig. 1](#), where configurations are given for the insertion of [j] after [i] and [w] after [u].

The generalisation that in glide formation both place and aperture features spread, is best captured in an analysis which assumes that the entire vocalic node of the vowel spreads, taking place and aperture features with it. Glide formation can thus be expressed

⁸ The other vowels of English [ɛ, ʌ, ɒ, æ] cannot occur in final position.

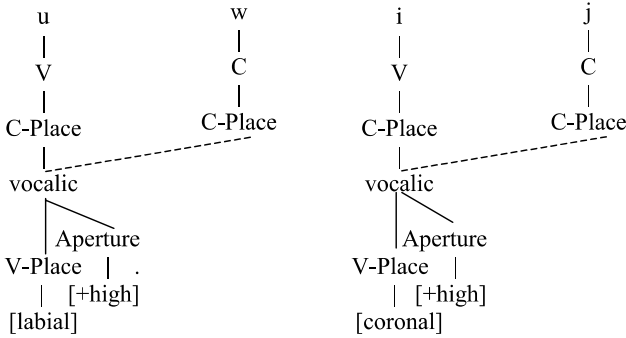


Fig. 1. English glide insertion in Feature Geometry.

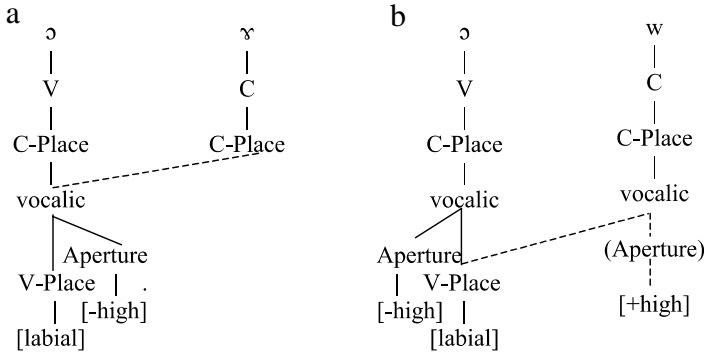


Fig. 2. Illicit glide formation in English: (a) illicit spreading I: non-high glide formation, (b) illicit spreading II: [+high] insertion.

as the spreading process of one node alone. All vocalic features spread onto the consonantal slot. The observation that all vocalic features spread explains why glide formation is impossible after a non-high vowel. Consider two possible types of spreading from a non-high vowel (here: [ɔ]), which are both illicit types of spreading in English: formation of a non-high glide and spreading of the place feature alone (Fig. 2).

Tree (a) in Fig. 2 shows a configuration where the vocalic node still spreads, along with the feature [-high]. The resultant segment is a non-high glide, expressed here as [ɣ], which is, however, not a possible segment of English. Alternatively, the V-Place node alone may spread (or just the terminal place feature), thus creating a [labial] glide where height is specified by an insertion process. This strategy is not attested in English (although it occurs in other languages); all features must spread, no mfeatures may be inserted. As both strategies of glide formation are apparently blocked in English,⁹ a different strategy must come to rescue and fill the hiatus position, intrusive [r]. The following section provides an OT analysis of hiatus resolution in English on the basis of these findings.

⁹ Glide formation in English seems to be a good example of what Padgett (1995) has termed ‘sour grapes spreading’: Either all features will spread, or none will.

5.1. An OT analysis of intrusive [r]

The default strategy to avoid hiatus in English is glide insertion. The necessary constraints and their ranking have already been introduced in Section 4. The two constraints which determine whether epenthesis occurs in hiatus position or not are repeated in (19–20):

- (19) ONSET Syllables have onsets
 (20) DEP-IO Output segments have a correspondent in the input

Secondly, there is the markedness scale for intervocalic consonants, repeated here as (21):

- (21) *V_V/lar » *V_V/obs » * V_V/nas » *V_V/l » *V_V/r » *V_V/V

In order to get the observed variation (glide formation does not occur if the first vowel is not high), additional constraints are needed, however, constraints that militate against those types of spreading formulated in Fig. 2 – types of spreading that do not occur in English. I propose that the illicitness of these types of spreading stems from two constraints, each of which penalises one of the two spreading types. The prohibition against non-high glide formation is captured by a constraint which bans non-high glides in English (see also Bermúdez-Otero and Börjars, 2002, for a similar application of this constraint), formalised in (22):

- (22) *G_[-hi] glides are [+high]

The second type of spreading is militated against by a constraint which prohibits the insertion of a feature [high] which is not present in the input (recall that the feature [+high] must be inserted if only the place feature spreads). This constraint is of the DEPENDENCY family.

- (23) DEP(hi) The feature [high] as a correspondent in the input
 (no insertion of the feature [high])

DEP(hi) will prevent glides from being inserted context-free; only gliding-as-spreading will be allowed. DEP(hi) is not violated in glide formation because the [+high] specification of the glide is not inserted but spreads from the preceding vowel; spreading hence does not incur a violation of a faithfulness constraint (for an opposing view under which segment intersection is not spreading but correspondence, see e.g. Bakovic, 2000). As violations of these two constraints DEP(hi) and *G_[-hi] are not found in English, I assume that they are ranked in the top stratum.

Now consider first a case of glide formation. The tableau in (24) works very much like the tableau in (17) above. For the potential input *key is* /ki: ɪz/, a set of candidates is generated. As ONSET outranks DEP-IO, the first candidate, which is faithful to the input, is not optimal; it fatally violates ONSET. The remaining three candidates all have different hiatus breakers, a glide [j], [r] or the glottal stop [ʔ]. All three of them violate DEP-IO, but they do so to satisfy higher-ranked ONSET. The new constraints *G_[-hi] and DEP(hi) do not play a

role in this tableau. Instead, the optimal of the three candidates is evaluated only by the markedness scale in (21). As glides are less marked than [r] or a glottal stop (that violates the cover constraint *V_V/C, which incorporates all other – less sonorous – consonants), the glide [j] is selected as the epenthetic segment.¹⁰

(24) Glide insertion after [+high] vowels

/ki: ɪz/	ONSET	*G _[-hi]	DEP(hi)	DEP	*V_V/lar	*V_V/r	*V_V/V
[ki:ɪz]	*!						
[ki:jɪz]				*			*
[ki:rɪz]				*		*!	
[ki:ʔɪz]				*	*!		

A different segment will be selected, however, if a different input is chosen, an input where the first of two vowels is [-high], as exemplified in the following tableau, for which the input *law is* /ɔ: ɪz/, is chosen. Now [r] is the optimal epenthetic consonant.

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

/ɔ: ɪz/	ONSET	*G _[-hi]	DEP(hi)	DEP	*V_V/lar	*V_V/r	*V_V/V
[ɔ:ɪz]	*!						
[ɔ:wɪz]			*!	*			*
[ɔ:ɹɪz]		*!		*			*
[ɔ:rɪz]				*		*	
[ɔ:ʔɪz]				*	*!		

Again, the first candidate is out because it violates ONSET. Of the remaining four candidates, two show glide insertion, viz. the two types of glide insertion which have been called illicit above. Why are they illicit? The second candidate [ɔ:wɪz] violates DEP(hi), because this is the candidate where the place feature (here: [labial]) spreads but not the aperture feature, which is inserted instead, yielding epenthetic [w] (compare (b) in Fig. 2 above). The third candidate [ɔ:ɹɪz] does not violate any anti-insertion constraints because the feature specification of the preceding vowel spreads entirely onto the glide, corresponding to the configuration in Fig. 2(a). However, the resulting segment is not a possible segment of English (it violates the constraint against non-high glides), and therefore it is also not optimal. This leaves us with a situation in which glide formation is impossible: If all features spread, an illegal segment results. If only some features spread, others will have to be inserted, which is also ruled out.¹¹ Therefore, a different segment will be selected, which

¹⁰ A potential candidate where the other glide [w] is inserted ([ki:wɪz]) is ruled out by DEP(F) constraints – the glide is always a copy of the preceding vowel.

¹¹ Note that it is in principle also possible to form a glide by spreading from the following vowel, here [ɪ], which would yield [ɔ:jɪz]. However, directionality in glide formation seems to be fixed in English (and not only there; see e.g. Booij, 1995 on Dutch glide formation which works similarly); it is always the preceding vowel which spreads. How such directionality effects are motivated is not an issue of the present paper, though.

is [r] because it is the nearest neighbour of the glides on the markedness scale. Put differently, [r] is inserted because it is the most prominent non-glide on the prominence scale. Intrusive [r] is a case of a prominence or sonority-driven epenthesis process.¹²

This observation links in an intriguing way to Wiese's (2001) hypothesis that the class-hood of rhotics is not established by any common feature shared by all rhotics (the types of /r/ found in the world's languages being very diverse phonetically) but only by sonority. According to Wiese, /r/ is an element which is found between laterals and glides on the sonority scale, independent of its actual phonetic realisation; otherwise, /r/ is largely devoid of phonological content. The claim that the notion of rhoticity is closely connected to sonority is now supported from a different viewpoint as well, and sonority-driven epenthesis lends further evidence to Wiese's hypothesis. On the one hand, /r/ is targeted because of its sonority, irrespective of the actual phonetic realisation of /r/, which differs across lects. On the other hand, /r/ is a good epenthetic consonant not only due to its sonority but also because of its accompanying lack of phonological content – the epenthetic segment also needs to be phonologically as empty as possible because insertion always entails unfaithfulness, and the less is inserted, the more faithful the output is to the input. The optimal epenthetic segment is thus determined by two factors, first its sonority, as argued in detail above, but also the faithfulness violations incurred. Faithfulness is the reason that glides are not inserted context-free, and faithfulness is also a likely factor that influences insertion of /r/, if one assumes with Wiese that /r/ does not have much content phonologically (faithfulness will favour /r/ over other sonorants).

5.2. *Epenthesis and deletion*

So far, nothing has been said about deletion of /r/ in coda position which diachronically is the first necessary step for reanalysis to take place and which synchronically coincides with intrusive [r]: Only non-rhotic dialects intrude. The question of why deletion occurs is quickly answered (and has been answered in the OT literature, as e.g. in McCarthy, 1993 and Anttila and Cho, 1998) as the effect of a constraint prohibiting /r/ in coda position. Vocalisation of coda /r/ is a crosslinguistically observed phenomenon and can also be explained as an effect of the peak and margin hierarchy which also prohibits high-sonority codas. Leaving aside offglides in diphthongs and long monophthongs (which might be analysed as being syllabified into the nucleus anyway), high-sonority elements are thus predicted to undergo deletion in this position, because they are bad coda elements. Hence, /r/ is deleted or syllabified into the nucleus (vocalised). Incidentally, only non-rhotic dialects, i.e. dialects which delete /r/, also seem to show /l/-vocalization (see e.g. Johnson and Britain, 2003), that is deletion of the next most sonorant segment from coda position, suggesting that the constraint against /r/ in codas is indeed motivated by the above discussed prominence scales.

Many researchers have noted that only dialects which delete [r] in coda position can have intrusive [r]. Some have therefore argued that an analysis of intrusive [r] must preclude the possibility of rhotic accents undergoing it. Gick (1999) presents one such analysis

¹² Note that an additional constraint will be needed for (non-rhotic) dialects which do not have intrusive [r], a faithfulness constraint which blocks insertion of segments which are neither contentless (like glottal stops) nor faithful copies of a neighbouring segment (like glides). A discussion of such potential blockers is outside the scope of this article, however.

in which vocalisation of /r/ and intrusion are tied closely together such that loss of rhoticity is a necessary condition for intrusive [r]. The analysis proposed here does not seem to preclude the possibility of rhotic accents having intrusive [r]; the interplay of the peak markedness scale with the general constraint ranking in (25) could in principle be stated for any dialect of English, regardless of its rhoticity. The question is, however, whether this really is an undesired side effect of the analysis.

The key question to me is whether a hypothetical rhotic dialect with intrusive [r] (an unattested dialect) should be ruled out on principled grounds, as a synchronically impossible dialect, or whether it simply is a diachronically unlikely dialect. I suspect that the latter is the case. I do not see why it should be computationally or physically impossible for speakers of a rhotic accent to use [r] as an epenthetic segment as well. The question rather is why they should start doing so. Here, deletion of /r/ and its alternation with zero provide an incentive for reanalysis and hence for constraint reranking. Without the presence of such alternations, there is no motivation for speakers to alter their grammar in order to have a hiatus breaker for non-high vowels.

This point is corroborated by data from other languages. Insertion of an ‘unusual’ consonant (i.e. no glide or glottal stop) frequently seems to result from reanalysing consonant-zero alternations, as shown e.g. by Vaux (2002). This paper cannot suggest, let alone provide analyses for all of these instances of consonant epenthesis (which in fact seems to include a diverse set of consonants), but it shows that any constraint rerankings which yield different epenthetic consonants must be motivated by the data, e.g. by reanalysing alternations. In this sense, intrusive [r] is not ruled out to occur with rhotic dialects as well (it certainly is not ruled out by the formalism), but it is considered unlikely to occur with them because nothing motivates the necessary adjustments in the grammar (in the constraint ranking).

Besides, deletion and epenthesis are in some sense linked under the present analysis, as both are motivated by the same prominence hierarchy. Deletion is likely in one position because /r/ is a dispreferred segment there (in margins, especially codas); in other positions, it is a good epenthetic consonant because the reverse scale holds (in peaks). How an alignment of the two scales with respect to each other might offer an explanation to why deletion of a segment in one position can lead to its insertion in a different position, remains to be seen, however. More research is needed in this direction.

5.3. *Further grounding the process*

There is evidence that [r]-insertion is phonetically licensed as well. While [r]-insertion is principally explained by the prominence scale, other, possibly not strictly phonological factors come into play as well, grounding this process. Recall that the crucial reason for invoking prominence scales to explain different types of epenthesis was the drive to maximise or minimise contrast. Glides are minimally contrastive and thus optimal in intervocalic position. If [r] also turns out to be not only the second-best segment in terms of sonority but also similar to its environment in other respects (and therefore minimally contrastive), then its selection as an epenthetic segment receives further motivation, and indeed there seems to be a close connection between [r] and especially central/back and low vowels. Acoustically, the F1 and F2 of [r] are similar to the F1 and F2 of non-high front vowels, the distinctive trait of [r] being a lowered third formant. This corresponds articulatorily to a pharyngeal constriction found in [r] as well as in schwa and in low vowels (Gick, 2002a). Hence, the phonetics of [r] shows some interesting similarities to the phonetics of especially low and central

vowels, which can also manifest itself in proper phonological processes. Kenstowicz (2001) argues that the low perceptibility of /r/ after back vowels is also a trigger for its deletion in Korean and Fon loanword adaptation. Crosslinguistically, /r/ frequently has a lowering effect on adjacent vowels (Lindau, 1985), and vocalisation of /r/ seems to go universally in the direction of central or back low or mid vowels, as in English, where it vocalises as schwa. A more detailed description of the effects of /r/ on vowels, with special reference to English dialects, can be found in Uffmann (in press).

6. Alternative analyses of intrusive [r]

This section will defend the analysis proposed in this article against alternative accounts. Three competing analyses will be evaluated. First, intrusive [r] has been analysed as a spreading process, with [r] being a low or non-high glide. Under such an analysis, intrusive [r] is thus identical with regular glide formation (e.g. Bakovic, 1999; Ortmann, 1999). Second, there is Orgun's (2001) analysis which also makes crucial reference to prominence scales. The general argument, however, is markedly different from the one presented here, and I will discuss a number of points which render Orgun's analysis problematic. Third, I will compare my analysis to the theory of perceptually motivated epenthesis found in Steriade (2001). Ultimately, all three accounts suffer from problems that a prominence-based analysis of intrusive [r] does not encounter.

6.1. Spreading-based accounts

If English /r/ is so similar to the vowels after which it is epenthesised, why then does this paper not assume a spreading process to explain intrusive [r]? Several researchers have proposed a spreading account for intrusive [r] (e.g. Bakovic, 1999; Ortmann, 1999). Bakovic, following Gnanadesikan (1997), classifies English /r/ as a glide, specified as [low] or [pharyngeal]. Under this assumption, intrusive [r] is just regular glide formation. Two main arguments can be brought forward against such an analysis, however. First, [r] lacks some typical glide characteristics. The uncontroversial glides [w] and [j] first of all have restricted phonotactics, which is typical of glides. In onset clusters, [w] can only appear after a non-labial obstruent (banning [pw, fw] sequences) and it is clearly dispreferred before [u] (the only exception probably being *swoon*), and [j] can only appear before [u:] (in words such as *queue*, *puke*, *few*, *dew*) in onset clusters. [r] shows no such restrictions, neither with respect to its combinatorics in onset clusters,¹³ nor with respect to the following vowel. The only condition is that the first consonant of the cluster is an obstruent, a condition not shared with the uncontroversial glide [j] which also appears after sonorants. In addition, glides all correspond to a full vowel, but the only vowel which /r/ could be argued to correspond to is the reduced vowel schwa, an argument based on schwa-[r] alternations in rhotic vs. non-rhotic dialects (e.g. Gick, 1999).¹⁴ The second argument concerns the nature of the vowels after which [r] intrudes. It seems problematic to treat /ə, ʌ, ɔ:/ all as [low] or [pharyngeal], especially /ɔ:/ which is also considerably raised in many Southern

¹³ leaving aside the sequence /sr/, which is probably an accidental gap, and the impossibility of a voiced fricative plus /r/, which is a constraint which also holds for /w/ and nasals, however.

¹⁴ That is, if it really alternates at all. The variable pronunciation of *fear* as [fiə]–[fir] could be said to display this alternation. It is not clear, however, how an (attested) pronunciation like [fiər] could be handled in such a theory.

English dialects, approximating [ɔ:]. The same holds for the vowel [ɛ:] after which intrusion has also been observed (cf. footnote 1). While it seems possible to assume a spreading account for speakers who only intrude after schwa and [ɑ:] (see also Wells, 1982; Gick, 1999 for a description of this class of speakers), vowels which are demonstrably [pharyngeal] (see also Uffmann, *in press* for an elaboration of this argument), the inclusion of [ɔ:] (and possibly [ɛ:]) into the set of [pharyngeal] vowels seems problematic.¹⁵

Ortmann (1999) provides a different type of spreading account in which [r] is said to carry the feature [-high], without necessarily being a glide. While this circumvents the problems raised by Bakovic's analysis, the feature specification proposed is ad hoc. There is no independent piece of evidence that [r] is [-high]. On the contrary, all evidence points at [r] being actually [low], not just [-high] (Gnanadesikan, 1997; Uffmann, *in press*). At any rate, there are types of /r/ for which it might be hard to argue at all that they are [low] or [-high], especially labiodental variants of /r/ currently spreading across England (see e.g. Foulkes and Docherty, 2000; Britain, 2002). How could insertion of [v] be motivated as spreading of [low] or [-high]? In sum, spreading accounts of intrusive [r] run into a number of problems.¹⁶ Uffmann (*in press*) develops the hypothesis that the current pattern of intrusion might have arisen from an original spreading process which was subsequently generalized into a sonority-based insertion process. However, the current pattern of epenthesis poses problems for strictly spreading-based accounts into which a sonority-based analysis does not run.

6.2. Orgun (2001): a different kind of prominence

An analysis which looks superficially similar to the one defended in this paper is proposed by Orgun (2001). His analysis runs into a number of problems as well, however. Orgun also makes use of prominence scales, although he invokes scales different from those introduced here. First, he proposes a scale for coda consonants which is based on the markedness scale for peaks.

(26) *CODA-t » *CODA-n » *CODA-r » *CODA-w,j

The relevant constraint here is *CODA-r, the constraint which prohibits [r] to appear in coda position. This scale is complemented by a scale for nuclei, which is expressed positively:


(27) NUC-a » NUC-e » NUC-i,u

The relevant constraint here is NUC-i,u which demands that [i] and [u] should stand in nucleus position. Put differently, this constraint prohibits glides. By ranking NUC-i,u above *CODA-r, Orgun gets the correct candidates selected in his tableaux, repeated here in (28) and (29) (note that Orgun also uses McCarthy's FINAL-C constraint instead of ONSET to trigger epenthesis):


¹⁵ Spreading-based accounts can also not explain the sporadic overapplication of intrusive [r]. Sivertsen (1960: 136–9) finds some examples of [r] even after high vowels in her corpus. A sonority-based account can explain such occurrences as a failure of glide formation and can predict that the process might in fact become regular, such that [r] becomes the default epenthetic consonant (by banning glide formation). Spreading-based accounts preclude the possibility of such a development, however.

¹⁶ One anonymous reviewer notes that, in addition, spreading accounts establish no formal link at all to the fact that intrusive [r] is intimately related to deletion of the same consonant (see also Section 5.2).

(28) intrusive [r] satisfies NUC-i,u

drawing /drɔ:ŋ/	FINAL-C	NUC-i,u	*CODA-r	*r
drawing	*!			
 draw[r]ing			*	*
draw[j]ing		*!		

(29) after high vowels, NUC-i,u is vacuously violated

seeing /sijŋ/	FINAL-C	NUC-i,u	*CODA-r	*r
see[r]ing		*		*!
 see[j]ing		*		

The first tableau shows that glide insertion is more marked than insertion of [r]. That [r] is not inserted across the board is shown in the second tableau: As the underlying form contains a glide anyway, NUC-i,u will be violated vacuously. In this case, a general prohibition against [r] will kick in and render the candidate with epenthetic [r] suboptimal.

This analysis looks simpler than the one proposed in Section 5.1 but it runs into numerous problems. First of all, the basic ranking of NUC-i,u over *CODA-r makes the statement that glides are more marked than coda [r], which contradicts known facts of English: In non-rhotic accents of English like the ones discussed here, coda [r] are strictly prohibited while glides can occur freely. Orgun's ranking can under no circumstances account for forms such as *we* or *you* (which violate NUC-i,u) and at the same time capture the generalisation that all coda [r] are deleted: If they are deleted, all glides have to be deleted as well, because the prohibition against glides ranks above the prohibition against coda [r]. Note also that Orgun's basic ranking is the opposite of the ranking proposed in this article, where glides are considered less marked than rhotics.

Second, in order for the ranking to work, forms like *seeing* must contain an underlying glide; a form without a glide would not violate NUC-i,u, and consequently [r] would be epenthised. Orgun must prespecify the input, which is in violation of Richness of the Base (see above). Third, [r] must be analysed as being ambisyllabic, in order for *CODA-r to be violated. No such additional assumptions are necessary in the analysis suggested above. Fourth, the markedness scale in (26) looks problematic. It claims that [r] is less marked in coda position than other consonants. Why then is [r] deleted from coda position in non-rhotic dialects of English or German (Wiese, 1996)? The opposite is true: [r] is a marked coda consonant. I think that the problems mentioned are really fundamental problems, none of which are encountered in the analysis given in Section 5.1. Orgun's analysis should therefore probably be rejected.

6.3. Perception-based models

A final possible analysis of intrusive [r] will be briefly discussed now which is outlined in Steriade (2001) in her P-map proposal which links phonological processes to the notions of

perceptibility (or perceptual salience) and confusability. In particular, a segment is a good epenthetic segment which is most confusable in a given position because it is closest to zero. Steriade argues that this is the reason for the divergent insertion of glides and glottal stops. Glides are closest to zero perceptually in intervocalic position, and glottal stops are closest to zero word-initially. In this framework, epenthesis of [r] could be motivated as epenthesis of the least perceptible (or most confusable) consonant after back vowels.

Conceptually, this proposal looks similar to the one advocated here which draws upon the notion of prominence. I argued that a prominent segment (a glide) is inserted between two prominent segments to minimise contrast, and this could also be recast as insertion of a perceptually minimally different segment. There are, however, some important differences to the Steriade model. On the one hand, prominence is a phonological concept here, grounded in the sonority hierarchy, and not a perceptual property, which is grounded in auditory phonetics rather than in more abstract (cognitive and formal) symbolic categories. More importantly, however, explicit reference to perceptibility seems problematic empirically. We have seen that glottal stops in German are inserted not only word-initially but also foot-initially. Here, a glottal stop is arguably not closest to zero perceptually, as its insertion generates a clearly perceptible period of silence intervening between the two vowels (see the examples in (7) again). Glide formation would probably be predicted by this model instead. In addition, we have also seen that some English dialects do not restrict intrusive [r] to back/low vowels but extend it to all non-high vowels instead, including front [ɛ:] where [r] might in fact not be the consonant most closely corresponding to zero. Moreover, it is not clear whether insertion of labiodental [v] as a common realization of /r/ can also be perceptually motivated. Instead, intrusive [r] seems a process which is explicable from phonological generalizations more than from phonetic or perceptual observations, a point which also extends to other insertion processes, like glottal stop insertion in German.¹⁷

7. Summary

This paper argued for a novel analysis of intrusive [r] by following a new approach towards consonant epenthesis in general. Markedness scales, as originally proposed by Prince and Smolensky (1993), were invoked to explain crosslinguistically frequent epenthetic consonants. Different scales, defined over different prosodic positions, can explain why glottal stops are used in certain positions (word- and foot-initial positions) while glides are used in others (intervocalically). Contra Rubach (2000), it is therefore not necessary to stipulate two distinct levels of derivation, each of which with its separate ranking, to explain how two different epenthesis strategies can coexist within one language. In the light of these findings, intrusive [r] was explained as a rescue strategy of epenthesis where glide formation is blocked. This strategy is essentially a prominence-driven one where the most sonorous, i.e. the most prominent and least contrastive segment is inserted. Where glides cannot fill this position, liquids – and especially [r] – will do so.

These findings potentially lead into two new possible lines of research which I want to discuss briefly now. The first line regards the question of liquid epenthesis crosslinguistically. This paper makes the prediction that it should not simply be an idiosyncratic trait

¹⁷ For further criticism of the Steriade model, see also Vaux (2002), who discusses consonant epenthesis crosslinguistically, and Uffmann (2004), who takes issue with the predictions this model makes for vowel epenthesis.

of English but occur more often where glide formation is blocked. In fact, there seem to be more instances of epenthetic /r/ crosslinguistically, which cast doubt on the claim that it is an unnatural process. In Bavarian, there is a process of [r]-insertion very similar to that of English, as discussed in Gutch (1992).¹⁸ By and large, [r] is inserted as a hiatus breaker in Bavarian after low vowels, as in *draa[r] i* ('I turn'). Gutch also cites evidence from Old and Middle High German texts that intrusive [r] was at least sporadically present in these varieties (see Gutch, 1992 and Uffmann, in press for a more detailed discussion). Lombardi (1997) also discusses two languages which seem to have productive epenthesis of /r/, at least in restricted contexts, Japanese and Gokana. Interestingly, many researchers in the past adopted a deletion account for Japanese, on the basis that /r/ is not a natural hiatus filler. This paper has shown that /r/ can be conceived of as a natural hiatus filler, however. Perhaps other liquid-zero alternations, which commonly receive an explanation in terms of liquid deletion, can also be reformulated as epenthesis processes in the future. To mention one such potential candidate, consider determiner allomorphy in Haitian Creole. The pertinent data are found in (30):

- (30) Determiner allomorphy in Haitian Creole
- | | | | |
|------|------------------|----------|--------------|
| /la/ | after consonants | liv-la | 'the book' |
| /nā/ | after nasals | madam-nā | 'the lady' |
| /ja/ | after front Vs | lapli-ja | 'the rain' |
| /wa/ | after back Vs | bato-wa | 'the boat' |
| /a/ | after /a/ | papa-a | 'the father' |

The standard analysis (e.g. Nikiema, 1999) assumes underlying *la* and an additional process which deletes /l/ postvocally. The main reason for assuming deletion in this context has been that there seems to be no reason why /l/ should be inserted, of all consonants; /l/ is not a natural epenthetic consonant. On the other hand, deletion accounts run into difficulties when forced to explain why deletion takes place: Deletion creates hiatus, which then has to be repaired via glide formation. Incidentally, Gerlach (2001) describes a very similar process in Portuguese, viz. allomorphy of the personal pronoun clitic *los/os*, which is triggered by the same environments as Haitian allomorphy. She proposes that /l/ is epenthetic in Portuguese, although she prefers a somewhat problematic spreading account to explain why /l/ is inserted. In the light of the findings of this paper, both Haitian and Portuguese might receive a novel analysis where liquid epenthesis occurs when glide formation is impossible because the preceding segment is not a vowel. A principled account of liquid-zero alternations remains a desideratum, but it seems possible that liquid epenthesis might actually be more common than previously thought, once traditional deletion accounts receive a new explanation. On a larger scale, a principled cross-linguistic analysis of potential epenthetic consonants is still lacking in order to support or to refute the hypotheses of this paper. Future research will hopefully fill this gap.

A second gap which still needs to be filled regards the nature of markedness constraints in OT, with respect to the distinction between paradigmatic and syntagmatic markedness constraints. The standard view of markedness is that of paradigmatic markedness, where the markedness of a segment is evaluated in isolation and in relation to other sounds.

¹⁸ The parallelism between Bavarian and English was noted as early as Jespersen (1913). It is surprising how little attention it has since enjoyed.

Paradigmatic markedness is context-free markedness, captured in a constraint like *DORSAL, which states that universally, dorsals are marked segments, and captured in markedness relation, as in the hierarchy *DORSAL » *CORONAL, which states that dorsals are more marked than coronals. This view of markedness is found, for example, in Lombardi's (1997) typology of epenthetic consonants, which also is a context-free typology, as discussed above, and it is a view of markedness against which McCarthy's (1993) statement that [r] is no default segment of English must be understood.

This view contrasts sharply with notions of syntagmatic markedness, i.e. the markedness of a segment in a specific environment. Unfortunately, syntagmatic markedness constraints have so far been formulated impressionistically very often, as in Pater's (1999) constraint *NC₀, which prohibits a voiceless consonant following a nasal. Such constraints often simply spell out the marked context which is avoided and consequently tend to look ad hoc. A more formal and more principally constrained account of syntagmatic markedness thus still is necessary. The use of prominence scales could be a step in the right direction in formalising syntagmatic markedness effects. An account of optimal epenthetic consonants in terms of syntagmatic markedness was shown to be superior to traditional, paradigmatic accounts in this paper. The elaboration of such context-sensitive markedness hierarchies might be a promising enterprise for future research in phonological theory.

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