

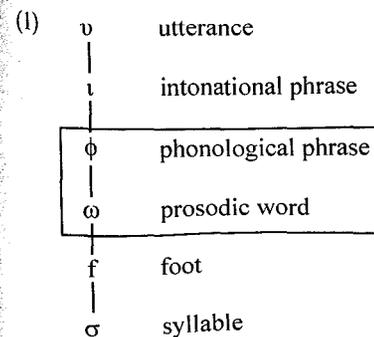
9 The onset of the prosodic word¹

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In one of the pioneering works of Optimality Theory (Prince and Smolensky 1993/2004), McCarthy (1993a) offers a comprehensive analysis of *r*-insertion in non-rhotic dialects of English, and suggests that the constraint driving the process is not an onset-related constraint, but rather a constraint requiring prosodic words to end in a consonant ('FINAL-C'). While morphological categories such as roots or stems are sometimes subject to templatic requirements involving an obligatory final consonant, independent evidence for a requirement of this kind on genuine prosodic constituents, such as surface prosodic words, is sparse. This paper shows that, while McCarthy's treatment remains, in its essentials, a model of optimality-theoretic analysis, it is unnecessary to take recourse to FINAL-C once the onset requirements for different levels of the prosodic hierarchy, together with their associated faithfulness properties, are better understood.

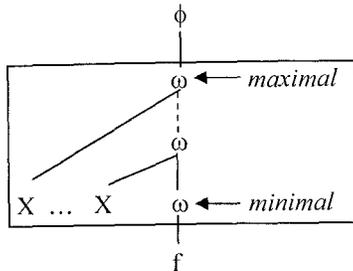
1 Introduction

This paper is a contribution to the study of a particular region of the prosodic hierarchy – the area falling between the prosodic word and the phonological phrase. The larger goal (see also Ito and Mester 2007a,b) is to explore the consequences of a framework with minimal assumptions about prosodic levels above the word-internal constituents, positing only the two layers of constituency below the intonational phrase that all researchers agree on: the prosodic word and the phonological phrase (1).

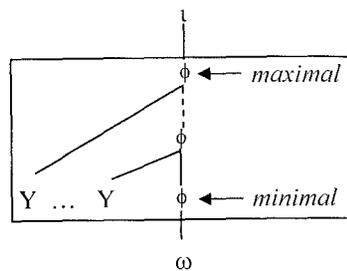


Note the absence of additional categories between ϕ and ω , such as the ‘clitic group’ (Nespor and Vogel 1986, Hayes 1989, Nespor 1999), and the distinction between ‘major’ and ‘minor’ phonological phrases (McCawley 1968, Selkirk and Tateishi 1988; renamed as ‘intermediate’ and ‘accentual’ phrases, respectively, in Pierrehumbert and Beckman 1988). The standard picture of the prosodic hierarchy, we argue, has too many categories, and at the same time, too little structure. We motivate a sparse hierarchy where prosodic adjunction plays a large role in parsing phonological strings, in the way indicated in (2) (for head-final structures).

(2) Prosodic word projections:



Phonological phrase projections:



For a given prosodic category κ , we refer to the resulting larger structure as the maximal (projection of) κ , and its innermost subconstituent of type κ as the minimal (projection of) κ , along lines familiar from syntactic constituent structure (see in particular Grimshaw's (2005) work on extended projection). In the interest of notational convenience, we sometimes use κ^l and κ_i for the maximal and minimal κ , respectively, as indicated in (3).

- (3) κ^l $\stackrel{\text{def}}{=}$ the maximal (projection of) κ : κ not dominated by κ .
 κ_i $\stackrel{\text{def}}{=}$ the minimal (projection of) κ : κ not dominating κ .

Within a particular grammar, independent factors relating to syntax-phonology alignment, depth of projection, and length impose limits on the size of extended ω - and ϕ -structures. The important point here is the distinction between categories and their instantiations. By singling out maximal and minimal projections, our claim is that the theory maintains the right amount of flexibility to distinguish what needs to be distinguished while avoiding an over-abundance of descriptive categories. It is always tempting to add new levels in order to cope with the different domains that the empirical facts of individual languages seem to demand. The difficulty is to do so in a way that does not lose sight of the overall explanatory goal – minimally, a motivated identification of categories across languages, such that the ‘xyz-phrase’ of one language can be confidently equated with the ‘XYZ-phrase’ of another, in a way that is comparable to the security of such identifications in syntactic research.²

In a larger context, our proposal is situated in the Weak Layering theory of prosodic structure of Ito and Mester (1992), formulated in optimality-theoretic terms by Selkirk (1995), where a prosodic category κ may dominate the same category κ (in violation of Strict Layering) if compelled by higher-ranking constraints. In such cases the resulting structure violates a constraint against recursivity.

The empirical focus of this paper is the *r*-sandhi phenomenon in English, and an influential analysis developed in two important papers by John McCarthy (McCarthy 1991, 1993a), with subsequent discussion by various researchers, and many attempts at reanalysis. *R*-sandhi, which occurs in several non-rhotic varieties of English, refers to the appearance of both underlying and non-underlying *r* as hiatus breakers in forms like *moth*[ə̃ r̃]is and *ide*[ə̃ r̃]is, for speakers who otherwise have *moth*[ə̃] and *ide*[ə̃]. This paper revisits the prosodic conditions of this process. Our first step will be to get a clear view of the varying range of contexts where *r*-sandhi occurs in different non-rhotic varieties, including non-standard dialects spoken in the British Isles. Building on previous analyses – most importantly, Kahn (1976, 1980) and McCarthy (1993a) – our ultimate aim, within the overall approach sketched above in (2), is a better understanding of the prosodic structure of collocations formed by full lexical words with associated function words.

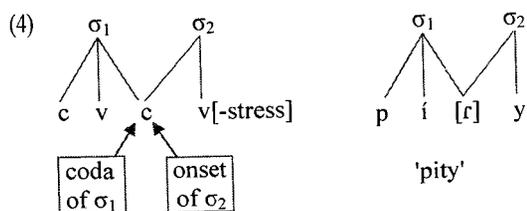
In the process, we will have occasion to revisit the FINAL-C constraint posited by McCarthy (1993a). We will argue that this constraint, often viewed as problematic, can indeed be dispensed with while preserving all the major insights of McCarthy's analysis. As we will show, progress in the area depends on a proper analysis of the phonology of word onsets, including both markedness and faithfulness properties. In a nutshell, and in terms of the theoretical assumptions laid out above, *r*-sandhi does not result from a FINAL-C requirement applying at the end of the prosodic word (which would amount to a kind of obligatory coda, unparalleled elsewhere in the study of syllabic form), but rather from an Initial-C requirement applying at the beginning of the maximal prosodic word (i.e., a member of the ONSET family of constraints). Furthermore, the coda properties of linking and intrusive *r*, leading to its overall ambisyllabic status, are not due to the existence of some constraint demanding the presence of a coda, but are explained by the location of the source of the segment's featural content – viz., the vowel of the preceding syllable. In a similar way, we anticipate that other cases where FINAL-C has been invoked will yield to similar kinds of reanalysis once the prosodic structures involved have been correctly identified.

2 Syllable-based explanations: ambisyllabicity and flapping

The concept of the syllable is central to phonological constituent structure and has long been indispensable for serious phonological analysis. 'Closed syllable' vs. 'open syllable', 'heavy syllable' vs. 'light syllable' play a central role as environments for sound changes and phonological processes in both neogrammarian and structuralist linguistics. In a curious contrast with generative syntax, early generative phonology was an attempt to break away from this tradition and to do phonology without phonological constituent structure. The non-viability of strict segmentalism was quickly recognized, and syllable structure was shown to be irreplaceable in providing the environments for many, if not most, phonological processes (see Hooper 1972 and Vennemann 1972, among others). These works viewed the role of the syllable mainly as adding another boundary to the set of boundary symbols available to phonology, thus continuing the essentially linear conception of phonological structure, i.e., as consisting of a string of segments and boundary symbols, inherited from Chomsky and Halle (1968).

Kahn (1976), in a detailed study of allophonic processes in English conditioned by syllable structure, took the crucial step from boundary markers to genuine constituency, marking the beginning of a formal and principled study of syllabic phonology. Together with other roughly simultaneous pioneering research in autosegmental and metrical phonology, it was this work that led to the modern theory of prosodic structure as a hierarchy of constituents standing in correspondence to grammatical structure, and providing the domains in which phonological processes take place.

Kahn's central argument has two parts: (i) The environments of segmental processes (aspiration, glottalization, and flapping in American English) make essential and irreducible reference to syllable structure, and (ii) these syllable structure specifications cannot be reduced to boundary symbols ordered within the linear string of segments, but require genuine prosodic constituent structure. The process of flapping (or more accurately, tapping) is of central importance in this context. Word-internally, the flapped segment belongs both to the coda of the first syllable and to the onset of the following syllable (through Kahn's (1980) rule of 'Medial Ambisyllabification'), as shown in (4).



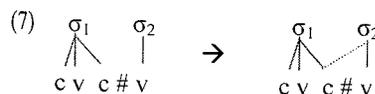
Prototypical word-internal examples appear in (5). Ambisyllabification applies to all consonants, but is most tangible for underlying /t/, which is ambisyllabically realized as a flap. Flapping is obligatory between stressed and stressless syllables, as in (5a). Between two stressless syllables, it is optional (5b).

- (5) Flapping in the onset of unstressed syllable
- a. betting → bé[r]ĩng
water → wá[r]ēr
pity → pí[r]ỹ
- b. ability → abílí[t,r]ỹ
affirmative → affirmá[t,r]ĩve

There is no flapping in the onset of word-internal syllables with primary or secondary stress; instead we find aspirated [t^h] (6).

- (6) Aspiration in the onset of stressed syllables
- atone → á[t^h]óne
fatigue → fá[t^h]ígue
latex → lá[t^h]èx

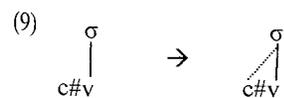
While word-medial ambisyllabification is coda-creating and restricted to onsets of unstressed syllables (*a[r]óm* vs. *a[t^h]ómic*), ambisyllabification across a word boundary, illustrated in (7), is onset-creating and takes place before unstressed and stressed syllables alike.



Illustrative examples for both cases appear in (8).

- (8) a. Pre-unstress environment:
go[r] it, a[r] Amánda's, isn't tha[r] amázing?
- b. Pre-stress environment:
go[r] émail, a[r] Émily's, wasn't tha[r] áwful?

The process involves a rule of 'Trans-Word-Boundary Ambisyllabification', which Kahn (1980: note 11) identifies as the reassertion of the universal preference for onsets (9) at word junctures.



The concept of ambisyllabicity that lies at the core of Kahn's analysis is not without its critics, and there have been several attempts, starting with Kiparsky (1979), to replace it with some other environment, mainly 'foot-internal' (see Jensen 2000 for a recent comprehensive discussion). It is no surprise that this kind of substitution is often possible – after all, foot-internally is where ambisyllabicity is most expected, and not at foot edges, where crisp prosodic edges are called for (see Ito and Mester 1999a:208 for a formal analysis). But the two are not co-extensive, as dramatically highlighted by pre-stress external sandhi cases of flapping such as *go[r] email* (8b), etc. In Kiparsky's (1979) original reanalysis, such recalcitrant cases are captured by means of opaque rule application, where the cover feature 'lax' gets assigned cyclically in non-foot-initial position, and is then post-cyclically cashed in, after resyllabification, for different phonetic properties (flapping, glottalization) in different contexts (prevocally vs. other environments). In this analysis, the *t* of *got* becomes [+lax] on its own cycle, which is then either spelled out as [+glottalized], or as [+voiced] after resyllabification has applied in *got email*.³ Virtually every aspect of this analysis – cyclic rule ordering, opaque rule application, use of cover features – is at variance with current theoretical assumptions. For these reasons, even though what we have to say here could perhaps be restated in terms of a foot domain account, we follow McCarthy (1993a) and retain classical Kahnian ambisyllabicity, given that it unifies the pre-unstress and pre-stress environments of flapping in (5) and (8) in a natural way that is not easily available to a foot-domain account (see also Gussenhoven 1986 and Rubach 1996 for further arguments in favor of ambisyllabicity).

The fact that VC#V leads to ambisyllabicity calls for a comparison with underlying V#CV. The issue already attracted the attention of structuralist phonologists,⁴ who noted, citing segmentally identical but prosodically contrasting minimal pairs like *an aim* (with ambisyllabic [n], in Kahn's terms) and *a name* (pure onset [n]), that the two remain distinct in all styles of speech. The post-Bloomfieldian principle of the separation of linguistic levels, with its concomitant rejection of all grammatical prerequisites for phonemic analysis, led to the postulation of juncture phonemes in this context, linearly ordered between segmental phonemes, an analytical tradition carried on in classical generative theory in the form of boundary symbols (see Pyle 1972 for a discussion of the problematic aspects of such reifications of the edges of phonological constituents). McCarthy and Prince (1993a) take up this well-known junctural contrast and illustrate it with the example in (10).

- (10) a. /C#V/ juncture – ambisyllabicity: *sought Ed* = [sɔɹɛd]
 b. /V#C/ juncture – heterosyllabicity: *saw Ted* = [sɔ^hɛd]

Departing from their analysis in some respects and closely following Kahnian ideas, we can rationalize these findings as arising out of a simple interaction of syllable wellformedness (cf. Kahn's (1980: note 11) characterization of (9) as a reassertion of the universal preference for onsets at word junctures) with syntax-prosody mapping constraints governing stems (or morphological words), as in (11) and (12).⁵ The perfectly governing stems (or morphological ONSET, and the resyllabifying candidate (11c) violates both ALIGN-RIGHT and ALIGN-LEFT, leading to the selection of the ambisyllabic (11b), which violates only the latter.⁶

(11)

		ALIGN-RIGHT (stem, ω)	ONSET	ALIGN-LEFT (stem, ω)
a.	$\begin{array}{c} [\omega \sigma_1] \quad [\omega \sigma_2] \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ s \quad o u g h t \quad \quad E d \end{array}$		*!	
b.	$\begin{array}{c} [\omega \sigma_1] \quad [\omega \sigma_2] \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ s \quad o u g h [r] \quad \quad E d \end{array}$			*
c.	$\begin{array}{c} [\omega \sigma_1] \quad [\omega \sigma_2] \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ s \quad o u g h t \quad \quad E d \end{array}$	*!		*

The contrasting example (12) shows no corresponding linking of onset-/t/ to coda position. The winning candidate (12c) violates none of the three constraints, reflecting Kahn's (1980: note 12) diagnosis that no ambisyllabicity is expected here since, as syllabified at the word level, 'the input string already has the preferred syllable shape'.

(12)

		ALIGN-RIGHT (stem, ω)	ONSET	ALIGN-LEFT (stem, ω)
a.	$\begin{array}{c} [\omega \sigma] \quad [\omega \sigma] \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ s \quad a w \quad \quad T e d \end{array}$	*!	*	*
a.	$\begin{array}{c} [\omega \sigma] \quad [\omega \sigma] \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ s \quad a w \quad \quad [r] e d \end{array}$	*!		
c.	$\begin{array}{c} [\omega \sigma] \quad [\omega \sigma] \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ s \quad a w \quad \quad T e d \end{array}$			

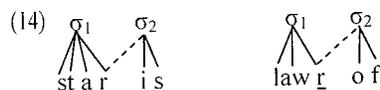
3 R-sandhi in non-rhotic English

Flapping is restricted to certain dialect areas, including North American, Australian, and Cockney, even though its deeper syllabic source, the ambisyllabic configuration, is arguably pan-dialectal. A second sandhi process, involving *r*, is found in a different and partially overlapping group of dialects, all of which share the loss of *r* in syllable codas. Most well-known as a feature of the *Received Pronunciation* ('RP') of British English, *r*-sandhi is also found in other non-rhotic variants of English, as spoken in New Zealand, Eastern Massachusetts, South Africa, and in the Deep South of the U.S. The process occurs after the non-high vowels [ə, ɔ:, ɑ:] and is found both at word junctures and word-internally at morpheme boundaries ('level II', in terms of level-ordered morphology (Siegel 1974)).

(13) *r*-sandhi

	Linking <i>r</i> (underlying, etymologic)	Intrusive <i>r</i> (non-underlying, non-etymologic)
External sandhi:	bette r / bette ^r off sta r / sta ^r is	comma / comma ^r in law / law ^r of
Internal sandhi:	soa r / soa ^r ing sta r / sta ^r y	withdraw / withdraw ^r al Kafka / Kafka ^r esque

Since our focus is on phonological structure and not phonetic details of articulation, we render linking and intrusive [r] as 'r' and 'r̄', respectively, for easy legibility. Kahn (1976) and McCarthy (1993a) have argued that the liaison element (the rhotic linking consonant, whether underlying or intrusive) is always ambisyllabic, as in (14), showing a mixture of onset and coda properties.



R-sandhi is very productive, as shown by the intrusive *r* in loanwords like the *Stella Artois event* and in the interlanguage of non-rhotic English learners of foreign languages (French: *j'étais déjà r̄ici*; German: *ich habe r̄eine Reservierung*; Latin: *hosanna r̄in excelsis*) (after Wells 1982 and McMahon 2000). Sandhi phenomena of this kind are widespread, and the English facts have close parallels in other languages. For example, Bavarian German has an *r*-sandhi process virtually identical to (13), with both linking and intrusive *r* (the latter underlined), as shown in (15), where Standard German glosses have been added for comparison.⁷

(15) *r*-sandhi in Bavarian German

a. Internal	zwoa	<i>zwei</i>	'two'
sandhi:	da zwoa ^{r̄} a	<i>der Zweier</i>	'the two'
	owa	<i>ober</i>	'upper'
	Owa ^{r̄} rammagau	<i>Oberammergau</i>	(place name)
b. External	wia ^{r̄} i gsagd hab	<i>wie ich gesagt habe</i>	'as I said'
sandhi:	ma ^{r̄} uns	<i>man/wir uns</i>	'one/we us'
	kema ^{r̄} is	<i>gekommen ist</i>	'has come'
	Mia kena ^{r̄} awa ^{r̄} aa ^{r̄} an ^{r̄}	<i>Wir können aber auch ein</i>	'But we can
	andasmoi kema.	<i>andermal kommen.</i>	also come
		lit. 'We can however also	another time.'
		another time come.'	

3.1 Hiatus avoidance and onset

Given the background of the flapping case (11), where the assignment of the consonant to the following syllable in utterances like *sough*[r] *Ed* is clearly driven by the constraint ONSET, it is a natural expectation that linking and intrusive *r* in non-rhotic dialects of English should be another ONSET effect.⁸ After all, the prosodic context and the resulting configuration of ambisyllabicity are entirely parallel for flapping and for *r*-sandhi. A starting point for such an onset-driven analysis is shown in (16) for a case of intrusive *r*; *saw*[r] *Ed*, where the constraint against insertion (DEP) is ranked below ONSET (see Anttila and Cho 1998).

(16) ONSET » DEP

<i>saw Ed</i>	ONSET	DEP
a. $[\omega \sigma] \quad [\omega \sigma]$ s aw E d	*!	
b. $[\omega \sigma] \quad [\omega \sigma]$ s aw [r] E d		*

There are naturally many questions of detail, to be taken up in section 4,⁹ but the broad outlines of such an onset-driven analysis seem straightforward.

3.2 FINAL-C and the function word gap

It comes as somewhat of a surprise, therefore, that this is by no means a universally accepted conclusion. In a groundbreaking early contribution to Optimality Theory (Prince and Smolensky 1993/2004), McCarthy (1993a) offers a comprehensive and theoretically insightful analysis of *r*-sandhi in one specific dialect, that of Eastern Massachusetts. He starts out (1993a:2) with the observation that ‘it is generally agreed that *r* is inserted to resolve hiatus, by separating two adjacent hetero-syllabic vowels’ (i.e., the effect of a hiatus-resolving ONSET constraint). His own analysis, however, does not involve ONSET, but rather makes crucial use of a different constraint, ‘FINAL-C’, which declares prosodic words ending in a vowel ill-formed.

(17) FINAL-C: *V]_ω (A prosodic word ends in a consonant.)

FINAL-C is a surprising assertion in that it bans one of the few uncontested desiderata of prosodic form, the open syllable, in a specific context. While the ends of words are known to be prosodically non-prominent, and prone to weakenings and deletions of all kinds, involving both vowels and consonants, it is a different matter altogether to conceptualize a subset of these phenomena as a direct preference for word-final consonants.

McCarthy’s basic analysis is summarized in (18)–(20), where each tableau combines the evaluation of two separate inputs, with violation marks applying equally to each candidate in each cell. FINAL-C is dominated by a coda condition ruling out *r* exclusively occupying coda position.¹⁰ Thus no intrusive or linking *r* appears when the form stands in isolation (18) and before C-initial words (19).

(18)

<i>Wanda</i> <i>Homer</i>	CODA-COND	FINAL-C
[_ω σ σ] ☞ <i>Wanda</i> ☞ <i>Home#</i>		*
[_ω σ σ] <i>Wanda</i> _r <i>Homer</i>	*!	

(19)

<i>Wanda left</i> <i>Homer left</i>	CODA-COND	FINAL-C
[_ω σ σ] [_ω σ] ☞ <i>Wanda left</i> ☞ <i>Home# left</i>		*
[_ω σ σ] [_ω σ] <i>Wanda</i> _r left <i>Homer left</i>	*!	

When the second word is V-initial, however, *r* can be inserted in the coda and simultaneously occupy onset position, as an ambisyllabic consonant. CODA-COND is crucially not violated: As is usual for licensing conditions of this type (see Ito 1986, 1989, and Goldsmith 1989), *r* is allowed in the coda if the segment is also linked to the onset of the following syllable.

(20)

<i>Wanda arrived</i> <i>Homer arrived</i>	CODA-COND	FINAL-C
[_ω σ σ] [_ω σ σ] <i>Wanda arrived</i> <i>Home# arrived</i>		*!
[_ω σ σ] [_ω σ σ] ☞ <i>Wanda</i> _r arrived ☞ <i>Homer</i> arrived		

Substituting ONSET for FINAL-C in the tableaux above creates no problems: The winning candidates in (18) and (19) will have no violations, and in (20) the violation profile does not change. So why have recourse to the prima facie unmotivated FINAL-C, instead of the prosodically well-motivated hiatus-resolving ONSET constraint? After all, FINAL-C, which requires prosodic words to end in a consonant, is a strange prosodic wellformedness constraint and is more like an ‘anti-wellformedness’ constraint requiring a consonant in a marked position, where it leads to perceptual and articulatory difficulties. Why not use ONSET?

This is where a crucial observation about *r*-sandhi becomes important. McCarthy (1993a) argues that recourse to FINAL-C makes sense of the fact (originally observed in Kahn 1976; see also McCarthy 1991) that *r*-insertion fails to take place after phrase-medial function words, which are taken to not constitute prosodic words on their own, following standard views. This is indeed an interesting restriction on *r*-sandhi in non-rhotic variants of American English, and we turn to the details below, including the somewhat divergent facts in dialects spoken outside the American continent. Besides its optimality-theoretical insights, McCarthy’s paper is noteworthy for the systematic study of this important restriction on the process: *R*-insertion does not indiscriminately apply to break up hiatus, but leaves hiatus after function words unresolved, as shown in (21).

(21) No intrusive *r* after function words in non-rhotic American English

- Didja eat *didja reat
- I wanna eat *I wanna reat
- He went to eat *he went to reat
- The apples *the rapples

The analysis is built on the uncontroversial assumption that function words do not constitute prosodic words in themselves (following the standard prosodic distinction between lexical and function words motivated in Selkirk 1984 and subsequent work), and in English show proclitic behavior, as a default. This results in a crucial difference in ω -parsing (McCarthy 1993a:7):

- (22) a. (Let) [Wanda_o] [eat_o] → (Let) [Wanda_r] [eat_o]
 b. (I'm) [gonna eat_o] → (I'm) [gonna eat_o] ([*gonna_r eat_o])

Focusing on this difference in parsing, McCarthy (1993a) argues that the constraint driving *r*-sandhi should not be ONSET, but rather a constraint requiring prosodic words to end in a consonant – i.e., FINAL-C (17) – the consonant of choice in the case of English being *r*. With FINAL-C, so the reasoning goes, the issue in (22a) is no longer whether the syllable *eat* begins with an onset, but whether the preceding prosodic word *Wanda* ends in a consonantal coda, and *r*-sandhi is the way the grammar chooses to supply the required consonant. But in (22b), FINAL-C does not demand a coda at the end of a function word like *gonna*, so *gonna eat* is optimally realized without *r*. ONSET, on the other hand, which simply requires an onset in all syllables, wrongly predicts *r*-insertion in **gonna_r eat* (and in all examples in (21)).

The function word gap constitutes a strong argument in favor of FINAL-C, and against an onset-driven approach. In fact, it might be too strong – as we will see in the next section, the very success in deriving the function word gap from first principles turns into a liability in dialects where intrusive *r* appears precisely in the position whose exclusion motivated the move away from ONSET to FINAL-C in the first place, namely, after function words.

3.3 *R*-insertion after function words in Cockney English

It is well known that Cockney English and some other dialects spoken in the British Isles show a more extensive process of *r*-insertion because more vowels are reduced to schwa, the main sponsor of the inserted segment. For example, Wells (1991) points out that ‘the broad Cockney vowel corresponding to RP /aʊ/ in *mouth* is phonetically [æə], leading to intrusive *r* in phrases such as *how[r] it happened*. (Socially intermediate London speech has [æʊ], with no *r*-intrusion; the types of intrusive *r* mentioned [...] are all absent from RP.) This leads to insertions as in (23) (examples in this section are taken from McMahon 2000, Sivertsen 1960, Trudgill 1974, and Wells 1982).¹¹

- (23) a. Cockney
tomato and tomat[ə̃ r]and cucumber production
window up pull the wind[ə̃ r]up
you how I'll tell y[ə̃ ræ:]
you a give [jə̃ rə] job
- b. Norwich¹²
to it t[ə̃ r]it
by a run over b[ə̃ rə] bus
of old lot [ə̃ r]old
to eat out t[ə̃ r]eat
to eight quarter t[ə̃ r]eight

These accents with more pervasive *r*-insertion differ from RP and from non-rhotic North American in terms of the degree of vowel reduction (*window* [wində], etc.), but this alone does not account for *r*-sandhi cases like *give you* [jə̃ r]a job – after all, non-rhotic North American accents also reduce *you* to [jə], but still do not allow such post-function-word contractions (*didja eat*, **didja_r eat*). Crucially, the British dialects shown in (23) show intrusive *r* not only after a lexical word but also after a function word – i.e., precisely in the context where the constraint FINAL-C, which demands a C only ω -finally, is designed to remain silent.

An interesting question is what happens in these dialects to the prototypical clitics of English – the indefinite and definite articles *a* and *the*, both of them function words in proclisis to following nouns and adjectives. In both cases, the usual outcome, as in other dialects of English, involves the special lexical allomorphs [ən] and [ði:] which are selected prevocally, preempting any *r*-sandhi. Sivertsen's (1960:136) Cockney materials, however, also include the following transcription:

- (24) Indefinite *a* with intrusive *r*:
not a hope not [ə̃ rəʊp]

This is the kind of intrusion one might have deemed impossible, on the basis of the American English facts alone.¹³

A first idea might be that what is different about the grammar of post-function-word *r*-inserters is simply the prosody of function words themselves. Are they perhaps parsed as full prosodic words (25a) in Cockney and Norwich English, so that FINAL-C would still be responsible for *r*-insertion?

- (25) A non-solution: a dialect difference in function word parsing
- Post-function-word *r*-inserters: (quarter) [to_ω][eight_ω] → t[ə̃r]eight
 - r*-inserters with function word gap: (quarter) [to eight_ω] → t[ə̃] eight

However, this is not a promising route to take. The relevant forms (*of*, *to*, *you*, *a*, and *by* in (23)) are all pronounced with an unstressed [ə̃] and fail to meet the standard phonological criteria for parsability as independent prosodic words (Selkirk 1984). They can only be analyzed as proclitic (25b) – a characteristic shared by most, if not all, dialects of English.¹⁴

Looking at these dialect data, there is clearly no sense in which *r*-insertion is barred from applying after function words in their normal parse – i.e., as proclitics. What we have here, then, is insertion in all the prosodic contexts that give rise to intrusive *r*, including after a genuine function word. Thus, different from the variety of English that McCarthy (1993a) was analyzing, *r*-sandhi in these dialects seems to be triggered by ONSET, not by FINAL-C. We will return to a formal analysis of these facts in section 4.5.

3.4 FINAL-C in Universal Phonology

We are faced with a situation, then, where FINAL-C seems to provide a better explanation for some dialects, and ONSET for other dialects. This is at least a partial vindication of the onset-account of *r*-sandhi, the traditional approach to the phenomenon adopted by virtually all analyses apart from McCarthy's (1993a) FINAL-C account. Having two entirely different explanations of *r*-sandhi for two very similar dialects of the same language is not very satisfying. An appeal to constraint reranking is certainly thinkable, with ONSET and FINAL-C acting as the decisive constraints in different grammars, but a unified approach that manages to reduce the variation to a single factor would certainly be more principled, all else being equal. In addition, without an interesting factorial typology emerging, simply moving specific constraints around in the ranking amounts to a facile stipulation to 'account for the facts' – a practice perhaps too easily resorted to in OT analyses.

In a more general vein, FINAL-C has remained controversial as a universal constraint, and independent evidence for a requirement of this kind on surface prosodic words is sparse (but see Bonet and Lloret 2005) – as opposed to morphological templates, where a final consonant is often part of the defining shape (see Wiese 2001). Thus all Proto-Indo-European roots have the form CVC (according to Benveniste's (1935) theory), i.e., they end in an obligatory final consonant (including laryngeals), and similar generalizations are familiar from many languages and language families, such as Bantu or Mayan. Similarly, Arabic stems are required to end in a consonant (McCarthy

and Prince 1990b). But these 'Final-C' requirements are part of the canonical forms of morphological categories such as roots or stems, not conditions on output prosody.

Prima facie counterevidence to FINAL-C as a constraint on prosodic words is found in languages like Maori (Hale 1973) that ban any kind of consonant cluster and have only open syllables – (C)V, (C)VV – with the additional option of allowing a word-final consonant, only to undergo a subsequent sound change deleting all word-final consonants, destroying precisely the configuration called for by FINAL-C.

Optimality theorists are quick to point out, quite accurately, that such evidence is not lethal as long as FINAL-C is a violable constraint. True enough, the Maori change could be described as a shift from the ranking [FINAL-C » NoCODA » MAX-C] to [NoCODA » FINAL-C » MAX-C]. Since final consonants are only admitted, not required, at the earlier stage, DEP-C needs to be high-ranking in order to prevent epenthesis from inserting final C's across the board. This points to a persistent problem with 'anti-wellformedness' constraints like FINAL-C: As a reviewer reminds us, pathological rankings arise very easily, such as [FINAL-C » NoCODA » F], where F is shorthand for MAX, DEP, and other relevant faithfulness constraints. This predicts the existence of the implausible language (CV)*CVC, where all final syllables are closed but all other syllables open.

Whatever the status of FINAL-C in Universal Phonology, however, we are here concerned with a different point: The dialectal evidence shows that a full explanation of *r*-sandhi in English cannot lie in this constraint; an appeal to ONSET therefore remains essential. As we will show in the next section, once ONSET is part of the game, it is a straightforward matter to extend the account to also cover the dialects with the 'function word gap' which seemed to require an appeal to FINAL-C. In fact, the presumed shortcomings of the onset approach disappear once the markedness and faithfulness properties of word onsets in an extended word projection are properly understood.

4 Extended word structures and ONSET

What we need, then, is a refined version of the ONSET-based approach. To recapitulate, the FINAL-C approach accounts for *r*-sandhi and the function word gap by the conjunction of the three assumptions in (26).

- (26) a. Both intrusive *r* and linking *r* are ambisyllabic, and therefore do not violate the Coda Condition against *r* exclusively linked to the syllable coda.
 b. Full lexical words are prosodic words (ω); function words are not.
 c. The constraint responsible for intrusive *r* and linking *r* is FINAL-C: *V]_ω.

We agree with the ambisyllabicity analysis (26a) and the non- ω -hood of function words (26b), but replace FINAL-C (26c) with a specific version of the ONSET constraint – namely a version specific to the beginning of ω^1 , the *maximal prosodic word*. We will now show that it is unnecessary to take recourse to the problematic FINAL-C constraint once the onset requirements for prosodic words and their associated faithfulness properties are taken into account.

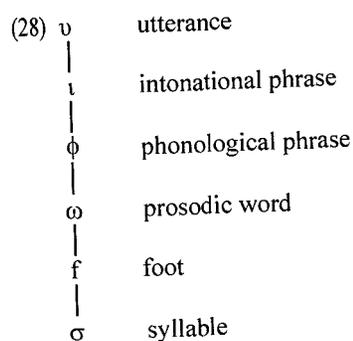
4.1 Proposal

Our proposal involves the three main ingredients in (27), which we will subsequently take up one by one.

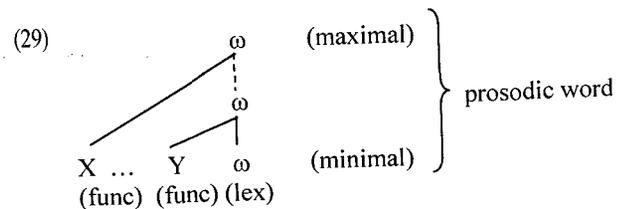
(27) Main ingredients of the analysis

- Adjunction to ω , up to a prosodic word constituent of maximal size.
- Strict onset requirement in maximally prominent positions.
- Positional faithfulness (anti-epenthesis) at the beginning of prosodic words.

As discussed in section 1, we assume the prosodic hierarchy in (28) (repeated from (1) above), with the option of recursivity at every level, and with a distinction between maximal and minimal instantiations of categories.



In agreement with earlier researchers, including Selkirk (1995), among others, we assume that function words in English form adjunction structures with following lexical words. Our specific proposal appears in (29).



The resulting larger structure is referred to as ω^1 ('maximal prosodic word') and its innermost subconstituent of type ω as ω_1 ('minimal prosodic word'), in the way shown in (30) (following the general scheme given in (3) in section 1).

- (30) ω^1 = maximal (projection of) ω : ω not dominated by ω .
 ω_1 = minimal (projection of) ω : ω not dominating ω .

Maximal prosodic words roughly correspond to the 'clitic groups' of other theories; we leave the question open whether the minor (or 'intermediate') phrase needs to be distinguished from the maximal prosodic word – in terms of (2) (see section 1), it could be identified as the minimal phonological phrase. What interests us here is that maximal words are subject to a specific instance of the onset requirement, stated in (31):

- (31) ONSET(ω^1): * $[\omega, V$ (Maximal projections of ω cannot begin with a vowel.)

The constraint in (31) is violated by vowel-initial maximal prosodic words, but not elsewhere – non-maximal prosodic words (i.e., those dominated by another prosodic word) are only subject to the normal ONSET requirement. ONSET(ω^1) is part of a group of onset constraints that also includes the requirement for stressed syllables to have an onset, resulting in derived contrasts in Dutch and German involving glottal stop epenthesis in cases like *The[ʔ] áter* vs. *thèatrálisch* 'theater, theatrical'. Another related requirement is the foot-initial onset requirement seen, for example, in the Australian language Aranda (Goedemans 1994). It appears, then, that (31) is just another piece of the well-established family of constraints (see also Smith 2002, Flack 2006, 2007a and section 4.5 below).

The last ingredient in our analysis (27c) is simply an instance of positional faithfulness (Beckman 1997) – a constraint against epenthesis at the beginning of prosodic words. The relevant constraint, which we refer to as DEP(ω -init), is formulated in (32).

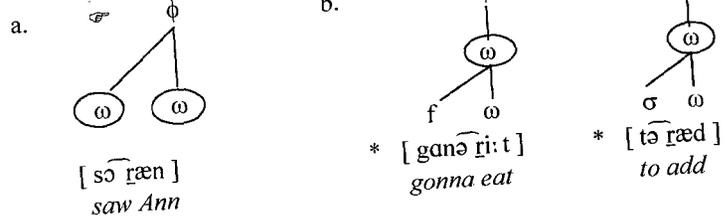
- (32) DEP(ω -init): Any element of the output in ω -initial position has an input correspondent.

DEP(ω -init) governs the left edge of any prosodic word constituent, whatever its size. It is violated by intrusive *r*, but not by linking *r*. We return to this constraint in some more detail in section 4.3.

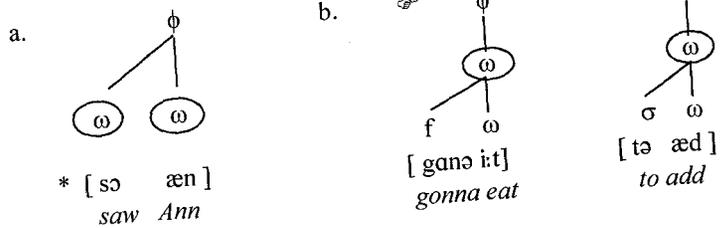
In (33) and (34) we illustrate the kind of prosodic parsing we are arguing for here. The relevant syntax-phonology mapping constraint is the LEX \approx PR constraint of Prince and Smolensky (1993/2004:45) – the familiar requirement on lexical words (*saw, Ann, eat, add*, etc.) to be left-/right-aligned with prosodic words (see Selkirk 1995 for relevant discussion and motivation). No such requirement exists for function words (*gonna, to*, etc.), which are themselves simply dominated

by the lower prosodic categories (*gonna* by f , *to* by σ), and are adjoined to the following lexical word (maximal projections of ω are circled for perspicuity).

(33) *r*-inserting candidates



(34) Hiatal candidates



The *r*-inserting candidates in (33) are in competition with the hiatal candidates in (34). For a phrase ϕ consisting of two maximal prosodic words, such as *saw Ann*, the preference for the *r*-inserting (33a) follows from the fact that $\text{ONSET}(\omega')$ – the requirement for maximal prosodic words to have an onset – dominates $\text{DEP}(\omega\text{-init})$ – the constraint against epenthesis in prosodic word-initial positions:

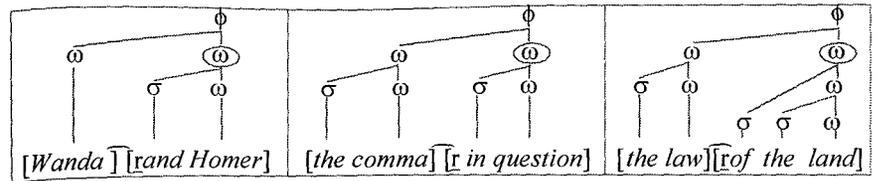
(35) $\text{ONSET}(\omega') \gg \text{DEP}(\omega\text{-init})$

On the other hand, a prosodic word that is in construction with a preceding function word, such as *eat* in *gonna eat*, is not maximal, but forms a subpart of an extended ω -structure. Therefore $\text{ONSET}(\omega')$ is silent in this case, and since general ONSET ranks lower than $\text{DEP}(\omega\text{-init})$ (36), no intrusive *r* is found in this context, and the hiatus structure (34b) wins over (33b).

(36) $\text{DEP}(\omega\text{-init}) \gg \text{ONSET}$

The overall prosodic constructions involving function words (such as *gonna eat* and *to add*) are themselves maximal prosodic words, and are hence subject to the higher-ranking $\text{ONSET}(\omega')$ constraint. This is why *r*-insertion is found on procliticized V-initial function words, as illustrated in (37) where the relevant maximal prosodic words are circled.¹⁵

(37)



Assembling all of these findings, we arrive at the overall ranking in (38), where $\text{ONSET}(\omega')$ dominates $\text{DEP}(\omega\text{-init})$, followed by their more general versions, ONSET and DEP , ranked in the same order.

(38) $\text{ONSET}(\omega') \gg \text{DEP}(\omega\text{-init}) \gg \text{ONSET} \gg \text{DEP}$

We return below to the consequences of the fact that general ONSET dominates general DEP . For the two pairs of related constraints in (38) we assume, with Beckman (1997:37–38), that the ranking [*position-specific* \gg *general*] can be taken as fixed without loss of generality. We will consider the factorial typology produced by this set of constraints in section 5.

4.2 Illustration and ranking

We now illustrate this analysis in more detail. As already pointed out, the requirement for maximal prosodic words to have a firm consonantal beginning dominates the constraint against non-input material in prominent prosodic word-initial position, as shown in bold in (39). This allows intrusive *r* to fill the onset of a maximal ω .

(39) $\text{ONSET}(\omega') \gg \text{DEP}(\omega\text{-init})$

<i>saw Ann</i>	$\text{ONSET}(\omega')$	$\text{DEP}(\omega\text{-init})$	ONSET	DEP
ϕ [ω saw][ω Ann]		*		*
[ω saw][ω Ann]	*!		*	

When the onset of a maximal prosodic word is not involved, as in the case of words that are in prosodic construction with preceding functional material, $\text{DEP}(\omega\text{-init})$ prevents intrusive *r*. It is thus the dominance relation [$\text{DEP}(\omega\text{-init}) \gg \text{ONSET}$] (40) that explains why there is no *r*-insertion after function words in dialects adopting this kind of ranking.

(40) DEP(ω -init) » ONSET

<i>gonna eat</i>	ONSET(ω^1)	DEP(ω -init)	ONSET	DEP
$[\omega^1 (r\ gonna) [\omega^1 \text{eat}]]$		*!		*
$[\omega^1 (r\ gonna) [\omega^1 \text{eat}]]$			*	

<i>to add</i>	ONSET(ω^1)	DEP(ω -init)	ONSET	DEP
$[\omega^1 (t\ o) [\omega^1 \text{add}]]$		*!		*
$[\omega^1 (t\ o) [\omega^1 \text{add}]]$			*	

It also follows straightforwardly (see (41)) that V-initial function words at the left edge of a maximal prosodic word are still regulated by ONSET(ω^1).

(41) ONSET(ω^1) » DEP(ω -init)

<i>Wanda and Homer</i>	ONSET(ω^1)	DEP(ω -init)	ONSET	DEP
$[\omega^1 \text{Wanda}][\omega^1 \text{and}][\omega^1 \text{Homer}]$		*		*
$[\omega^1 \text{Wanda}][\omega^1 \text{and}][\omega^1 \text{Homer}]$	*!		*	

This brings us to a small and rather obvious issue that needs to be resolved. As McCarthy (1993a) points out, while it is true that in non-rhotic American accents function words reject intrusive *r* (**gonnā reat*), they do not reject linking *r*, and in fact require it: (*for eating* [fə'ri:ɪŋ], **fo'eating* [fə'i:ɪŋ]). It is therefore only the epenthetic nature of intrusive *r* that excludes it after function words in the onset of a non-maximal ω . The other variant of *r*-sandhi, linking (i.e., underlying) *r*, is not ruled out here, and is in fact obligatory as an onset filler. This set of facts follows straightforwardly in our analysis. As (42) shows, when a function word ends in an underlying *r*, connecting this segment to the onset of the following ω (that the function word is in construction with) does not violate DEP(ω -init). We have here a case of the emergence of the unmarked (McCarthy and Prince 1994).

(42) Emergence of ONSET:

<i>for eating</i>	ONSET(ω^1)	DEP(ω -init)	ONSET	DEP
$[\omega^1 (f\ o\ r) [\omega^1 \text{eating}]]$				
$[\omega^1 (f\ o\ r) [\omega^1 \text{eating}]]$			*!	

Here the *r* is underlying material, even though originating in a different morpheme. The contrast between (42) and (40) testifies to the continued synchronic relevance of the distinction between linking *r* and intrusive *r*.

4.3 Why insert *r*?

We have so far treated intrusive *r* simply as an epenthetic segment, without addressing any of the issues concerning the nature of the segment that have been debated in the literature. In this section, we will briefly lay out our assumptions insofar as they are immediately relevant for our analysis: Why insert *r*, of all segments?

Viewing intrusive *r* as simply triggering a DEP violation (as in (40) above, e.g.) makes the implausible claim that the [ɹ] of English, a segment that has struck few observers as a model of unmarkedness, is in fact the default consonant of the language. Noting this fact, McCarthy (1993a) adopts a (later much criticized) rule of *r*-insertion ($\emptyset \rightarrow r$), which stands outside of the OT constraint system and serves to expand the candidate set without accruing faithfulness violations.¹⁶

More recently, turning away from the view that inserted *r* is only the synchronically arbitrary and unnatural remnant of the historical development (*r*-deletion followed by rule inversion, see McMahon 2000 for a thorough exposition), other approaches have emerged which look at *r*-insertion not in isolation, but in the context of the other hiatus processes in English. Relevant work includes Baković (1999) and Uffmann (2005), building on previous research including Kahn (1976:69–70), Broadbent (1991), and Gnanadesikan (1997:159–162), and we here follow their lead. The basic idea is that *r*-insertion is a kind of diphthongization, parallel to the transitional glide found after high vowels in similar contexts. Some examples of the latter appear in (43) (from Gimson and Cruttenden 2001:288–290).

- (43) *my arms* *may ask* *he ought*
 [maɪ ˈɑ:mz] [meɪ ˈɑ:sk] [hi: ˈɔ:t]
- annoy Arthur* *beauty and*
 [ənoɪ ˈɑ:θə] [bju:tɪ ˈænd]
- window open* *now and then* *you aren't*
 [wɪndəʊ ˈəʊpən] [naʊ ˈænd ðen] [ju: ˈɑ:nt]

The same authors also note that this transitional [ɹ] remains distinct from phonemic [j], citing contrasts as in (44).

- (44) a. *my ears* b. *my years*
 [maɪ ˈɪəz] [maɪ jɪəz]

In the case of the (tense and diphthongized) front vowels [i:, eɪ], the back vowels [u:, oʊ], and the diphthongs [aɪ], [oɪ], and [aʊ], the glide elements [ɹ] and [w] serve to smooth the hiatus (see *Ann* [si: ˈjæn], *know Ann* [nou ˈwæn], etc.). The

remaining vowels that occur word-finally, [ɑ:, ɔ:, ə], lack a corresponding glide element, and the segment [ɹ] appears as their closest consonantal counterpart (45), parallel to the glide in (43) and (44a). This account is most appealing for low vowels and schwa, whose production is known to be often accompanied by pharyngeal constriction (Gnanadesikan 1997, Gick 2003). As Uffmann (2005) observes, there is indeed a dialect where intrusive *r* only occurs after these vowels, not after [ɔ:] (see also Wells 1991). Many questions in this area still remain to be answered (see the works cited above for further details), but all in all an approach that sees intrusive *r* as sponsored by the preceding vowel seems well motivated.

- (45) *Shah of Persia* *spa and music*
 [ʃɑ: rəf pə:zə] [spa: rænd mju:zɪk]
- vanilla ice cream* *saw Ann*
 [vənɪlə rɔ:skɪjɪm] [sɔ: ræn]

Seen in this light, *r*-insertion has two parts: (i) insertion of a bare segmental root node, and (ii) place features of the preceding vowel are recruited to fill in the empty root node. The regular interface constraint aligning the right edge of a stem (or a morphological word) to a prosodic constituent, minimally a syllable, then anchors these place features to the coda, creating ambisyllabicity, the source of the 'Final-C' syndrome.

DEP(ω -init) and DEP in the analysis presented above should therefore be replaced by DEP-ROOT(ω -init) and DEP-ROOT, respectively – constraints against insertion of a bare segmental root node (and not of a whole segment with all its place features). This is shown in (46), where the winning candidate (46b), with a one-to-many correspondence relation, violates lower-ranking INTEGRITY.

(46) *Wanda ate*

	/wanda et/	ONSET(ω^1)	DEP-ROOT(ω -init)
a.	[ω wanda] [ω et]	*!	
b.	[ω wanda] [ω ret] [place]		*

Candidates such as *[wanda] [jeit] or *[wanda] [weɪt] violate higher-ranking DEP-place, as does post-pausal /ed/ → *[rɛd] in (47).¹⁷

(47) *Ed*

	/ed/	DEP-PLACE	ONSET(ω^1)	DEP-ROOT(ω -init)
a.	[ω , ed]		*!	
b.	[ω , rɛd]	*!		*

The analysis of the intrusive *r* in *saw rEd* thus parallels that of the trans-word flapping situation in *sought Ed* discussed in section 2 above. The final [t] in

sought is made ambisyllabic because of the ONSET requirement (now identified as ONSET(ω^1)). Here too, the onset-filling material comes from the previous word. In both cases, what appears to be a requirement that there be a final consonant in a prosodic word is, rather, the enforcement of the alignment constraint matching the right edge of every stem or morphological word with the right edge of a syllable. Together with ONSET(ω^1), the result is a linked structure (either at the level of the root node, as in the ambisyllabic case, or at the level of the place node in the intrusive *r* case).

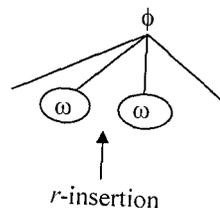
Nowhere in this analysis is there a need for an appeal to FINAL-C, or to some other constraint imposing special closure properties on prosodic words. Rather, the analysis simply asserts that every syllable needs an onset, and that this is even more urgent at the beginning of a maximal ω -complex, with a positional faithfulness constraint against ω -initial epenthesis ranked in between. Non-insertion after a function word is just a consequence of the parochial ranking in (48) (repeated from (36)), and not excluded for some fundamental reason, as in the FINAL-C analysis.

- (48) ONSET(ω^1) » DEP-ROOT(ω -init) » ONSET » DEP-ROOT

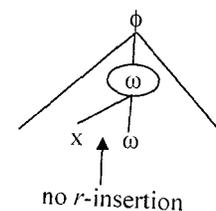
4.4 Other *r*-sandhi locations

So far we have shown how the overall ranking in (48) accounts for the *r*-sandhi between two maximal prosodic words (49a) and in extended prosodic word structures (49b).

(49) a.



b.

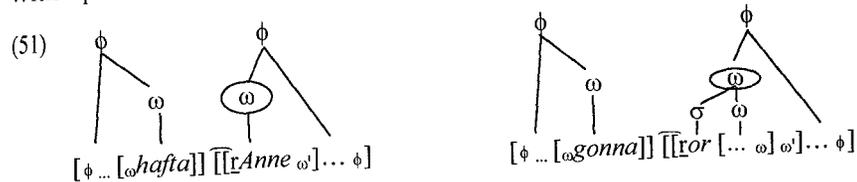


It remains to make sure that the present analysis can account for all other *r*-sandhi locations. We identify three such cases discussed in McCarthy (1993a).

- (50) a. Phrase-finally after function words
 (e.g., [If you hafɪə] [ɹAnne might help_φ]; [Are ya gonna] [ɹɔr aren't ya_φ]?)
- b. Enclitics in construction with a preceding prosodic word
 (e.g., draw rɪt; saw r(h)ɪm)
- c. Word-medial cases of *r*-insertion at level II morpheme boundaries
 (e.g., draw rɪŋ; withdraw rəl)

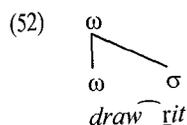
In phrase-final position, *r*-insertion occurs even after function words, as in (50a), where the phrasal parse is marked by [..._φ]. Given the layering principles

of the prosodic hierarchy, the left/right edges of higher prosodic units correspond to left/right edges of lower prosodic units (Hayes 1989b). As illustrated schematically in (51), phrase-final function words such as *hafta* and *gonna* must in this position be parsed as prosodic words – the explanation given for the FINAL-C account – but it also means that the following phrase must begin with a prosodic word, and because of its position, it can only be a maximal one.



Phrase juncture *r*-sandhi is therefore a straightforward consequence of high-ranking ONSET(ω').

Turning to enclitic cases (50b) (*draw rit*, etc.), these are prosodified as extended word structures, where the extension is found to the right.



For the enclitic *it*, an adjoined syllable, neither ONSET(ω') nor DEP-ROOT(ω -init) are relevant. Instead, we see here the effects of the ranking of the general constraints [ONSET » DEP-ROOT], which results in intrusive *r* (53).

(53) Encliticization

<i>draw it</i>	ONSET(ω')	DEP-ROOT(ω -init)	ONSET	DEP-ROOT
\neq [[<i>draw</i> _{ω}][<i>rit</i> _{ω}]]				*
[[<i>draw</i> _{ω}][<i>it</i> _{ω}]]			*!	

There is a clear difference in phrasing between such word+enclitic collocations and stem+level II suffix combinations. The latter are involved in the third case listed in (50), word-medial *r*-insertion at level II morpheme boundaries, such as *draw ring* or *withdraw ral* (50c). As shown by Hayes (1989b:207) for *visit it* vs. *visited*, the /t/ may be slightly aspirated in *visited*, but not in *visit it*. In our terms, *visit it* and *draw it* are extended prosodic word structures (53), whereas *visited* and *drawing* are prosodified as single (nonextended) prosodic words. In ω -medial position, the two high-ranking constraints are irrelevant, and ONSET » DEP-ROOT again explains the *r*-sandhi, as (54) shows.

(54) Affixation

<i>draw+ing</i>	ONSET(ω')	DEP-ROOT(ω -init)	ONSET	DEP-ROOT
\neq [[<i>draw</i> _{ω}][<i>ing</i> _{ω}]]				*
[[<i>draw</i> _{ω}][<i>ing</i> _{ω}]]			*!	

Here we find an advantage of the present ONSET-driven analysis over that of the FINAL-C analysis. The FINAL-C constraint correctly controls the phrase junctures (50a) and encliticized forms (50b), since the appropriate junctures also coincide with ω -final positions. However, for the word-medial cases of *r*-insertion, it becomes necessary to require a recursive ω -structure as in (55), so that *r* can be inserted prosodic word-finally.

(55) [[*draw* _{ω}][*ing* _{ω}]] \rightarrow [[*draw r* _{ω}][*ing* _{ω}]]

This kind of replication of morphological structure as prosodic structure for level II phonology was standard practice in early OT (see McCarthy and Prince 1993b), following the lead of the version of Lexical Phonology developed in Inkelas (1989). With Correspondence Theory (McCarthy and Prince 1995, Benua 1997, among others), however, output-output (OO-) correspondence constraints have in many cases made such recursive prosodic structure mimicking recursive grammatical structure unnecessary. To take a standard example for illustrative purposes, consider *condem<n>*, where the output of the base form has deleted the stem-final *n*, resolving the illicit final cluster. With level I suffixation, *condemnation*, the stem-final *n* is simply resyllabified as the onset of the vowel-initial suffix. However, with level II suffixation, *condem<n>ing*, higher-ranked (level II) OO-correspondence enforces deletion of the stem-final *n* in correspondence to the base output.

Interestingly, standard OO-correspondence constraints do not provide a solution for *r*-sandhi since here the unaffixed base form ([*draw* _{ω}] for intrusive *r*, [*sta#* _{ω}] for linking *r*) lacks *r* – precisely the property to be copied over to the derived forms [*draw* _{ω}][*ing* _{ω}] and [*sta* _{ω}][*ing* _{ω}].

Attempts to pursue an analogy-based analysis would need recourse to more powerful, and therefore more problematic, versions of OO-correspondence where phrasal forms like *draw rit Emily* or *draw rit* figure directly in the computation of the lexical form [[*draw* _{ω}][*ing* _{ω}]] (see also note 3 above). Besides questions of power, this also raises issues of redundancy, since we would have ended up with a theory having both OO-relations and extra prosodic complexity replicating morphological structure. In our ONSET-driven analysis, no such recursive prosodic structure mimicking morphological constituency is required; hence there is no redundancy with respect to OO-correspondence constraints.¹⁸

4.5 An empirical argument for the onset-driven analysis

A major empirical argument showing that what drives *r*-insertion is an ONSET-constraint and not FINAL-C is the fact that the function word gap – the non-appearance of intrusive *r* after phrase-medial function words in non-rhotic American English – is only one half of the story. In the very same context, several British dialects show intrusive *r* (e.g., *to eat* as $[\omega (\sigma t\partial) [\omega \text{reat}]]$ in the dialect of Norwich, etc., see (23) above). This is no anomaly in the ONSET-driven analysis, but a consequence of a slight difference in constraint ranking: Instead of dominating ONSET, DEP-ROOT(ω -init) is dominated by it, as in (56).

(56)

	ONSET(ω')	ONSET	DEP-ROOT(ω -init)	DEP-ROOT
<i>to eat</i>			*	*
$[\omega (\sigma t\partial) [\omega \text{reat}]]$				
$[\omega (\sigma t\partial) [\text{eat}_\omega]]$		*!		

A FINAL-C analysis cannot account for this dialect with a simple reranking of the relevant constraints since the constraint driving *r*-insertion, FINAL-C, holds only for prosodic words and has nothing to say about function words like *to*, neither in American nor in British dialects.

If our goal is a unified analysis of the overall system of English accents, where different modes of *r*-sandhi emerge out of different rankings of the same constraints, this means that we cannot use, as the main driving force for *r*-sandhi, a constraint that has the function word gap already built into it. In other words, for this reason alone we cannot rely on FINAL-C, even if the other problems connected with this constraint (see the discussion in section 3.4) did not exist.

Looking at the other side of things, are there reasons to worry about the soundness of a theory with specific versions of syllable structure constraints like ONSET for prominent positions, such as beginnings of maximal prosodic words? A reviewer raises the question whether there are any languages which consistently ban onsetless syllables only word-initially while permitting them word-internally, noting that the opposite pattern (onsetless syllables *permitted* word-initially, but *banned* word-internally) is well-attested.

Fortunately, these worries have been laid to rest in recent work by Flack (2006, 2007a), a detailed typological survey showing that the phonotactic restrictions holding at different prosodic levels stand in a systematic pattern of upward inheritance ('any restriction which can hold on syllable onsets can also hold word-initially, phrase-initially, and utterance-initially, and any coda restriction can also hold word-finally, phrase-finally, and utterance-finally')

(Flack 2006:1)). Flack develops a constraint format that captures this kind of patterning in an elegant way. Regarding the question at hand, word onsets vs. syllable onsets, she provides an illustrative list of more than twenty languages, from Babungo (Niger-Congo, Cameroon) to Yagua (Peba-Yaguan, Peru), where onsets are required in all and only word-initial syllables.

A fundamental insight of OT relates to the fact that wellformedness is a multi-faceted affair. There are many different, and often conflicting, dimensions of markedness and of faithfulness in terms of which structures need to be compared. A structure scoring high on one scale can score low on another one, and since different grammars rank the constraints differently, no single grand cross-linguistic chain of wellformedness can exist, where structures would be lined up from good to bad to ugly. For the case at hand, just as there are positional markedness constraints such as ONSET(ω') ruling out marked structures in prominent positions, there are also positional faithfulness constraints (such as IDENT(σ_1) (Beckman 1997) or DEP(ω -init) (this paper)) and other constraints (such as ALIGN(MWd, Left, ω , Left), see McCarthy and Prince 1993a) demanding specific faithfulness to input structures (including marked structures) in a similar set of prominent environments. Consequently, the existence of languages banning onsetless syllables only word-initially does not preclude the existence of languages banning them only word-internally (Axininca Campa (McCarthy and Prince 1993b) is a familiar example). The upshot is that word-initial onsetless syllables are not in a general way more marked or less marked than word-internal ones.

5 Dialect variation and factorial typology

In order to probe the soundness of the constraint system we have developed, we conclude by studying the factorial typology of the four central constraints that are involved. They can be ranked in $4! = 4 \times 3 \times 2 \times 1 = 24$ ways. [ONSET(ω') » ONSET] is a fixed ranking, leaving only 12 of these 24 rankings, and the other fixed ranking [DEP-ROOT(ω -INIT) » DEP-ROOT] reduces this number to the 6 rankings shown below in (57)–(62). A more detailed investigation across the English-speaking world would be needed to reach a firm conclusion, but this factorial typology seems to closely approximate the actual range of variation found in terms of *r*-insertion, with the usual caveat that not every dialect predicted to exist is guaranteed to actually be spoken (or be spoken by enough speakers to gain it an entry on a dialect map). Ranking I (57) captures non-rhotic dialects with the function word gap, and ranking II (58) non-rhotic dialects without the function word gap, as discussed earlier.

(57) Ranking I: *r*-insertion between words (but not after function words) and word-internally

Input	Output candidates	ONSET(ω')	DEP-ROOT(ω -init)	ONSET	DEP-ROOT
saw Ann	φ [$_{\omega}$ saw][[Ann $_{\omega}$]]		*		*
	[$_{\omega}$ saw][Ann $_{\omega}$]	*!		*	
gonna eat	[$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]		*!		*
	φ [$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]			*	
for eating	φ [$_{\omega}$ ($_{\sigma}$ for)] [eating $_{\omega}$]]				
	[$_{\omega}$ ($_{\sigma}$ fo ')] [eating $_{\omega}$]]			*!	
draw+ing	φ [draw .ing $_{\omega}$]				*
	[draw .ing $_{\omega}$]			*!	

(58) Ranking II: *r*-insertion between words (including after function words) and word-internally

Input	Output candidates	ONSET(ω')	ONSET	DEP-ROOT(ω -init)	DEP-ROOT
saw Ann	φ [$_{\omega}$ saw][[Ann $_{\omega}$]]			*	*
	[$_{\omega}$ saw][Ann $_{\omega}$]	*!	*		
gonna eat	φ [$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]			*	*
	[$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]		*!		
for eating	φ [$_{\omega}$ ($_{\sigma}$ for)] [eating $_{\omega}$]]				
	[$_{\omega}$ ($_{\sigma}$ fo ')] [eating $_{\omega}$]]		*!		
draw+ing	φ [draw .ing $_{\omega}$]				*
	[draw .ing $_{\omega}$]		*!		

Ranking III results in a kind of *r*-insertion, reported as one variant of RP, which allows the process between words but avoids it word-internally.

(59) Ranking III: *r*-insertion between words (but not after function words), but not word-internally

Input	Output candidates	ONSET(ω')	DEP-ROOT(ω -init)	DEP-ROOT	ONSET
saw Ann	φ [$_{\omega}$ saw][[Ann $_{\omega}$]]		*	*	
	[$_{\omega}$ saw][Ann $_{\omega}$]	*!			*
gonna eat	[$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]		*!	*	
	φ [$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]				*
for eating	φ [$_{\omega}$ ($_{\sigma}$ for)] [eating $_{\omega}$]]				
	[$_{\omega}$ ($_{\sigma}$ fo ')] [eating $_{\omega}$]]				*!
draw+ing	[draw .ing $_{\omega}$]			*!	
	φ [draw .ing $_{\omega}$]				*

Ranking IV is interesting since it has the opposite distribution of *r*-insertion (word-internally, but not between words). We have met speakers claiming to speak this kind of variety, but further investigation is clearly called for. Generally speaking, as a reviewer reminds us, there seem to be many languages (for example, in Niger-Congo) that freely tolerate V-syllables in word-initial position but do not tolerate word-internal hiatus.

(60) Ranking IV: *r*-insertion word-internally, but not between words

Input	Output candidates	DEP-ROOT(ω -init)	ONSET(ω')	ONSET	DEP-ROOT
saw Ann	[$_{\omega}$ saw][[Ann $_{\omega}$]]	*!			*
	φ [$_{\omega}$ saw][Ann $_{\omega}$]		*	*	
gonna eat	[$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]	*!			*
	φ [$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]			*	
for eating	φ [$_{\omega}$ ($_{\sigma}$ for)] [eating $_{\omega}$]]				
	[$_{\omega}$ ($_{\sigma}$ fo ')] [eating $_{\omega}$]]			*!	
draw+ing	φ [draw .ing $_{\omega}$]				*
	[draw .ing $_{\omega}$]			*!	

Finally, ranking V (which produces the same results as ranking VI) holds for varieties of English without *r*-insertion.

(61) Ranking V: No *r*-insertion anywhere (same result as ranking VI)

Input	Output candidates	DEP-ROOT(ω -init)	ONSET(ω')	DEP-ROOT	ONSET
saw Ann	[$_{\omega}$ saw][[Ann $_{\omega}$]]	*!		*	
	φ [$_{\omega}$ saw][Ann $_{\omega}$]		*		*
gonna eat	[$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]	*!		*	
	φ [$_{\omega}$ ($_{\tau}$ gonna)] [eat $_{\omega}$]]				*
for eating	φ [$_{\omega}$ ($_{\sigma}$ for)] [eating $_{\omega}$]]				
	[$_{\omega}$ ($_{\sigma}$ fo ')] [eating $_{\omega}$]]				*!
draw+ing	[draw .ing $_{\omega}$]			*	
	φ [draw .ing $_{\omega}$]				*!

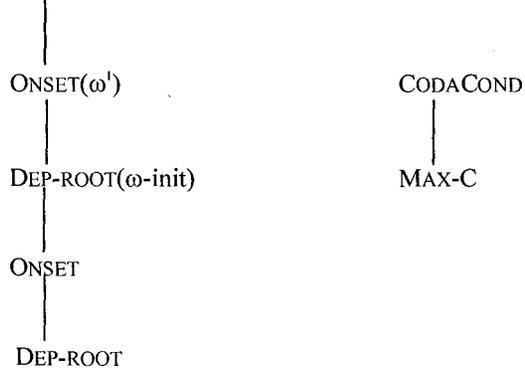
(62) Ranking VI: No *r*-insertion anywhere (same result as ranking V)

Input	Output candidates	DEP-ROOT(ω -init)	DEP-ROOT	ONSET(ω^1)	ONSET
saw Ann	$[\omega, \text{saw}] [\text{Ann } \omega]$	*!	*		
	$\varnothing [\omega, \text{saw}] [\text{Ann } \omega]$			*	*
gonna eat	$[\omega, (\text{gonna})] [\text{eat } \omega]$	*!	*		
	$\varnothing [\omega, (\text{gonna})] [\text{eat } \omega]$				*
for eating	$\varnothing [\omega, (\text{for})] [\text{eating } \omega]$				
	$[\omega, (\text{fo})] [\text{eating } \omega]$				*!
draw+ing	$[\text{draw} \omega] [\text{ing } \omega]$		*		
	$\varnothing [\text{draw} \omega] [\text{ing } \omega]$				*!

6 Conclusion

The final ranking of the constraints responsible for *r*-sandhi in the non-rhotic dialects of English with the function word gap is given in (63).

(63) DEP-PLACE



A proper understanding of the larger prosodic collocations formed by prosodic words and function words, as well as the constraints and faithfulness properties of word onsets, allows us to avoid appealing to a problematic 'anti-wellformedness' constraint like FINAL-C.

Empirically, our analysis not only accounts for the complex distribution of the linking *r*-consonant in RP and the Eastern Massachusetts dialect, but also extends straightforwardly to the different distributions in other dialects. While preserving the central insights of McCarthy (1993a), which remains not just a classic but also a model of optimality-theoretic analysis, the present proposal is theoretically grounded in correspondence theory (positional faith-

fulness), and is a natural outgrowth of a conception of prosodic structure that views function words as occupying positions within extended word structures (maximal prosodic words). From a broader perspective, this is made possible by an approach to the prosodic hierarchy that radically reduces the number of universal prosodic categories while enriching the set of structural relations that they enter into.

Notes

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- The problem is made harder by the strategy sometimes encountered of literally defining prosodic categories that should be part of Universal Phonology in terms of language-specific processes and phonetic properties (cf. terms like 'accent phrase', 'tone group', etc.); see Truckenbrodt (2007) for discussion.
- Bermúdez-Otero (2007) revives Kiparsky's analysis, including this use of the feature [lax], in the context of a stratal OT-account, with important new evidence involving *l*-darkening and pre-fortis clipping (as in *látex*), showing that it is not possible to account for all of the phenomena involved just by appealing to the ambisyllabic context. As long as OT-grammar continues to distinguish lexical and postlexical levels, however, it is unclear what the evidence implies for ambisyllabicity itself. For example, *l*-darkening might be word-level, but flapping (and ambisyllabicity) phrase-level. For pre-fortis clipping, neither ambisyllabicity nor the foot-medial position provides the right environment, and either approach is free to adopt another kind of analysis, such as Bermúdez-Otero's ω -domain account. An additional issue arises with *r*-sandhi: Since the *r* shows a mixture of onset and coda properties (McCarthy 1999a describes it as 'lenited relative to the unambiguous onset *r*', with supporting spectrograms), an analysis without ambisyllabicity might have to resort to considerable abstractness and claim, in a recapitulation of history, that non-rhotic dialects permit coda *r* at the word level, only to rule it out at the phrase level. In this view, the linking *r* of *hear[r] Ann* inherits its coda properties from an abstract earlier stratum where *hear* actually has a coda *r* (a transderivational account seems impossible since

- the isolation form is *r*-less), and a form like *sav[r]* needs to receive an intrusive *r* at the word level, only to lose it again, Duke-of-York style, at the phrase level unless a vowel-initial word follows (*sav[r] Ann*).
- 4 See Bloomfield (1933:113), Hockett (1958:54–61), and Harris (1951:79–89). The latter presents an especially detailed and lucid treatment of the issues.
 - 5 Here ‘ ω ’ indicates ‘prosodic word’, ‘|’ the morphological word boundary, ‘ φ ’ the winning candidate, and ‘!’ a fatal violation. Following McCarthy (2002), we do not use the redundant shading of candidate cells, for typographical clarity.
 - 6 The question of whether all gradient OT-constraints can be reinterpreted as categorical (McCarthy 2003c) is not relevant here. We assess alignment violations as in the version of alignment theory in Ito and Mester (1999a:201–210): Noncrisp linkage is not disaligning (e.g., [r] in (11b) fulfills ALIGN-RIGHT), but violates a separate CRISPEDGE constraint. In languages with full resyllabification across words, such as Spanish, ONSET and CRISPEDGE are ranked higher than ALIGN-RIGHT.
 - 7 The examples in (15) are from our own field notes (Deggendorf, Lower Bavaria, Dec. 2005) and from Merkle (1975:30–33). Besides insertion of *r*, there is also insertion of *n*, as in *won i* ‘where I’. As Christian Uffmann (personal communication) has pointed out to us, there are even sporadic appearances of *r*-sandhi in Standard German – for example, in the denominal adjectives *Jena-r-er* and *Fulda-r-er* based on the place names *Jena* and *Fulda*.
 - 8 This is one reason why a direct appeal to a hiatus constraint is less attractive in this case, even if such as constraint is part of the constraint set (as argued in Borroff 2003, among others). It is clear that not all instances of hiatus resolution are driven by ONSET; see Ola Orié and Pulleyblank (1998) for a case where the crucial factor is word and foot minimality.
 - 9 In particular, the constraint DEP against simple segment insertion will be replaced by a constraint involving the insertion of a segmental root node, with place features spreading from the preceding vowel (Baković 1999 and Uffmann 2003, 2005). This means *r*-insertion is a kind of diphthongization, and cannot occur utterance initially where there is no preceding vocalic content (see section 4.3).
 - 10 As a reviewer reminds us, the highly sonorous *r* is not a dispreferred coda in itself – rather, it is precisely its high sonority and similarity to vowels that predestines it to vocalize and become part of the syllable nucleus. CODA-COND should here be understood as an abbreviation for this much more complex interaction.
 - 11 Thanks to Daniel Kaufman for first bringing these dialect facts, and their relevance, to our attention.
 - 12 Trudgill (1974:162) also notes an interesting OCP-type restriction in Norwich speech: ‘[l]ntrusive *r* does not occur in contexts like *extra eggs*, where an /r/ precedes an unstressed /ə/ in the same syllable.’
 - 13 Sivertsen (1960) comments that ‘[t]his is not the usual way of bridging the hiatus after the unstressed indefinite article: it is more common to use the form /an/: /fájn+anówm+fòh+ðəm/ *find a home for them*. Curiously enough, in the few cases where /ər/ has been recorded for the indefinite article it has only been where the next word starts with /h/ in RP.’ Our proposal is that the influence of *h*-ful RP speech – i.e., the style of speech that does not drop the *h* in a word like *hope* – is powerful enough in this case to prevent the selection of the appropriate pre-V allomorph [ən] before *hope* [oʊp] (the phonology is reminiscent to that of *h*-*aspiré* words in French), and in just this case *r*-insertion takes over.
 - 14 A related empirical finding concerns linking *r*, not intrusive *r*: Cockney English shows examples of linking *r* where it is exclusively an onset and not at all connected to coda position, i.e., where its appearance cannot be motivated by FINAL-C. Sivertsen (1960:137) points out that ‘[l]inking /r/ may also occur when a potential preceding /ə/ is missing, so that there is no hiatus to bridge’, citing the forms below (reproduced here in the original phonemic transcriptions).

after them	/áhfrəm/
alter it	/ówltrít/
remember it	/rímémbrít/
over it	/ówvrit/
good for himself	/gúd+frisélf/

A full analysis of these forms would require a better understanding of their syllabification, and their relation to the corresponding forms with vowels, than we possess at the moment. What seems clear, however, is that the linking *r* in these output forms is not associated to some ω -final coda position, making it difficult to motivate it by a constraint demanding ω -final codas. On the other hand, the forms do not seem to present obstacles for an onset-based analysis.
 - 15 The occurrence of intrusive *r* in compounds (*schwa-r-epenthesis*, *spa-r-experience*, etc.) shows that the second member must be a maximal word, i.e., the whole compound is prosodically some kind of phrase.
 - 16 In fact, a rule with a full-fledged environment such as $\emptyset \rightarrow r/ _ \#$ is necessary (McCarthy 1993a:18, note 12) in order to avoid initial epenthesis (*Alan* \rightarrow **Ralan*), and is still not sufficient to cover word-internal intrusive *r* at level II junctures. As Uffmann (2005) observes, an analysis assimilating intrusive *r* to linking *r* by positing a floating *r* lexically at the end of all lexical items subject to *r*-intrusion in a prevocalic context is not viable because of the productivity of the process, as seen in loanwords and even in interlanguage productions (see section 3 above), where a lexical solution is out of the question. The process must be able to deal with input material that lacks *r*.
 - 17 David Teeple (personal communication) points out that there is a crosslinguistic tendency, seen also in English (/ɛd/ \rightarrow *[jɛd]), for features of the nucleus not to spread leftwards to fill the onset.
 - 18 It is worth pointing out that our analysis does not depend on very specific assumptions about the prosodic structures involved. Even though the contrast

between the extended word structure $[[draw_{\omega}] \widehat{rit}_{\omega}]$ and the simplex word structure $[draw \widehat{ring}_{\omega}]$ is well motivated (see the discussion in the text), the *r*-insertion facts themselves would be correctly predicted even without this kind of difference in prosodification.

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