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A DOMAIN-BASED PHONOLOGY: THE EVIDENCE FROM MODERN IRISH*

Andrew Carnie

1. INTRODUCTION

In recent years, the model of Lexical Phonology and Morphology (Kiparsky 1982; Mohanan 1982; Halle and Mohanan 1985) has come under attack (Sproat 1981; Inkelas 1989; Halle and Vergnaud 1987). In this paper I present a non-stipulative alternative to the theory of Lexical Phonology. I claim that Irish is best accounted for by a post-syntactic domain-based theory of phonology. This model is based on a morphological version of X-bar theory, adjunction processes, and a smaller than word version of Selkirk's (1986) derived domains theory of sentence phonology—all otherwise motivated principles of the grammar. In addition to being built on principles that are independently required in the grammar, this model offers certain empirical advantages over Lexical Phonology: it allows an account of bracketing paradoxes in Irish, facts that cannot be handled by the theory of Lexical Phonology. I will examine the derivational and inflectional morphology of Irish with respect to the ordering of morphological and phonological processes and I will show that the language proves problematic for the theory of Lexical Phonology. There is straightforward evidence in Irish of traditional level ordering. However, there is also a large productive set of words where this level ordering creates a classical bracketing paradox: the phonological rule application cannot occur in the same order as the morphological derivation. To account for these cases, I propose to use mapping algorithms to derive prosodic domains for rule application from the morphological structure, instead of applying those rules directly to the morphological structure. Inkelas (1989) attempts to develop a similar theory to account for English and Malayalam data. I will show however, that my proposals are more motivated and economical than those of Inkelas, as they follow directly from principles available elsewhere in the grammar. In section 1 of the paper, I will survey some of the basic rules of Irish phonology. In section 2, I examine morphological processes in Irish, and the evidence for a level distinction in the language. In section 3, the problematic paradoxical cases are examined. My proposed solution for these cases is present in section 4. Finally, in section 5, an examination of an apparent Irish counter-example to my theory shows that it follows from other principles of Irish morphology.

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2. SOME RULES OF IRISH PHONOLOGY

In this section, I shall survey a representative sample of rules from Irish phonology. This list should not be taken as exhaustive, and I refer the reader to Ó Siadhail (1989) for a more detailed phonological analysis of the language. The rules that have been selected for presentation here were chosen on the basis of their lack of dialectal variation, their interactive properties and their productivity.

2.1. Stress

In the unmarked case, stress in Irish falls on the initial syllable of a word (Christian Brothers 1960). For example in the following simple words stress is initial:

- (1) a. *baile* 'town' /baljə/ b. *athair* 'father' /ahər/
 b. *cuirim* 'I put' /kɪrəm/ d. *eolas* 'knowledge' /jɔləs/

Ó Siadhail (1989) demonstrates that Irish stress is quantity sensitive. A branching nucleus (i.e. a long vowel)—but not a branching rhyme (closed syllable)—is considered heavy. The morphemes (*e*)*ach* '-ish' /ax/ and (*e*)*acht* '-ation' /axt/ are treated as heavy syllables in the Munster Dialect. The following pattern emerges (where ' = stress):

- (2) a. \acute{V} : \check{V} *bóthar* 'road' /bo:hər/
 b. \check{V} \acute{V} : *corcán* 'pot' /kər'ka:n/
 c. \check{V} \check{V} \acute{V} : *spealadoir* 'mower' /ʃpələ'do:r/
 d. \check{V} : \acute{V} : *díomhaoin* 'idle' /di:'wi:n/
 e. \check{V} : \acute{V} : \check{V} : *ógánach* 'youth' /o:'ga:nəx/
 f. \check{V} \acute{V} : \check{V} : *caillíní* 'girls' /kəl'i:ni/
 g. \acute{V} : \check{V} \check{V} : *méaracán* 'thimble' /mja:rəka:n/
 h. \acute{V} \check{V} \check{V} \check{V} : *clutharacán* 'leprechaun' /kluhərəka:n/

An exact metrical description of this data is beyond the scope of this paper. However, the following generalizations (after Doherty 1991) can be made concerning stress assignment:

- (3) (i) If the second syllable is heavy stress it.
 (ii) Otherwise stress the leftmost heavy syllable.
 (iii) Otherwise stress the initial syllable.
 (iv) no syllable other than one of the first three from the left may be stressed.¹

Short unstressed vowels, as in English, are subject to vowel reduction to schwa. Further, there are a series of lexically marked exceptions (often borrowings) to the rules (e.g. *abhaile* 'homewards' /ə'walə/.)

2.2. Epenthesis

Irish has strict conditions on syllable structure. In impermissible sequences of consonants, an epenthesis process applies to licence unsyllabified segments. Roughly speaking,² an impermissible sequence of consonants occurs when two adjacent consonants follow a short vowel and are not minimally distant by four sonority values on the sonority scale or are homorganic.³ This constraint holds in coda clusters, coda-onset clusters (e.g. ...CVC]σ [CVC...), but not within onset clusters. This is exemplified in the following examples:

- (4) a. *airgead* 'money' /argəd/ → [arəgəd]: CVC]σ [CVC
 b. *bolb* 'caterpillar' /bolb/ → [boləb]: CVLC]σ
- (5) a. *corp* 'body' [korp]
 b. *banc* 'bank' [baŋk]
- (6) Insert an epenthetic vowel between a sonorant and a following consonant iff
 (a) the preceding vowel is not long;
 (b) the second consonant is not a voiceless stop; or
 (c) the sonorant and the stop are not at the same place of articulation.

2.3. Vowel elision

Irish has a process by which a short vowel is deleted before any other vowel. The following derivations demonstrate this phenomenon:

- (7) a. *cúpla* 'couple' /ku:plə/ + *l* 'plural' /i:/ → *cúplal* 'couples' /ku:pli:/
 b. *mo* 'my' /mo/ + *obair* 'work' /obər/ → *m'obair* 'my work' /mɔbər/
 c. *so* 'easily' /so/ + *ólta* 'drunk (verb)' /o:ltə/ → *so-ólta* 'drinkable' /so:ltə/

The rule does not apply when the first vowel is long:

- (8) *ml* 'mis' /mi:/ + *iompar* /ompər/ → *ml-iompar* 'misconduct' /mi:ompər/

It applies inflectionally (as seen in (7a)), derivationally (as in (7c)) and in the sentence phonology (7b). In the sentence phonology, its application is subject to the same domain restrictions—see section 4.1 below—as other prosodic processes (such as initial consonant sandhi) in that it cannot apply across an]x^{max} boundary. In the sentence phonology, there are a number of specific morphemes which do not trigger this rule. For example, the morpheme *a* 'her' does not elide before a vowel: rather an /h/ is inserted between the vowels. The morphemes that do this do not form a natural class, thus must be marked in the lexicon, just like those that trigger the initial consonant sandhi.

This model explains the ordering of morphemes (level 1 occur inside level 2 and level 2 occur inside of level 3) and the failure of some rules to apply across certain boundary types.

We can apply this classical model to the phonology of Irish. Irish has two identifiable classes of derivational morphemes and a third class of inflectional ones. These classes are ordered with respect to one another in terms of morphological organization. Level 1 morphemes are always internal to level 2 ones, and level 2 morphemes are always internal to inflectional morphemes.⁵ The phonological rules discussed in section 2 are also subject to the restrictions imposed by the level ordered model. Some rules apply at one level but not at the others (apply to some morphemes but not to others). The following is a partial list of the morphemes at the given levels:

<u>Level 1</u>		<u>Level 2</u>		
<i>an-</i>	very	<i>ath-</i>	re-	
<i>bi<th>h-</th></i> <td>bio-</td> <td><i>bun-</i></td> <td>first, initial</td>	h-	bio-	<i>bun-</i>	first, initial
<i>colg-</i>	sharp/straight	<i>do-</i>	un-, in-	
<i>il-</i>	multi-/poly-	<i>sean-</i>	old	
<i>comh-</i>	co-/equal	<i>so-</i>	-able, easy	
<i>dian-</i>	intense	<i>ml-</i>	mis-	
<i>glan-</i>	clean	<i>mion-</i>	micro-	
<i>ard-</i>	superb	<i>neamh-</i>	un-	
<i>ró-</i>	too			
<i>stor-</i>	eternally			
<i>-eoir</i>	-er	<u>Inflectional</u>		
<i>-ín</i>	diminutive	— all plural morphemes (<i>-í, -eanna, -a, -e,</i>		
<i>-iúil</i>	-al	<i>-atha, -acha,</i> etc.)		
<i>-íocht</i>	-ment	— genitive case markers		
<i>-eacht</i>	-ity, -ness	— tense markers		
<i>-iúil</i>	-tion	— agreement markers		
<i>-táite</i>	-en (deverbal adjective)			
<i>-ach</i>	-ish			
<i>-eolatócht</i>	-ology			

Evidence for this classification comes from the interaction of the phonological rules discussed in section 2. Stress assignment is a level 1 rule, as shown by the fact that it applies to, and is influenced by level one morphemes. In the word *an-mhaith* 'very good' /ə́nəwəh/ primary stress falls on the first syllable, a level 1 morpheme. In the word *brúidiúil* 'brutal' /bru:ɰu:ɰ/, stress, as predicted by the principles discussed in first section, falls on the second syllable: the level 1 morpheme *-iúil*. Stress does not fall on level 2 morphemes. In the word *seanmhathair* 'grandmother' (lit. old-mother) /ʃə́nəwəhə́r/ (after epenthesis: [ʃə́nəwəhə́r]), we would predict the stress to fall on the first syllable. However, *sean-ʃən* is a level 2 morpheme, and stress actually falls on the first syllable of the stem: [ʃə́nəwəhə́r]. The same analysis seems to hold true of the other morphemes marked as level 2 above. We can thus conclude that stress applies only at level 1, and that the morphemes listed as level 2 are added at a later stage in the derivation than the level 1 ones. The same analysis holds true for

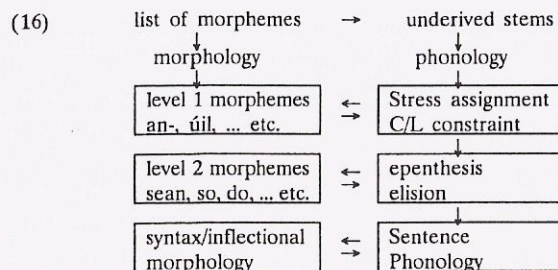
the constraint on *caol* and *leathan* quality as well. The CL Constraint applies to level 1 morphemes but not to level 2 ones. In the word *dianleathach* 'intensely wide/wide open', the final consonant of the level 1 morpheme *dian*, which is underlyingly *leathan*, assumes a *caol* quality in front of the *caol* initial consonant of the stem. This is not the case for level 2 morphemes. In the word *mionbhrístín* 'very small crumbs' [mionvrʲiʃtʲi:nʲ], the underlyingly *leathan* /n/ at the end of the level 2 morpheme *mion* 'micro' /mi:n/, does not share the *caol* quality of the /b/ at the beginning of the word *bhrístín* (in derived words an underlying *caol* /b/ is lenited to [v]); rather it retains its *leathan* quality (cf. *[mionvrʲiʃtʲi:nʲ]).

The rules of Elision and Epenthesis differ from the previous two rules in that they can apply to a whole word as opposed to just level 1 morphological outputs. For example, the level 2 morpheme *so* '-able' is subject to the rule of Elision: *so-ólta* 'drinkable' /so#o:ltə/ → [so:ltə]. Similarly, epenthesis applies within consonant clusters formed by level 2 affixation: *seanmhathair* 'grandmother' /Sə́n#wəhə́r/ → [Sə́nəwəhə́r]. This means that these two rules must appear at a later stage in the derivation than those processes which only apply to level 1 morphemes. This is consistent with the evidence that epenthesis is in a counterbleeding relationship with the constraint on *caol/leathan* quality.

We can characterize the inflectional stage as the postlexical stage of the phonology. Inflection can be shown to be final by its interaction with level 2 compounding. If inflectional morphology was at level 2 or earlier, there would be no way of blocking its application to the first part of a level 2 compound. For example, if we were to compound the elements *clár* 'index' /kla:r/ and *leabhar* 'book' /ʲawə́r/, and inflection were to occur before the compounding process (either at level 1, or at a precompounding stage of level 2) then there would be no way of blocking an incorrect plural output:

(15)	/kla:r/	+	/ʲawə́r/
LEVEL1			
Stress	'kla:r		'ʲawə́r
C/L	—		—
PLURAL	'kla:rʲ		'ʲawə́rʲ
LEVEL2			
epenthesis	—		—
elision	—		—
compounding			'kla:rʲʲawə́rʲ
			*['kla:rʲʲawə́rʲ] (cf. ['kla:rʲʲawə́rʲ])

Inflection must, therefore, occur after level 2 compounding to block the appearance of inflection on the non-final portions of the compounds. The ordering of inflectional processes after derivational ones is consistent with the current theory that inflection occurs in the syntax. The following classical model of Irish phonology thus emerges:



4. IRISH INFLECTIONAL MORPHOLOGY: BRACKETING PARADOXES

Kiparsky (1985) argues that there are strict restrictions upon the activation of the rules within the Lexical Phonology. Roughly put, Kiparsky argues that a rule may not be "deactivated" and the "reactivated" at different stages in the derivation. The constraint causes problems for the phonology of Irish. In the previous section, I showed that, morphologically, inflection must follow level 2 derivations. In this section I will show that, phonologically, inflection must precede level 2 processes, thus resulting in bracketing paradoxes.

Inflectional morphemes undergo, and condition, rules that apply at level 1, but not those that apply at level 2. Inflectional suffixes affect the stress patterns of words. For example, in the plural of the word 'shilling', the long vowel in the plural morpheme attracts the stress:

- (17) *scilling* + *t* → *scillingt*
/ʃkɪlɪŋ+i:/ → [ʃkɪlɪŋ'gi:]

Inflectional suffixes are also subject to the CL Constraint. The initial /t/ in the plural suffix *-te/-ta* takes on the CL quality of the stem. For example, with the word *móin* 'peat bogs', which has a *caol* final consonant, the plural morpheme takes the *caol* form /tʰə/. With the word *gleann* 'glen', however, the *leathan* final consonant requires that the plural morpheme take the *leathan* form /tə/:

- (18) a. *móinte* 'peat bogs' [mojnʰtʰə]
b. *gleannta* 'glens' [glejntə]

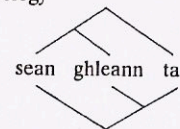
The pattern for the application of these two rules is thus as follows:

	<u>Stress</u>	<u>CL constraint</u>
Level 1	applies	applies
Level 2	—	—
Post-inflection	applies	applies

This is clearly a violation of Kiparsky's constraint on the deactivation of rules. This disjunctive ordering of rules indicates that the basic morphological structure of inflected Irish words is different from the phonological structure. For example,

in the word *seanghleannta* 'old glens' the morpheme *gleann* is a level 1 morpheme, the morpheme *sean* 'old' is level 2, and the plural *-ta* is inflectional. However, in terms of the phonology, the inflectional morpheme and the stem seem to function as a single unit and the level 2 morpheme as a separate one. This is true for all inflected Irish words derived at level 2. We can thus conclude that the domains of phonological rule application and morphological structure are not isomorphic, as they are predicted to be by classical Lexical Phonology. This lack of isomorphy can be represented schematically as:

- (20) Morphology



Phonology

Similar examples have been shown to exist in Russian, Warlpiri (Pesetsky 1979), and English (Sproat 1981). In classical Lexical Phonology, phonological domains and morphological structure are predicted to be identical, as the rules of the Phonology apply directly to the morphology. Obviously, as shown above, this cannot be true of a large portion of Irish words. Therefore, we have solid grounds for rejecting the level ordered model of the phonology in favor of an indirect reference model of phonological rule application.

5. AN INDIRECT REFERENCE THEORY OF PHONOLOGICAL RULE DOMAINS

Selkirk (1986) demonstrated that the rule domains of sentence phonology are not necessarily isomorphic to syntactic structure. She proposes to derive prosodic domains for rule application from the syntax using mapping algorithms. These algorithms use specific brackets in the syntax to delimit her derived prosodic domains. Since the problem of Irish inflectional phonology is also a case of a lack of isomorphy between (morphological) structure and the phonology, we can turn to Selkirk to provide a parallel upon which we might develop an indirect reference theory of smaller-than-word phonological rule domains. Unfortunately, morphological structure in the current state of the theory is not rich enough to provide the information necessary to derive lexical prosodic domains. I will show, however, that using three devices (which are all otherwise motivated in the grammar) we can enrich the information in the morphological structure to provide us with a basis upon which we can derive the correct phonological domains. The generation of these correct rule domains reveals the accuracy of this assumption of an enriched morphological structure. In this section I will first look at Selkirk's theory of sentence phonology; then I will look at a constrained way to enrich the morphological structure. Finally, I will show how the combination of these two, results in an account of the Irish bracketing paradoxes.

5.1. Indirect reference in the syntax phonology

According to Selkirk, every language has at least one (or more) parameterized syntactic bracket(s) which demark(s) prosodic units. Under her analysis, after the syntax a mapping algorithm defines prosodic domains by looking for certain "ends" of syntactic constituents. For example, one such "end" in Irish phonology is the bracket $]_X^{\max}$. This is the parameterized value for the algorithm that maps the domain for initial consonant mutations. In Irish, initial consonants are subject to certain sandhi phenomena. These mutations are triggered when the word is preceded by particular lexical items,⁶ these triggers must be lexically marked, as they belong to no semantically, phonologically, or syntactically identifiable class. The two sandhi phenomena are lenition (*Séimhiú* in Irish; it is also known, inaccurately, in the popular literature as "aspiration") and eclipsis (*an t-úrá*). In this section, I will only discuss lenition; however, the discussion should also be taken to be true for eclipsis.

Lenition, as its name implies, is a weakening of consonants. Non-coronal stops and /m/ become fricatives; coronals are debuccalized (become /h/), with the exception of /d/, which becomes the voiced velar fricative /g/, /f/ disappears entirely. The lenited segments retain the *caol/leathan* quality of their underlying representations (for example *caol* /j/ retains its palatalization in its lenited form /h/). The sounds /l/, /lʲ/, /n/, /nʲ/, /ŋ/, /ŋʲ/, may or not lenite depending upon the dialect (Ó Siadhail 1989), but in the standard dialect do not. Finally /x/, /v/, /w/ and /ʒ/ do not lenite. The following chart represents the alternation:

(21)	Caol (slender)		Leathan (Broad)	
	radical	lenited	radical	lenited
	bʲ	v	b	w
	pʲ	f	p	f
	mʲ	v	m	w
	β	∅	f	∅
	tʲ	hʲ	t	h
	dʲ	j	d	V
	ʃ	hʲ	s	h
	gʲ	j	g	ʒ
	kʲ	xʲ	k	x

These mutations are limited to application within the domain of a prosodically derived phonological phrase (Φ). The phonological phrase is not isomorphic to syntactic ones. Mutation may not occur between phonological phrases, only within them. For example, the word *bean* /ban/ 'woman' is a lexically marked lenition trigger. When followed by an adjective beginning with a lenitable consonant, this morpheme triggers the mutation. (In Irish orthography, a postconsonantal <h> indicates that lenition has applied.)

- (22) [*An bhean mhór*]_{np} (cf. underlying *mór*)
 []_Φ
 /ən van vo:r/ (cf. underlying /mo:r/)
 the woman big
 'The big woman'

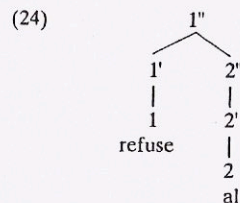
When the adjective and the trigger noun are bounded by a maximal category (as they are when the adjective is the predicate), however, the mutation does not apply:

- (23) [*Tá an bhean mór*]_{ap,ip}
 []_Φ []_Φ
 /ta: ən van mo:r/
 Be the woman big
 'The woman is big'

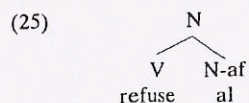
The phonological phrases, then, are derived using a parameterized mapping algorithm which looks for $]_X^{\max}$ brackets.

5.2. The mechanics of an enriched morphological structure

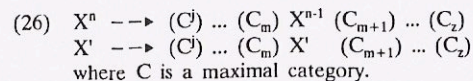
After Inkelas (1989), I assume that like words, every morpheme is associated with a subcategorization frame and selectional restrictions. These frames and restrictions, like the ones present in the syntax, determine the order positioning and co-occurrence of morphemes. Unlike, Inkelas, however, I will assume that the frames, again like those in the syntax, are responsible for the projection of the hierarchical structure built upon the words. Further, I will assume that this projection is constrained by the lexical counterpart of X-bar theory. In section 3, I presented evidence to show that there is a true categorial distinction between morphemes of the various levels. Some morphemes are affected by certain rules and others are not. Further, some morphological processes must occur after others (inflection must occur after level 2 compounding). I propose that this categorial distinction is marked as a feature in the lexicon, like syntactic categories, as there seems to be no way of predicting at what level a morpheme may occur. It is with these morphological categories (M-categories) that the morphological structure of a word is built. The M-categories are 1, 2, and 3. 1 categories are level 1 stems and morphemes, 2 category morphemes are level 2 morphemes, and 3 category morphemes are inflectional. M-categories are to be kept distinct from syntactic categories (S-categories are categories like noun, verb, adjective) whose positioning is built upon the morphological structure of the words, but is not categorially isomorphic to it, and is not constrained by X-bar theory. For example, the M-structure of the word 'refusal' is:



However, the structure of the same word in terms of S-categories is:



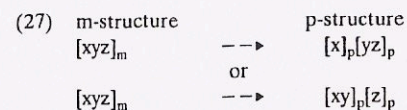
The difference between the two is that with M-categories the "head" is always the stem, whereas the S-categories it is the rightmost derivational affix that forms the head.⁷ The S-category structure can easily be derived from the M-structure by simply projecting the S-category and appropriate features up the rightmost branch of the tree. The M-categories are projected to a maximal level as constrained by a morphological version of X-bar theory. X-bar theory requires that all non-head material be maximal. More formally:



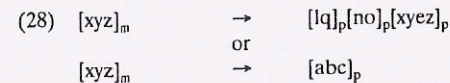
By using X-bar theory and projection with subcategorization (two otherwise motivated devices in the grammar) we are able to develop an enriched morphological representation.

5.3. Indirect reference in morphophonology

Inkelas (1989), in attempting to account for similar facts in Warlpiri and Malayalam, proposes a system where the lack of isomorphy is due to a series of mapping rules that directly convert morphological structure into phonological structure. These rules are generally of the form:



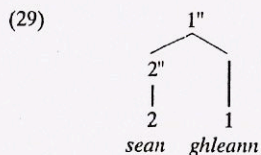
There are two theory internal reasons for rejecting Inkelas' system. Firstly, and most damaging, is the fact that like the rules of Transformational Grammar (cf. Chomsky 1965) that they resemble, these rules are highly unconstrained. There is no reason that a rule could not take the form:



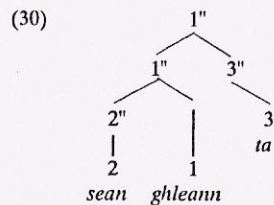
This formalism is clearly too powerful. It leads to irrecoverable derivations, and allows for unwarranted insertion and deletion at the mapping level. The second reason for not adopting Inkelas' formalism is that there is no independent motivation for rules of the type she is proposing. This in and of itself is not an argument against her system, but if the same empirical results can be derived, in a more constrained manner, from devices already available to the grammar,

then the latter approach is obviously to be preferred. I am proposing one such approach. Despite the problems with her formalism, the basic intuition behind Inkelas' approach is desirable: we want a series of regular rules that map morphological structure onto phonological structure. Given Selkirk's indirect reference mapping algorithms, and the enriched morphological structure I have proposed above, we have exactly such a system, using only otherwise motivated mechanisms.

Smaller-than-word phonological domains can be derived using indirect reference mapping and the morphological structure proposed. In section 5.1 above I showed that Irish phonology already makes use of a mapping algorithm for Φ that uses the X^{\max} parameter. This same parameter can be used for deriving the domain for "level 1" phonological processes (hereafter labeled α after Inkelas) in Irish: stress and the CL Constraint. To see how this works I will show the derivation of the word seanghleannta mentioned above in section 3. To start, the individual morphemes leave the lexicon and enter into the derivational morphology component where they are assigned structure using subcategorization and X-bar:



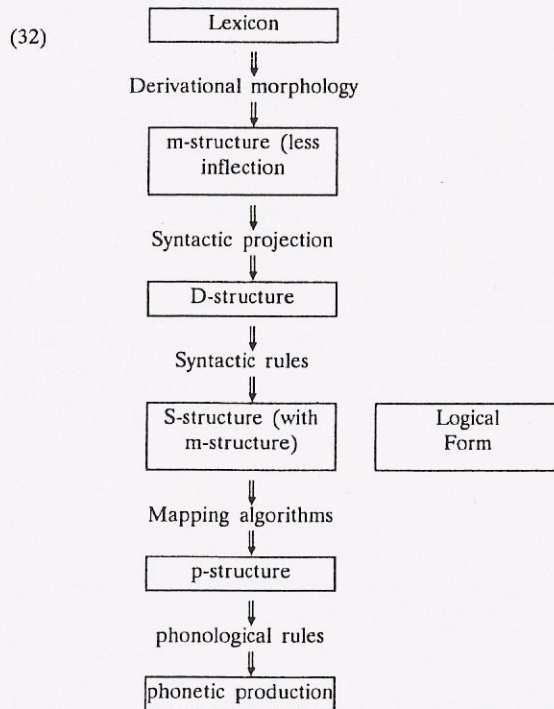
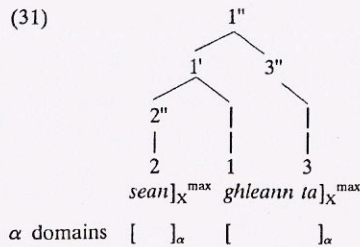
The word then proceeds to the syntax where inflectional information is adjoined to the structure:



After the syntax all the mapping algorithms apply (to both smaller-than-word structures and larger-than-word ones) and P-structure is generated. As is the case for syntactic rules (in both Bounding and Barrier theory; cf. Chomsky 1986), I shall assume that the lower member of an adjoined pair is non-maximal, thus will represent it as X' rather than X".

This provides us with the correct domains⁸ for the application of the "level 1" phonological rules of stress and *caol/leathan* quality. The domain for epenthesis and elision (β) can be derived using a different parameter (perhaps X^{\max}_{head}).

The model of grammar predicted by this theory is different from both Classical Lexical Phonology and Inkelas' Lexical Phonology, in that no phonology occurs in the lexicon proper, all phonology occurs in PF applying to p-structure:



In this model,⁹ all phonology is post-syntactic. This makes a great many predictions, beyond the scope of a small paper such as this. However, I will note in passing that the cases discussed in Hayes (1990) and Odden (1990) where rules of sentence Phonology must make reference to lexical information or must be ordered before lexical phonological rules are now less problematic. All the M-structure information is now present in PF, and there is no *a priori* reason that a rule of a larger prosodic unit (such as the phonological phrase) could not be ordered before one that applies to a smaller domain. This has the desirable

result of avoiding having syntactic information available in the lexicon (as we are forced to do with Hayes' Precompilation theory, and Odden's Lexical Sandhi theory.)

6. A PROBLEMATIC CASE: LENITION IN DERIVATIONAL MORPHOLOGY

The appearance of lenition in the derivational morphology of Irish appears to be problematic for this framework. As discussed above the domain of lenition in the sentence phonology is the phonological phrase (Φ). In many regards α appears to be the smaller-than-word equivalent of Φ ; they are both delimited by an $]_X^{\max}$ boundary and are both the domains for stress rules. However, lenition will occur across an α boundary, but not across a Φ boundary. This is seen in the word *seanghleannata*, where the underlying /g/ of *gleann* is spirantized to /ɣ/. It might be claimed that this is unproblematic and that the similarities between Φ and α are coincidental. However, there is further evidence to show that lenition is problematic for my theory. Proven lenition triggers fail to apply within an α domain, when the suffixed element is inflectional. Therefore the domain for smaller than word lenition does not appear to be identical with any of the already established domains (α , β or Φ). Furthermore, and more importantly, there appears to be no structural mechanism for defining this domain without also defining α . Take for example, the proven lenition trigger *bhufon* 'crowd':

- (33) *An bhufon mhór* (cf. *mór*)
 /ən wi:n wo:r/
 the crowd big
 'the big crowd'

Yet this morpheme does not trigger lenition when an inflectional suffix follows:

- (34) *sean bhufon ta* 'old crowds'
 /ʃən wi:n tə/
 [] _{α} [] _{α} domain of stress and caol/leathan
 [] _{β} domain of elision and epenthesis
 []_{?[]?} domain of lenition

Given the theory as described above, this is a surprising result. However, there are several properties of smaller-than-word lenition which indicates that (i) it is a different process from the syntactic one, and (ii) it is a morphological property here, not a phonological one. The evidence for these claims come from the fact that in all cases of derivational morphology, lenition occurs. It is triggered even by those elements which are not marked in the lexicon as lenition triggers in the sentence phonology. For example, the word *bíor* 'pin' is not a lenition trigger:

- (35) *An bíor mór* (cf. lenited *mhór*)
 /ən bi:r mo:r/
 the pin big
 'the big pin'

However, any derivational morpheme following it is lenited:

- (36) *bforchlar* (cf. underlying *clar* 'board')
 /bi:rxlar/ (cf. underlying /klar/)
 'pinboard'

We can thus conclude that lenition in derivational morphology is not the same process as that of the sentence phonology: it is not triggered by specific lexically marked morphemes but is a property of the derivational morphology itself. It is a predictable and regular process. Each time two elements are combined in the derivational component, the initial consonant of the second word will be lenited.¹⁰ Since inflection occurs in the syntax it will not be affected by this process, thus accounting for the failure of lenition to apply to inflectional morphemes. Therefore, it appears as if derivational lenition is a property definable in terms of the derivational history of a given word, rather than as a "true" phonological process which applies within derived domains; and is thus not an exception to the framework modeled above.

7. CONCLUSION

In this paper I have attempted to explore the application of below-the-word phonological processes in Irish. I first examined them in the light of Classical Lexical Phonology, where I showed that—as predicted by the level ordering hypothesis—morphemes grouped themselves with respect to the application of rules; certain rules did not apply to certain morphemes. However, I also showed that classical lexical theory could not account for a large class of inflected derived words. In these words the morphological structure is not isomorphic to the phonological structure. A theory of indirectly derived domains was developed where a prosodic structure was built upon an enriched morphological structure. The mechanisms used to do this are all motivated elsewhere in the grammar, and are all highly constrained. In this model all phonology is post syntactic. I also showed that an apparent exception to the mapping principles proposed above, derivational lenition, is really a feature of the morphology, not of the phonology. It is my hope that the framework outlined in this paper will be the seed for new research examining how it might be extended to account for a wider range of languages and phenomena.

NOTES

1. This final stipulation is not explicitly made by Doherty, but is implied by his three syllable stress windows.
2. See Carnie (1991) for a more detailed analysis of these facts.
3. Assuming the following scale: (1) Voiceless Stops, (2) Voiced Stops, (3) Voiceless Fricatives, (4) Voiced Fricatives, (5) Sonorants, (6) Vowels.
4. Interestingly, the orthography makes the same distinction. The consonants of the *caol* group are always flanked on either side by *gíatal caol* (slender vowels): <e>, <i>, <é> and <í>. These letters are not necessarily part of the pronunciation, but can be present only to represent the quality of the consonants. For example in the word *leathain* only the two <a>s are pronounced, the <e> indicates that the <l> is pronounced /l/ and the <i> indicates that the <n> is pronounced /ŋ/. The same holds true for the *leathan* group. They are always flanked

by *gíatal leathan* (broad vowels) in the spelling system. These are <a>, <á>, <o>, <ó>, <u>, <ú>. Again, these need not count in the pronunciation of the word and may only indicate the quality of the consonant.

5. This second statement is difficult to prove in terms of simple derivational morphology, as all level 2 affixes in Irish are prefixes, and all non-clitic inflectional morphemes are suffixes. Thus their ordering with respect to one another is not obvious. However, as will be seen below, there is also process of level 2 compounding, which must precede inflection.
6. One of them is also triggered by certain derivational morphological processes. This will be discussed in section 5. Until section 5 I will ignore the appearance of these processes in any derivations.
7. I shall restrict the usage of the term "head" to S-categories, and the term "stem" to talk about the "head" of M-structure. This is useful as it allows us to develop a structural description of the vague notion "stem".
8. The question that immediately springs to mind is how a system such as this can also derive the correct rule domains for a language where the inflectional material is in a different domain from derivational material. In such languages, one of the parameters for the indirect reference will have a different setting (e.g. $|x^{head}$ or $|x^{max}$).
9. Recently, the question of "incorporating" languages, such as the Athapaskan languages (cf. Baker 1988), has raised many questions about the derivational component. The model outlined above is fully compatible with such languages, the difference being that, in these languages, the derivational component is integrated with the syntax. For a view of how this might work, I refer the reader to an analysis of Slave (an Athapaskan language) by Rice (1991), where she analyzes the derivational morphology as a reflex of the syntax, and accounts for the phonology of this morphology using an indirect reference model, much like that proposed by Selkirk.
10. This might be due to some "connective" morpheme, whose phonological form is simply a floating [continuant] feature.

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1. INTRODUCTION

In this paper, I will provide evidence that syntactic *wh*-movement exists in Mandarin Chinese, contrary to what has been assumed in the literature (Huang 1982), and that clauses are highly structured in the language. I will achieve these objectives by investigating the distributional properties of *suo*, as in (1):

- (1) [xiaotou *suo* meiyou touzou _] de neixie shoushi zai
 thief SUO not-have steal DE those jewelry at
 zuozhi-shang.
 table-top
 'The jewelry that the thief didn't steal is on the table.'

I first investigate specific properties associated with *suo* and argue that *suo* is a "clitic-like" object-agreement marker which appears when syntactic movement of an accusative NP has occurred. *Suo* occupies a position lower than subject in IP, but higher than negation, which I will analyze as AgrO (object-agreement) position. Furthermore, sentences containing *suo* show Island effects, providing strong evidence that syntactic movement exists in the language. Finally, I will show that *suo* serves as a probe into the syntax of Chinese and will settle certain controversial issues in Chinese syntax, such as whether Raising verbs exist in the language, whether there is Restructuring and whether Topicalization involves movement. I will also offer a new analysis of the so-called passive in Chinese, namely the *bei*-construction, in light of *suo*'s behavior in this construction. I will argue that the *bei*-construction should not be equated with passive in English. *Wh*-movement instead of NP-movement is involved. Following Feng (1991), I propose a *tough*-movement like structure for *bei*-constructions, with the behavior of *suo* in *bei*-constructions following from this analysis.

The paper is organized as follows. Section 2 describes the properties of *suo*, including the environment that allows for its occurrence, the location of *suo* sentence-internally, and Island effects shown by *suo*-sentences. An analysis postulating *suo* as the object-agreement marker realized by movement through SpecAgrOP position is proposed in section 3. The properties of *suo* follow straightforwardly from this analysis. In section 4, *suo* is used as a tool to

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