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The Problematic Distribution of the Irish Past Tense Marker *d'*: Development of a case of phonologically conditioned allomorphy*

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Abstract The initial mutations of Irish and the other Celtic languages have been the subject of numerous analyses from both phonological and morphological perspectives. These mutations interact with the Irish verbal system in an apparently paradoxical way for a set of verbs with an initial *fC-* consonant cluster, such that there is no straightforward way to reconcile the operation of mutation and the (non-)deletion of the past tense marker *d'* in verbs such as *d'fhreagair* 'answered'. This article presents two analyses to account for this phenomenon, one in an autosegmental framework of phonology using Gussmann's (1986) mechanism of latent segments, and one building on Pyatt's (1997) Distributed Morphology account of mutations. I argue that the allomorphy of *d'* may be considered a case of non-optimising Phonologically Conditioned Suppletive Allomorphy (PCSA, Paster 2006), and, drawing comparisons to a similar phenomenon in Welsh, that a staggered insertion analysis within DM may therefore be most suitable. In general, these data suggest that the flexibility of DM in allowing for phonological subcategorisation may render it the best choice for modelling Celtic mutations. Furthermore, they contribute to existing literature arguing for the appropriateness of subcategorisation models over constraint-satisfaction models in cases of non-optimising PCSA. Finally, I suggest two historical explanations for the Irish data: one in terms of abductive reanalysis of a previous regular pattern, and another in which orthographic norms could have influenced the spoken language – leaving this final question open to future study.

1 Introduction

In this article I present and compare two analyses, one phonological and one morphological, of a problematic case of phonologically conditioned allomorphy arising from the interaction of initial consonant mutations and the Irish verbal system. In section 1, I outline initial mutations and the relevant parts of the verbal system, and describe the the object of discussion, namely paradoxical behaviour of a class of verbs I denote *fC-initial verbs*. In section 2, I give an analysis of these

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verbs in phonological terms, building on autosegmental mechanisms proposed by Gussmann (1986) to account for other phonological processes in Irish, and discuss the theoretical context of such an approach. Turning to a morphological analysis, in section 3 I present Pyatt's (1997) model of initial mutations in the Distributed Morphology framework, and demonstrate its failure to account for the phenomenon under discussion. In section 4, I consider the behaviour of these verbs as a case of Phonologically Conditioned Suppletive Allomorphy, and demonstrate how this allows for an efficient analysis within DM. Finally, in section 5, I consider potential historical pathways by which this allomorphy could have developed, and to what extent historical considerations might favour one analysis or another.

1.1 The Irish language

Irish is a Celtic language, of the Goidelic branch along with Scottish Gaelic and Manx. The other branch of the Insular Celtic languages, that is, those spoken in and around Britain and Ireland, is the Brythonic branch, which comprises Welsh, Breton and Cornish. Common to all Insular Celtic languages is the phenomenon of initial consonant mutations.

There is wide dialectal variation in spoken Irish, and no spoken standard. Dialects are roughly divided into three main groups in Munster, Connacht and Ulster; the written standard, *An Caighdeán Oifigiúil* (Rannóg an Aistriúcháin 1958), is based on all three. For the most part, dialectal differences are not relevant to the topics under discussion here, and unless otherwise stated I treat the written standard as generally representative of the majority of dialects.

1.2 Initial consonant mutations

1.2.1 Consonant inventory

The Irish consonant inventory is characterised by a contrast between velarised and palatalised consonants, usually referred to as 'broad' and 'slender' respectively, terms which I will use from here on. In Table 1, I present an adaptation of the inventory from de Bhaldraithe (1966) and Ó Dochartaigh (1992) for a 'general' dialect of Irish, although there are differences among dialects. Where the distinction is not relevant, I omit the secondary articulation, using /f/ for /fˠ fʲ/, for example.

1.2.2 Summary of mutations

The grammar of Irish, along with the grammars of the other Insular Celtic languages, is characterised by a system of initial consonant mutations, whereby the initial segment of a word undergoes some phonological change in a particular morphological or syntactic environment. There are two main types of mutation, known as lenition (*séimhiú*) and eclipsis (*urú*), which affect the majority of consonants; eclipsis is not relevant to this discussion, but I show the outcomes of lenition in Table 2.

/n ɾ l/ do not undergo mutation. In the history of Irish there existed a series /N R L/ which survives now only among a small minority of older speakers, primarily in

	Labial	Dental	Alveolar	Alveolo-palatal	Palatal	Velar	Glottal
Plosive	pˠ bˠ	t̪ˠ d̪ˠ				k g	
	pʲ bʲ			tʲ dʲ	c ɟ		
Fricative	fˠ vˠ		s			x ɣ	h
/approx.	fʲ vʲ			ʃ	ç j		
Nasal	mˠ	n̪ˠ				ŋ	
	mʲ			nʲ	ɲ		
Tap			ɾˠ				
			ɾʲ				
Lateral		l̪ˠ					
approx.				lʲ			

Table 1 Consonant inventory of Irish.

Radical	Lenition	Radical	Lenition
pˠ pʲ	fˠ fʲ	g ɟ	ɣ j
<p>	<ph>	<g>	<gh>
tˠ tʲ	h	mˠ mʲ	vˠ vʲ
<t>	<th>	<m>	<mh>
k c	x ç	fˠ fʲ	∅
<c>	<ch>	<f>	<fh>
bˠ bʲ	vˠ vʲ	sˠ ʃ	h
<b>	<bh>	<s>	<sh>
dˠ dʲ	ɣ j		
<d>	<dh>		

Table 2 Consonant mutations in Irish ('Radical' denotes the unmutated form).

Donegal, and lenite to /n ɾ l/ (Ó Dochartaigh 1992); elsewhere, they merged with /n ɾ l/, and I omit them from further discussion.

The environments in which initial mutations occur are numerous and for the most part idiosyncratic; they are 'triggered' usually by particular function words, as shown below, and there is no way to predict the mutation caused from the phonological form of a trigger.

1.2.3 Outcomes of mutation

Lenition causes plosives and /m/ to become fricatives or approximants, and fricatives to undergo debuccalisation, with /s/ → /h/ and /f/ deleting entirely. It is the most common mutation in Irish, and occurs after triggers such as the third person singular masculine possessive *a* and, in adjectives, a feminine singular noun:

(1) Examples of lenition

a. *a **gh**lúin* /ə ɣlʸuːnʲ/

'his knee' (Pyatt 1997: 43)

b. *ruaig **mh**ór* /ɾʸuəɟ voːɾʸ/

'bad bout' (Ó Siadhail 1989: 120)

Alongside the canonical mutations are two less common processes, *h-prothesis* and *t-prothesis*. H-prothesis attaches an /h/ to vowel-initial words; an example trigger is the negative imperative particle *ná*.

(2) *ná **h**-ól* /nʸɑː hoːlʸ/

'don't drink' (Ó Siadhail 1989: 122)

T-prothesis occurs with certain forms of the article before nouns beginning in a vowel or /s/; in each case, /t/ is attached to the noun (and replaces /s/ in the latter case).

(3) Examples of t-prothesis

a. *an **t**-eolas* /ənʸ tʲoːlʸəsʸ/

'the knowledge' (Ó Siadhail 1989: 145)

b. *an **t**súil* /ənʸ tʸuːlʲ/

'the eye' (Gussmann 1986: 904)

Whether these are grouped into the system of mutations varies in different accounts; for example, Pyatt (1997) (discussed below) classes h-prothesis as a mutation, since it is idiosyncratically triggered by a range of particles, but classes t-prothesis as a separate process since it occurs only with two forms of the article.

1.3 Verb formations with d'

1.3.1 Positive declarative past tense

The past tense of the majority of verbs is formed using one of two strategies: lenition of the bare verb stem (which is also the imperative form), or a proclitic particle *d'*/*do*. For most consonant-initial verbs, we see lenition:

(4) *bris* 'break' → *bhris* /vʲɾʲɪʃ/ 'broke'

For verbs beginning in /n ɾ l/, which do not lenite, the past tense form is identical to the imperative.

(5) *rith* 'run' → *rith* 'ran' /ɾʸɪ/

For vowel-initial verbs, the past tense is marked with the proclitic *d'*:

(6) *ól* 'drink' → *d'ól* 'drank' /dʸoːlʸ/

Finally, for verbs beginning /f/, which deletes under lenition , we see both lenition and a proclitic:

(7) *fás* 'grow' → *d'fhás* 'grew' /dʸɑːsʸ/

There is significant dialectal variation in the formation of the past tense. Among some older speakers, and in older Irish literature, a full proclitic *do* is used for all past tense forms, and functions as a leniting particle:

(8) *do phós* /dʸə fʸoːsʸ/

'married' (Ó Siadhail 1989: 176)

Some dialects show further variation with the *d'* itself undergoing lenition; this is also standard in Scottish Gaelic (Gillies 1993). However, unless otherwise stated I will be examining only the usage in the majority of current Irish dialects, namely the appearance of *d'* only before a vowel or lenited *f*.

1.3.2 Other verb formations

Negative declarative, interrogative and negative interrogative past tense verbs are also formed with lenition, but accompanied by different particles all ending in *-r*; *d'* is not present even for vowel-initial forms.

(9) Other past tense formations (Pyatt 1997: 147)

a. *níor bhris mé*

'I didn't break'

b. *ar bhris mé?*

'Did I break?'

c. *nár bhris mé?*

'Didn't I break?'

d. *níor ól mé*

'I didn't drink'

There are three additional tense/aspect formations which use lenition and/or *d'*. Two are the conditional and the habitual past, which show the same distribution of lenition and/or *d'* as the past tense, but have distinct endings. The third is the impersonal past tense form, which does not feature lenition at all, and may also feature *do* in some varieties:

(10) *(do) treabhadh*

'was plowed' (Armstrong 1975: 320)

The conditional and habitual forms are relatively rare, and so I will focus only on past tense forms for this discussion; at any rate, the distinction is not relevant to this discussion.

1.4 Problematic distribution of d'

Here I describe the phenomenon under primary investigation. Given the forms in (6, 7), it appears that *d'* surfaces in the past tense only when the lenited form of the verb is vowel-initial, and otherwise does not. This ostensibly accounts for why *d'* is present before a lenited verb originally beginning in /f/, such as *fás* → *d'fhás*, as the deletion of /f/ through lenition means the resulting form is vowel-initial. However, consider the forms in (11):

(11) *fC*-initial verbs (Armstrong 1975: 319)

a. *d'fhreagair* /dʲɾʲægəɾʲ/ (← *freagair 'answer'*)

'answered'

b. *d'fhliuch* /dʲlʲʊx/

'wetted' (← *fliuch* 'wet')

In such forms where the verb stem begins with a cluster /fɾ/ or /fl/, the lenited form is not vowel-initial, yet *d'* is still present. This seems to have been first noted

UR	do freagair	do rith	do ól
Lenition	do fhreagair	–	–
Deletion	fhreagair	rith	–
Elision	–	–	d'ól
SR	*fhreagair	rith	d'ól

Figure 1 Derivations of **fhreagair*, *rith*, *d'ól* (first proposal; UR, SR denote underlying representation, surface representation respectively).

UR	do freagair	do rith	do ól
Elision	d'freagair	–	d'ol
Lenition	d'fhreagair	–	–
Deletion	–	rith	–
SR	d'fhreagair	rith	d'ól

Figure 2 Derivations of *d'fhreagair*, *rith*, *d'ól* (second proposal).

and analysed by Armstrong (1975), who demonstrates that there is no simple way to order the components of the derivation of these forms in a way which accounts for these forms. For example, let us propose some underlying form of the past tense particle *do*, which is present in the UR before lenition, and a rule ordered afterwards that deletes the particle before a consonant. An elision rule is also required, for when *do* precedes a vowel. We obtain the derivations in Figure 1.

This ordering incorrectly derives **fhreagair*. However, we cannot specify that *do* deletes before a vowel or /ɾ l/, as we would incorrectly derive **d'rith* 'ran', **d'léigh* 'read' alongside *d'fhreagair*. Similarly, we cannot have a derivation which inserts *d'* after lenition, as there is no obvious way to specify phonologically that *fhreagair* should receive *d'* while *rith*, *léigh* should not. It seems that verbs such as *d'fhreagair*, which I shall refer to as *fC*-initial verbs, present an ordering paradox, whereby the information that conditions the non-deletion of the particle (an initial vowel or *f*) is destroyed by the lenition triggered by the particle itself. A list of such verbs is given in the Appendix.

Armstrong suggests a solution in which *do* is elided to *d'* before a vowel or *f* before lenition occurs, followed by lenition and deletion of remaining *do*; this gives the correct output as in Figure 2. However, as Armstrong himself argues, this specific behaviour of *do* would be at odds with the behaviour of vowel elision in the rest of the language; for example, with the homophonous leniting particle *do* 'your', we see different behaviour before *fC* clusters:

(12) *do fhreagairt (*d'fhreagairt)*

'your answering' (Armstrong 1975: 322)

It is clear that an analysis relying on this special elision behaviour is *ad hoc*, and not particularly well-motivated. In the remainder of this article I propose two analyses, one phonological and one morphological, to better account for this phenomenon.

2 Phonological Analysis

In this section I consider an entirely phonological analysis of this phenomenon, using two autosegmental mechanisms: floating features, used to account for certain assimilation effects in Irish, and latent segments.

2.1 Unpredictable broad/slender assimilation

Several analyses of Irish phonology (in particular Gussmann 1986; Ní Chiosáin 1991; Green 2000) discuss a phenomenon whereby the consonants of certain enclitics become broad or slender in a way which is unpredictable from the quality of the following vowel. For example, consider the following minimal pair:

(13) Consonant quality assimilation (Green 2000: 8)

a. *an úill sin* [ənˠ uːlʲ ʃɪnʲ]

'that apple.GEN'

b. *an Iúil sin* [ənʲ uːlʲ ʃɪnʲ]

'that July.GEN'

In isolation, the words *úill* and *Iúil* are pronounced identically as [uːlʲ], but when preceded by the article *an* /ənˠ/, the final /nˠ/ of the article becomes slender before *Iúil*. Such alternations have been analysed as the presence of an 'underspecified onset' (Ní Chiosáin 1991) in vowel-initial words, to which a preceding consonant assimilates and becomes broad or slender in certain prosodic conditions. These underspecified onsets usually correlate orthographically with an initial <a o u> (indicating broad quality) or <e i> (indicating slender quality). For example, consider *an eolais* [ənʲoːlˠɪʃ] 'the knowledge.GEN', in which orthographic <e> correlates with a previous slender consonant despite the following phonetically 'broad' vowel, or conversely *an oíche* [ənˠiːçə] 'the night', in which <o> correlates with a previous broad consonant despite the following phonetically 'slender' vowel.

2.2 Autosegmental analysis (Gussmann 1986)

Gussmann (1986) presents an analysis of these forms in an autosegmental framework of phonology (e.g. Goldsmith 1976, McCarthy 1981). In his analysis, vowel-initial stems contain an initial consonantal timing slot on a simple[1] CV skeleton, which is linked only to a 'floating' [back] feature representing broad/slender quality. The assimilation effects occur when the melodic content of the final consonant of a

[1] I.e., not mora-based.

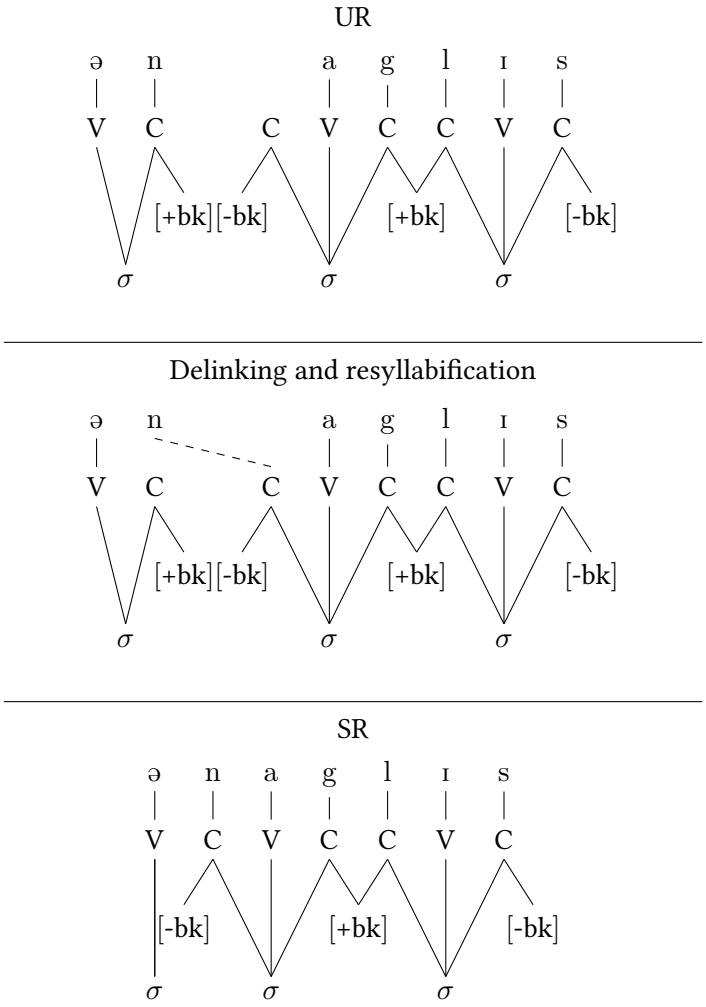

Figure 3 Derivation of *an eaglais* [ənʲaglʸɪʃ] with floating palatalisation (adapted from Gussmann 1986: 895-897).

preceding clitic is delinked from its original timing slot, and associated to this empty timing slot, receiving its [back] specification. In Figure 3, I give a sample derivation for *an eaglais* [ənʲaglʸɪʃ] 'the church', with palatalisation of the underlying /nʸ/.

For words originally beginning in /f/ which have undergone lenition, this assimilation effect still occurs. For example, in *an fheoil* [ənʲoːlʲ] 'the meat', the noun *feoil* /fʲoːlʲ/ is lenited by the feminine nominative singular article *an*, with deletion of the initial /fʲ/. The final /nʸ/ of the article is then made slender, as if the original slender quality of /fʲ/ were 'left behind'.

Gussmann analyses lenition of /f/ as the delinking of its melodic material from its timing slot, such that it is deleted on the surface; however, the timing slot and the associated [back] specification remain. The remaining timing slot allows for resyllabification of the previous consonant in the same way as for other vowel-initial words, as shown in Figure 4 for *an fheoil*.

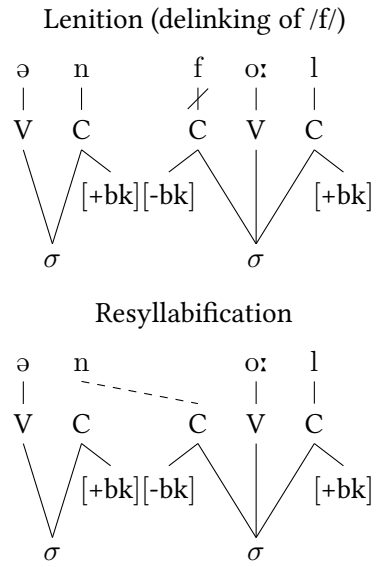

Figure 4 Derivation of *an fheoil* [ənʲoːlʲ] (adapted from Gussmann 1986: 895).

2.3 Latent segment analysis of fC-initial verbs

For *fC*-initial verbs, the same process could be used to explain the distribution of *d'*. I propose an underlying form of *d'* which is simply /d/ with no associated timing slot – a 'latent segment' in autosegmental terminology. This /d/ is able to associate to the empty initial timing slot of vowel-initial verbs, such as *ól*, and surface as [d]. This association occurs after lenition, so for all verbs with original initial /f/, the particle will also link to the empty timing slot left behind by the lenition of /f/. For other consonant-initial verbs, there is no available slot to link to; the unlinked /d/ is then deleted. In Figure 5 and Figure 6, I give derivations of *d'fhreagair* and *léigh* under this proposal.

The underlying form of d' must be a latent /d/ in this analysis, rather than, for instance, *do* /dˠə/. The latter is identical to the underlying form of the second person singular possessive *do* (causing lenition); as pointed out by Armstrong (1975: 322), this *do* does not undergo elision before lenited /f/, giving *do fhreagairt* 'your answering' rather than **d'fhreagairt*. If we also had *do* as the underlying form of the past tense marker, we would expect **do fhreagair*, unless we were to stipulate additional rules for elision and deletion. This rather defeats the purpose of an analysis using only the existing phonological processes of the language.

Furthermore, in order for deletion to occur correctly, the melodic material of *d'* must underlyingly not be associated to any slot on the CV skeleton, otherwise we would predict it to remain in forms such as **d'léigh*, **d'rith* (both /dl/, /dɾ/ being valid initial clusters). Gussmann (1986) proposes latent segments such as these

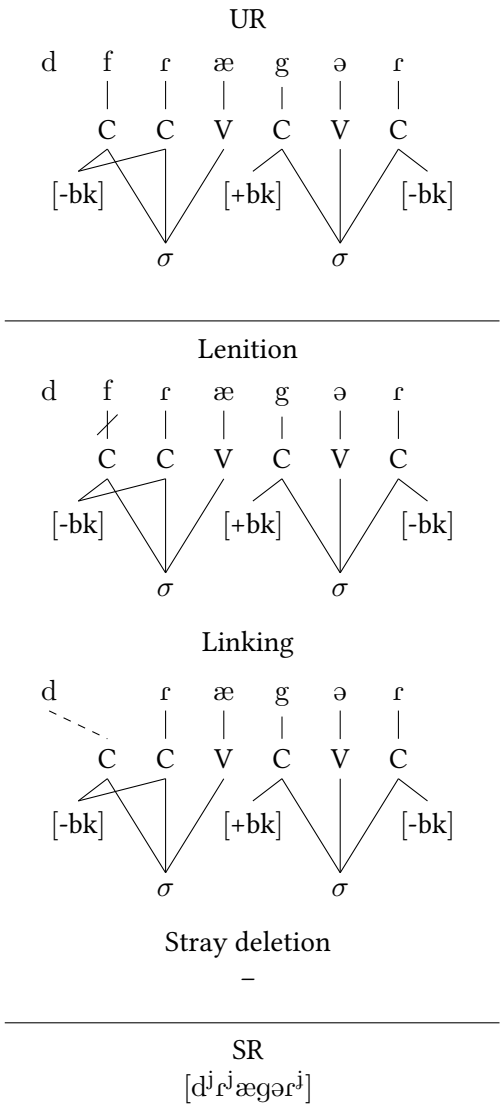

Figure 5 Derivation of *d'fhreagair* [dʲɾʲægəɾʲ].

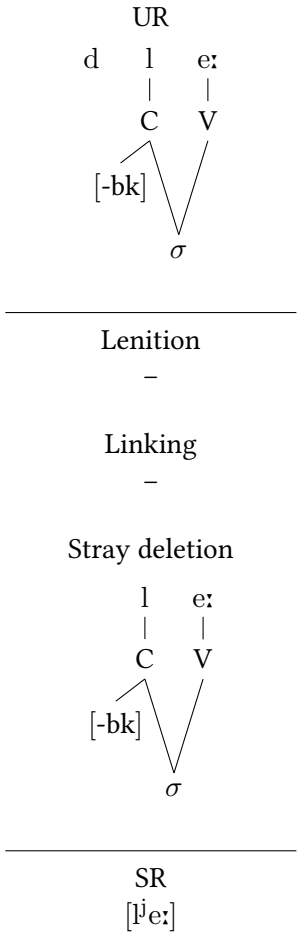

Figure 6 Derivation of *léigh* [lʲeː].

elsewhere in Irish to account for t-prothesis, as in (14):

(14) *uisce* → *an t-uisce*
[ɪʃcə] → [ənˠtˠɪʃcə]
'water.NOM' → 'the water.NOM'

He proposes that the underlying form of the article in this case has a final latent /t/, which surfaces only when followed by a vowel-initial word carrying the empty timing slot to which it can associate (Figure 7); this is the same process as I propose for *d'*. Before consonant-initial words, there is no empty C to which the stray /t/ can attach, and so it deletes.[2] A similar process could be proposed for the allomorphy of the prepositions *trí(d)* /tʲɾʲiː(d)/ 'through' and *le(is)* /lʲɛ(ʃ)/ 'with': these are realised as *trí*, *le* respectively except before the article *an*, where instead we see *tríd*, *leis*.

(15) *tríd*, *leis* before article (examples taken from the online version of Ó Dónaill 1977)[3]

a. ***tríd an*** *sneachta*

'through the snow'

b. ***leis an*** *aois*

'with old age'

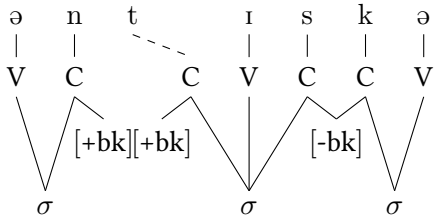

Figure 7 Derivation of *an t-uisce* [ənˠtˠɪʃcə] (adapted from Gussmann 1986: 904).

This suggests the possibility of underlying forms /tʲɾʲiː(d)/, /lʲɛ(s)/ with latent final segments as above. However, these segments only surface before *an*; elsewhere, *trí* is a lenition trigger and does not change before a vowel (16a), while *le* triggers h-prothesis before other vowel-initial words (16b).

[2] Except for some /s/-initial words, such as *súil* 'eye' ∼ *an tsúil*, which also undergo t-prothesis; Gussmann accounts for these with a separate rule.

[3] https://www.teanglann.ie

(16) *trí*, *le* before vowel-initial words

a. *uisce a chur* ***trí fhíon*** /tʲɾʲiː iːnˠ/

'to water wine' (Ó Dónaill 1977)

b. *le* ***h****insint*

'to tell' (Ó Siadhail 1989: 123)

If the underlying form of *trí* contained this latent segment, we would expect **tríd fhíon*; instead, the correct underlying representation must be simply /tʲɾʲiː/, with *tríd* conditioned specifically by a following *an*. For the same reason, we should not postulate a latent segment in *le*, not least because we observe *leis an* [lʲɛʃ ənˠ] with slender /ʃ/, rather than *[lʲɛsˠ ənˠ] as would be expected if there were a latent segment linking to the floating [+back] onset of the following word. For both prepositions, therefore, the allomorphs should be simply listed in the lexicon, and the relevant forms selected in the context of the following article. It seems, then, that t-prothesis as described by Gussmann is the only other context requiring a latent segment analysis.

2.4 Discussion

The advantage of this analysis is that it does not require the addition of any *ad hoc* rules to the derivation, unlike the analysis proposed by Armstrong (1975) (section 1.4). Rather, it utilises mechanisms which are standard in autosegmental phonology: latent segments have been used to analyse similar processes in other languages, as I discuss below, while floating features are already independently motivated within Irish by secondary place assimilation. Nevertheless, here I discuss potential empirical and theoretical objections to this analysis.

Perhaps the most significant issue is an empirical one, namely the robustness of the attestation of secondary place assimilation. Gussmann's (1986) analysis, along with those by Ní Chiosáin (1991) and Green (2000), seem to assume that the assimilation occurs consistently and in line with what is suggested by the orthography, reflecting the historical status of the vowels in question. However, existing fieldwork had already demonstrated beforehand that the picture is not so clear-cut. de Bhaldraithe's (1966) description of Cois Fhairrge Irish, for example, attests variability in assimilation in some forms (17a, b), and some forms where only the unexpected assimilation is attested (17c, d):

(17) Unexpected assimilations (de Bhaldraithe 1966: 53)

a. *an t-iomlán* [ə tʲʊmʟˠɑːnˠ] ∼ [ə tˠʊmʟˠɑːnˠ]

'the full amount'

b. *d'oibrigh* [dˠaɪbʲɾʲə] ∼ [dʲaɪbʲɾʲə]

'worked'

c. *an t-eallach* [ə tˠaːlˠəx] *(expected* *[ə tʲaːlˠəx] *unattested)*

'the cattle'

d. *an t-oileán* [ə tʲɪlʲɑːnˠ] *(expected* *[ə tˠɪlʲɑːnˠ] *unattested)*

'the island'

Further examples of this variability, drawing on other dialect descriptions, are given by Ó Cuív (1986), who attests 'considerable ambivalence' (p.413) in a number of forms. This could indicate that this phonological process has become somewhat unstable or marginal, with some words displaying the place assimilation that would be expected based on their surface phonetics (slender before a front vowel, broad before a back vowel) rather than their historical reflexes. Pyatt (1997: 249ff.) suggests that, since most vowel-initial words show secondary place assimilation in agreement with the surface phonetics of their initial vowel, the exceptional cases could reflect underlying diphthongs, or are simply idiosyncratically lexically specified; under either explanation, she rejects the necessity of floating features entirely. The variability and change in certain forms perhaps supports the view that these alternations are idiosyncratic and lexically specified, with phonologically exceptional words such as *oileán* (17d) changing sporadically over time to become less exceptional; however, it would likely take further analysis of the productions of present-day speakers to determine the extent of this change, and the productivity of the process in general. In any case, the latent segment analysis of *d'* is dependent on the existence of the floating onsets used to account for secondary place assimilation, and so if the validity of those floating onsets is doubtful, so too might the latent segment analysis be.

One potential theoretical objection is the rarity of these proposed latent segments in the Irish lexicon, with them occurring only in two items: *d'* and *an* (in t-prothesis environments). A similar objection is raised by Hansson (2005) in an analysis of Yowlumne, which exhibits unexpected C ∼ ∅ alternations that have been analysed using latent consonants (e.g. Zoll 1998). These latent consonants, appearing in certain affixes, are deleted in order to avoid CCC clusters (18a), which are otherwise resolved through vowel epenthesis when only 'full' consonants are present (18b):

(18) Yowlumne latent segments (Hansson 2005: 109)

a. /ʔaːml-(h)atn/ → [ʔaːm.latn] *(latent (h) deleted)*

'desire for help'

b. /ʔaːml-hat'/ → [ʔaːmil.hat] *(epenthesis)*

'call for help'

Hansson argues that, since latency is a phonological property of an individual segment, we should expect to find latent segments distributed across the inventory of affixes in Yowlumne – that is, they should not be conspicuously limited to a particular set of affixes, in this case a specific set termed 'templatic affixes'. In a

similar way, we might question the explanatory adequacy of proposing a latent segment to deal with only two cases in Irish (*d'* and t-prothesis), when such segments are not otherwise distributed throughout the inventory of Irish particles.

A second theoretical issue is a question of abstractness in general, namely the extent to which it is appropriate to propose latent segments in URs at all. Such analyses are relatively frequent in rule-based approaches to phonology following Goldsmith (1976); examples include those of Yowlumne as above, and of particular segmental alternations in French, as detailed comprehensively by Tranel (1981). For brevity I present just one such phenomenon in French, that of *h-aspiré* words. These are a set of words which are, on the surface, vowel-initial, but behave as if they are consonant-initial with respect to certain common phonological processes, namely elision, liaison and suppletion:

(19) Vowel-initial (*étau*) vs. *h-aspiré* (*héros*) (Tranel 1981: 296-297)

a. Elision
l'étau [leto] *(article 'le' elided)*

'the vise'
le héros [ləero] *(no elision)*

'the hero'

b. Liaison
un certain étau [ɛ̃sɛrtɛneto] *(final consonant of adjective remains before vowel)*

'a certain vise'
un certain héros [ɛ̃sɛrtɛ̃ero] *(final consonant deleted)*

'a certain hero'

c. Suppletion
un nouvel étau [ɛ̃nuvɛleto] *(suppletive form of adjective before vowel)*

'a new vise'
un nouveau héros [ɛ̃nuvoero] *(no suppletion)*

'a new hero'

The 'traditional' analysis (e.g. Selkirk & Vergnaud 1973) is to propose an abstract initial consonant /H/ which drives this unusual behaviour but never surfaces, preventing the listed phonological processes and then deleting afterwards. However, Tranel raises some theoretical and empirical objections to this analysis: first, this /H/ suffers from the same distributional defectivity as the latent segments of Yowlumne, appearing only in this one context. Perhaps more significantly, the behaviour of *h-aspiré* words is by no means uniform or stable. For instance, Tranel notes that the word *hameçon* 'hook', according to Cohen (1963), behaves as if it is *h-aspiré* with respect to liaison (*un hameçon* [ɛ̃amsɔ̃]), but not with respect to elision (*l'hameçon* [lamsɔ̃]) (p.299); he also gives several examples from spontaneous speech where

speakers have treated traditionally *h-aspiré* words as if they were vowel-initial, suggesting that this property may be somewhat unstable or under change. Tranel's analysis is instead that *h-aspiré* words are underlyingly vowel-initial, but idiosyncratically marked with 'rule features'[4] such as [-context Elision] which cause their exceptional behaviour by triggering or blocking a phonological rule; the inconsistent behaviour of words such as *hameçon* is the result of their being marked with some rule features, but not others. Under an abstract segment analysis, this inconsistency is unexplainable. Thus, Tranel opts for a more concrete phonological representation which is true to the surface form, on the basis that the abstract-segment solution oversimplifies the observed variation and change in real-world speech. Further objections Tranel poses are to do with the learnability of similar abstract segments in French. For example, the 'protective schwa', a usually-silent abstract segment proposed to block deletion of a preceding consonant, displays similarly variable behaviour, and reliably correlates only with a final <e> in the orthography. Since children obviously do not have access to orthography during the (early) acquisition process, Tranel argues, this analysis is 'not naturally learnable' (p.294).

There are striking similarities between this case and the Irish one. The phenomenon of secondary place assimilation is apparently unstable to an extent, and so, by Tranel's argument, a rigid analysis involving a highly abstract segment (here, a floating feature) may be less appropriate in accounting for the variation observed in natural speech. Furthermore, the assimilation is highly correlated with orthographic norms, with slender assimilation before <e i> and broad before <a o u>; we cannot say for certain (and not without further empirical study) whether the phonological process is influenced by the adult perception of the orthography, but the same objection of learnability could be raised. Again, since the latent segment analysis of *d'* depends on the autosegmental analysis of this assimilation, questions of the latter's validity are a concern.

We may also consider whether it would be reasonable to propose so abstract a solution as this latent *d'* in a hypothetical Irish′, which had no trace of secondary place assimilation, and therefore did not happen to have the necessary autosegmental structures available to permit this analysis. In this Irish′, we would need to posit both that all vowel-initial words have a floating onset, and that lenited /f/ 'leaves behind' such an onset, for no purpose other than to allow for the surfacing of [d] in the relevant contexts – surely a woefully *ad hoc* solution. In essence, it could be argued that the present phonological analysis is 'piggybacking' onto an already-existing one, which just happens to provide the required structures for the present analysis to function. Perhaps, however, it is irrelevant to consider this counter-factual Irish′, because the fact is that the required autosegmental structures *are* indeed available; I return to this issue in section 4.6, drawing a comparison with a similarly problematic case in Welsh.

[4] Conceptually similar to the diacritics used in DM to trigger mutations; see section 3.

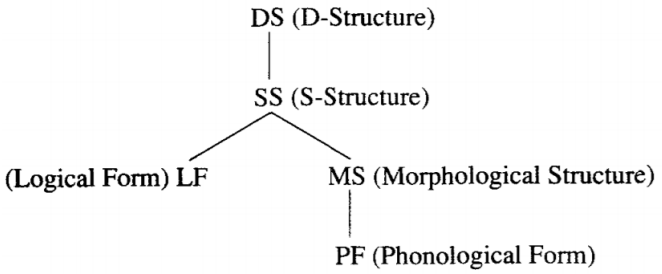

Figure 8 Basic DM architecture (Halle & Marantz 1993: 114).

3 Initial Mutations in Distributed Morphology

Here I present an overview of the Distributed Morphology framework and its application by Pyatt (1997) to initial mutations. I then show that the attested past tense forms of *fC*-initial verbs are incompatible with this model as formulated by Pyatt.

3.1 Summary of Distributed Morphology

Distributed Morphology (hereafter DM), a model proposed by Halle & Marantz (1993), is characterised by 'distribution' of word-formation rules throughout different stages of the derivation. It assumes a Y-model of syntax, but with an additional component of Morphological Structure (MS) between syntax and Phonological Form (PF) as in Figure 8.

The 'lexicon' in DM is split into parts termed the Vocabulary and the Encyclopedia; each Vocabulary Item in the Vocabulary is a pairing of a particular bundle of semantic, syntactic and morphological features with a phonological entry (Halle & Marantz 1994: 275), while the Encyclopedia relates these Vocabulary Items to meanings and real-world knowledge. Only the Vocabulary will be relevant to the current discussion. The input to MS from SS is a hierarchical grouping of terminal nodes consisting of bundles of features, with no phonological specification. In MS, the hierarchical structure may first be modified by Morphological Operations, then by Morphological Readjustment rules which modify the feature content of these terminal nodes themselves. At this point, the derivation still consists only of abstract feature specifications; it is only after all morphological operations have applied that phonological material is introduced in Vocabulary insertion.

Vocabulary Items compete for insertion according to the Subset Principle (Halle 1997), whereby, for a given terminal node, the Vocabulary Item with a set of features matching all, or a subset, of the features of the terminal node has its phonological information realised. Where multiple Vocabulary Items satisfy this condition, the one with the most matching features is inserted.

After Vocabulary insertion, the phonological forms in the derivation may be further modified by blocks of phonological rules. In her particular use of DM, Pyatt (1997) divides these blocks into, in strict order: Phonological Readjustment

rules, which are phonological rules conditioned purely by morphosyntactic features; morphologically-conditioned rules, conditioned both by phonological context and morphosyntactic features; and, finally, exceptionless phonological rules.

3.2 Pyatt's (1997) Model

3.2.1 Mutations in DM

Pyatt (1997) provides a model of initial mutations within the DM framework. The mechanism by which mutations are encoded in the grammar is the diacritic, which is 'a morphosyntactic feature whose sole information content is designating a phonological index as the trigger of a phonological readjustment or a morphologically conditioned phonological rule' (p.83). Diacritics may be listed in the Vocabulary or inserted during Morphological Readjustment, and after Vocabulary insertion, they trigger phonological rules on following words. To illustrate, I give Pyatt's derivation of h-prothesis in the phrase *le hór* 'with gold' (p.106-109). The preposition *le* 'with' has the following entry in the Vocabulary, where {H} signifies the diacritic for h-prothesis:

(20) $/\text{l}^{\text{j}}\text{ə}/ \leftrightarrow [\sqrt{WITH}, \text{P}^{\text{o}}, \{\text{H}\}]$

In Phonological Readjustment, there is a rule of h-insertion triggered by {H}, where M is any morpheme:

(21) $$\varnothing \rightarrow h \;/\; \underset{\{\text{H}\}}{M} \;[\#\_V$$

That is to say, /h/ is inserted before any vowel-initial word preceded by a morpheme bearing the diacritic {H}.[5]

3.2.2 Past tense formation

The ability to insert diacritics at MS allows certain generalisations to be captured more efficiently than simply listing each trigger word with its diacritic in the Vocabulary. For example, Pyatt (p.143-147) notes that all Irish preverbal particles expressing past tense also trigger lenition (see those given in section 1.3; Pyatt also adds *ba* (copula) and *gur* (complementiser) to the list of lenition triggers). This is captured in a single generalisation by a Morphological Readjustment rule for preverbal particles (p.144):

(22) $[\,] \rightarrow [\{L\}] \;/\; [+Past]$

This rule inserts an {L} diacritic, triggering lenition on a following morpheme, on all preverbal particles with the feature [+Past]. At the stage of Phonological

[5] The picture is slightly more complicated than this, as the environment is constrained by syntactic and prosodic considerations; this is discussed in more depth in Pyatt (2003)

Readjustment, this diacritic then triggers a set of phonological rules which perform the phonological process of lenition:

(23) Lenition (Pyatt 1997: 213)
1. f → ∅
2. s → h
3. m → μ
4. [-son] → [+cont]

The outputs of these rules are then 'repaired' by later phonological processes, using the Marking Statement framework of Calabrese (1995). For example, these processes repair [μ] (an alternative representation of [ṽ], which was a phoneme in Old Irish) to [v], the expected outcome of lenition of /m/; the details of these are not relevant here.

3.2.3 Analysis of d'

Pyatt (1997: 166-173) analyses the distribution of *d'* with a deletion rule ordered after mutation. In this analysis, the underlying form of the morpheme is /d/ with a feature [+Past], which is assigned the lenition diacritic {L} in Morphological Readjustment as described above. The morpheme deletes after mutation before a following consonantal onset. This rule must be in the block of morphologically conditioned rules, because it refers both to morphological information (by applying only to a particular item) and phonological information (the onset of the following word). We can formulate this rule as follows:

(24) *d'*-deletion
/d/ → ∅ / _#C

Because this is a morphologically conditioned rule, in the architecture of DM it must occur after all Phonological Readjustment rules, including mutation. As a result, it correctly derives forms such as *chan* 'sang', as in Figure 9.

Although Pyatt does not give an example, it would also correctly derive forms such as *d'ól*, *d'fhás*, as deletion does not apply before a vowel (Figure 10). However, it fails to derive *fC*-initial verbs (Figure 11).

Because the architecture of DM used by Pyatt requires morphologically conditioned rules to be ordered after Phonological Readjustment rules, there is no means

UR	d can
Lenition	d chan
Deletion	chan
SR	*chan*

Figure 9 Derivation of *can* → *chan* (adapted from Pyatt 1997: 171).

UR	d ól	d fás
Lenition	–	d fhás
Deletion	–	–
SR	*d'ól*	*d'fhás*

Figure 10 Derivations of *ól* → *d'ól*, *fás* → *d'fhás*.

UR	d freagair	d fliuch
Lenition	d fhreagair	d fhliuch
Deletion	fhreagair	fhliuch
SR	**fhreagair*	**fhliuch*

Figure 11 Incorrect derivations of *freagair* → **fhreagair*, *fliuch* → **fhliuch*.

by which Deletion could be ordered before Lenition. In any case, even if Deletion were to be ordered before Lenition, we would still be faced with an ordering paradox, as Lenition would not be triggered after the trigger was deleted. As such, there appears to be no solution within DM under a deletion analysis, where the underlying representation of the particle is simply /d/.

In the following section I argue for an alternative analysis within DM in which the distribution of *d'* is analysed as a case of Phonologically Conditioned Suppletive Allomorphy, and show that it may indeed be accommodated within Pyatt's analysis of mutations without recourse to any additional phonological framework as in section 2.

4 Phonologically Conditioned Suppletive Allomorphy

4.1 Summary of phonologically conditioned suppletive allomorphy

Allomorphy, that is, the alternation in the surface realisation of some morpheme (a 'morph') according to surrounding context, can be conditioned by either phonological or non-phonological conditions. Perhaps the most unintuitive type of allomorphy is that where an alternation is conditioned by phonological conditions, but the allomorphs do not share phonological resemblance – rather, the alternation is suppletive. A comprehensive overview of this allomorphy is given by Paster (2006), who terms it *Phonologically Conditioned Suppletive Allomorphy* (PCSA). Paster (2009) later outlines two theoretical approaches for modelling PCSA: the P>>M approach within Optimality Theory (OT) (e.g. McCarthy & Prince 1993) and a subcategorisation approach as previously used in the literature (e.g. Yu 2003). In P>>M, PCSA is derived from the ranking of phonological constraints (P-constraints) above morpho-

/xtˤa-{h, u}/	Max	Dep	Onset	No-Coda
☞ xtˤa-h				*
xtˤa.-u			*!	

/ktab-{h, u}/	Max	Dep	Onset	No-Coda
ktab-h				!*
☞ kta.b-u				

Figure 12 OT tableaux for /h, u/ allomorphy (Mascaró 2007: 717).

logical ones (M-constraints).[6] A simple example of this is the alternation of the 3rd person singular masculine pronominal clitic in Moroccan Arabic, which displays suppletive allomorphs of [h] following a vowel and [u] following a consonant:

(25) [h] ∼ [u] alternation (Mascaró 2007: 717)

a. xtaˤ-h

'his error'

b. ktab-u

'his book'

This is captured simply in an OT analysis (Figure 12), with the underlying form of the clitic as an unordered pair /h, u/, and the constraint ordering Onset >> No-Coda deriving the alternation. In the two cases, the constraints respectively act to avoid marked configurations of vowel hiatus (giving *xtˤa-h*) and a coda (giving *ktab-u*).

A subcategorisation model, on the other hand, would involve listing these affixes along with a particular subcategorisation frame, which can involve morphosyntactic or phonological information. Although Paster does not provide an analysis of this specific case, the subcategorisation frames would presumably be as follows (using Paster's notation):

(26) Subcategorisation frames for /h, u/ allomorphy
-h: [V_]
-u: [C_]

A significant advantage that Paster claims for subcategorisation over P>>M is in dealing with alternations that are not phonologically optimising; such an example is the allomorphy of the perfective suffix in Tzeltal (Mayan), which surfaces as [-oh] after a monosyllabic stem and [-ɛh] elsewhere:

[6] As Paster (2006: 4) notes, McCarthy & Prince (1993) use P to refer to prosodic constraints only, and not phonological constraints in general, as the bulk of their work concerns prosodic alternations. However, in Classical OT there is no reason to distinguish prosodic P-constraints from segmental ones, and in any case Mascaró (2007) (below) uses segmental constraints to analyze PCSA.

(27) Tzeltal perfective suffix allomorphy (Paster 2006: 271)

a. *s-mah-oh*

'he has hit something'

b. *s-maljij-ɛh*

'he has waited for someone'

As Paster argues, in this case there is no reasonable justification referring to surface naturalness for why [-oh] should be preferred following a monosyllabic stem; instead, the alternation is simply arbitrary, with no particular improvement in markedness for one allomorph over the other. Since the basic architecture of OT requires that P constraints refer either to markedness or faithfulness, it is harder to account for this allomorphy in a P>>M model, as no improvement in markedness is offered by the choice of allomorph.

Paster (2009) identifies four key predictive differences between the P>>M and subcategorisation models of PCSA, of which I give the three relevant to this discussion. Perhaps the most significant is that P>>M accounts of PCSA should only ever predict that the allomorph choice is phonologically optimising, a natural consequence of the tenets of OT; in a subcategorisation model there is no such requirement, and so PCSA may also be non-optimising. Secondly, the P>>M model, at least in its original conception in McCarthy & Prince (1993), is able to condition PCSA only on phonological patterns present in the output, because OT constraints apply only to surface phonological forms; this is somewhat dealt with by subsequent iterations of OT, such as Stratal OT, which are better equipped to handle cases of opacity (as summarised by Nevins 2011). In a subcategorisation model, PCSA can be conditioned only by the underlying forms of the relevant items, because allomorph selection occurs before phonological operations. Finally, Paster also predicts that PCSA should only be inward-sensitive, that is, the phonological properties of a stem can condition the selection of an affix, but not vice-versa. In Classical OT there is no such prediction, although again subsequent models such as Stratal OT do indeed separate different stages of word-formation and so may make such predictions.

It is worth noting that these approaches are not mutually exclusive; Booij (1998), for example, advocates the use of phonological constraints in cases where the allomorphy is indeed phonologically optimising, but subcategorisation when it is not. However, I argue below that only a subcategorisation-like approach is appropriate in the Irish case.

4.2 d' ∼ ∅ alternation as PCSA

Returning to Irish, I argue that the distribution of *d'* is not phonologically optimising. In the majority of cases, the presence of /d/ before a vowel could be argued to be optimising in that it provides vowel-initial words with an onset; however, this is not the case for *fC*-initial verbs. In *d'fhreagair*, *d'fhliuch*, there is already a consonant following /d/, so instead a cluster is created – at best, no more optimised than a simple onset. Furthermore, there is no /d/ before verbs such as *rith*, *léigh*, so the

surface patterns are inconsistent: we cannot say that /d/ appears only to create an onset, and nor can we say that it appears before /ɾ l/ to create a cluster. This non-optimisation suggests that a subcategorisation approach may be more appropriate here than P>>M.

I therefore propose a set of listed allomorphs {/d/, ∅} for the past tense marker. The choice of allomorph is conditioned by the onset of the following verb: /d/ is chosen before verbs with initial vowel or /f/ (before lenition occurs), and ∅ is chosen otherwise. Note that this requires a fairly unusual disjunction {V, /f/} (where V is any vowel) as the class of onsets which condition the /d/ allomorph; in Paster's model, there is nothing preventing such a conditioning environment, but I discuss this disjunction in section 4.6.

4.3 Implementation in DM

The mechanism of Vocabulary insertion in DM is not consistently termed 'subcategorisation', but is similar in terms of how it operates: one of a set of phonological forms corresponding to a terminal node is selected based on the features of the surrounding environment. At any rate, Myler & Vaux (2009) group DM with other 'Localist' theories under the umbrella of subcategorisation approaches. As a result, this particular case is fairly simple to implement in a way which is in-keeping with Paster's approach. I propose the following for the insertion of this past tense marker before a verb, borrowing notation from Acquaviva (2014: 563) for the Vocabulary entry of the marker:

(28) Insertion of past tense marker

a. T[v, Tense:Past] → /d/ / _#{V, /f/}

b. T[v, Tense:Past] → ∅ (Elsewhere case)

Both allomorphs bear the Lenition diacritic {L} supplied by the Morphological Readjustment rule in (26), and so lenite the following verb where applicable. Once again, Lenition takes place after allomorph selection in Phonological Readjustment. This analysis requires that the phonological content of the verb following the particle is available during the process of lexical insertion, which in turn requires that the lexical item (the verb root) is inserted before the functional item (the particle); this will be discussed in more detail below.

Here I give illustrative derivations under this analysis, proceeding from the output of Morphological Structure. This analysis correctly derives the absence of *d'* in verbs undergoing lenition such as *chan* 'sang', as well as verbs for which lenition is vacuous, such as *léigh* 'read' (Figure 13). It also correctly derives the presence of *d'* before vowels and *fh* in *d'ól* 'drank', *d'fhás* 'grew' (Figure 14), assuming that between Lenition and the surface form there is some automatic phonological rule assimilating /d/ to the following segment with respect to secondary place, as described in section 2. Finally, *fC*-initial verbs such as *d'fhreagair* are correctly derived, due to the insertion being conditioned on the initial /f/ of the inserted verb root (Figure 15).

Output of MS	T[Past, {L}] $\sqrt{SING}$	T[Past, {L}] $\sqrt{READ}$
Vocab. Ins. – lexical	T[Past, {L}] can	T[Past, {L}] léigh
Vocab. Ins. – (28a)	–	–
Vocab. Ins. – (28b)	∅{L} can	∅{L} léigh
Phon. Readj. – Lenition	∅ chan	∅ léigh
SR	*chan*	*léigh*

Figure 13 Derivations of *can* → *chan*, *léigh* → *léigh*.

Output of MS	T[Past, {L}] $\sqrt{DRINK}$	T[Past, {L}] $\sqrt{GROW}$
Vocab. Ins. – lexical	T[Past, {L}] ól	T[Past, {L}] fás
Vocab. Ins. – (28a)	d{L} ól	d{L} fás
Vocab. Ins. – (28b)	–	–
Phon. Readj. – Lenition	d ól	d fhás
SR	*d'ól*	*d'fhás*

Figure 14 Derivations of *ól* → *d'ól*, *fás* → *d'fhás*.

Output of MS	T[Past, {L}] $\sqrt{ANSWER}$
Vocab. Ins. – lexical	T[Past, {L}] freagair
Vocab. Ins. – (28a)	d{L} freagair
Vocab. Ins. – (28b)	–
Phon. Readj. – Lenition	d fhreagair
SR	*d'fhreagair*

Figure 15 Derivation of *freagair* → *d'fhreagair*.

4.4 Implications for lexical insertion

A key assumption of this analysis is that the phonological information of the verb root is available during the selection of the past tense allomorph, which in turn entails that the verb is itself inserted before the past tense marker. This is an assumption previously made in DM by Bobaljik (2000, 2012) and others in order to account for certain cases of morphosyntactically conditioned allomorphy; here, I will argue it can be used to analyse this case of phonologically conditioned allomorphy. Bobaljik (2000) argues for three basic properties of Vocabulary insertion, of which I give the two that are relevant here:

(29) Assumptions for Vocabulary insertion (Bobaljik 2000: 12)
'cyclicity: [Vocabulary insertion] proceeds root-outwards, and;
rewriting: as morphosyntactic features are expressed by vocabulary items, these features are used up and no longer a part of the representation.'

Notably, Bobaljik assumes that diacritics are introduced at Vocabulary insertion and so are not 'used up' due to rewriting; here, we would have to assume that the mutation diacritics, introduced in MS, are able to survive the rewriting process and trigger Phonological Readjustment rules. Bobaljik (2012: 163-167) later uses diacritics in a similar way during MS (i.e. before Vocabulary insertion) in an analysis of English comparative adjectives, and so this is probably a reasonable assumption to make under his model. A direct consequence of these two properties is that allomorphy conditioned by morphosyntactic features can only be outward-sensitive (i.e. conditioned by nodes further away from the root), because for any node that is undergoing insertion, all nodes closer to the root have already been inserted and so their morphosyntactic features have been rewritten. Conversely, allomorphy conditioned by phonological information can only be inward-sensitive. This latter statement is exactly equivalent to Paster's (2009) claim that a subcategorisation model permits only inward-sensitive PCSA; Bobaljik (2000) does not particularly discuss this, but the idea is developed further by (for instance) Bonet & Harbour (2012). Furthermore, since Vocabulary insertion is completed before the blocks of morphophonological and phonological rules, phonologically-conditioned allomorphy can refer only to the phonological form of an adjacent node at the point of insertion – that is, its underlying form, rather than its surface form. This corresponds to another of Paster's predictions for a subcategorisation model. It seems, then, that Bobaljik's (2000) instantiation of Vocabulary insertion may be a good way to model Paster's predictions about PCSA in general.

4.5 Staggered Insertion in Welsh

A similar use of cyclicity is made by Hannahs & Tallerman (2006) in an analysis of rule-ordering paradoxes involving mutation in Welsh. In Welsh, the definite article has three allomorphs, which are phonologically conditioned: following a vowel-final word, it has the form *'r*, which is not relevant here; otherwise, it has the form *y* before a consonant (30a) and *yr* before a vowel (30b).

(30) Welsh definite article allomorphy (Hannahs & Tallerman 2006: 782-783)

a. *y llyfr*

'the book'

b. *yr afon*

'the river'

As in Irish, the definite article triggers lenition on a following feminine singular noun; in Welsh, it triggers the 'soft mutation', which, among other effects, causes deletion of initial *g*. Definite article allomorphy interacts with *g*-initial words as follows:

(31) *g*-initial words (Hannahs & Tallerman 2006: 785)

a. *glasog* ∼ *y lasog*

'gizzard' ∼ 'the gizzard'

b. *gardd* ∼ *yr ardd*

'garden' ∼ 'the garden'

In (31b) *gardd* ∼ *yr ardd*, the initial *g* of the noun is deleted due to soft mutation; with the resulting form now being vowel-initial, the allomorph *yr* is selected. In (31a) *glasog* ∼ *y lasog*, the noun is still consonant-initial after soft mutation and so *y* is selected. The apparent ordering paradox inherent in this is that the form of the definite article is chosen after mutation takes place, and yet the mutation is triggered by the presence of the definite article. A second functional item displaying a similar allomorphy is the negative subordinate marker *na(d)*, which surfaces as *nad* before a vowel (32a) and *na* elsewhere (32b). The difference, however, is that this marker also causes soft mutation, and yet still surfaces as *na* before a vowel-initial word that has undergone deletion of initial *g* (32c); that is, there is no ordering paradox as for the definite article.

(32) Welsh negative subordinate marker allomorphy (Hannahs & Tallerman 2006: 807-808)

a. *Dywedodd Aled* ***na*** *ddylai Mair fynd.*

'Aled said that Mair ought not to go.'

b. *Dywedodd Aled* ***nad*** *aeth Mair ddim.*

'Aled said that Mair did not go.'

c. *Dywedodd Aled* ***na****/*****nad*** *ofynnodd Mair ddim (radical: gofynnodd 'asked')*

'Aled said that Mair did not ask'

Syntactic structure	[Det	N]
Insertion of content word	–	gardd
Triggering of mutation	–	ardd
Insertion of article	yr	ardd
Output	*yr ardd*	

Figure 16 Derivation of *yr ardd* (adapted from Hannahs & Tallerman 2006: 808).

Syntactic structure	[Det	N]
Insertion of content word	–	gofynnodd
Triggering of mutation	na	gofynnodd
Insertion of article	na	ofynnodd
Output	*na ofynnodd*	

Figure 17 Derivation of *na ofynnodd* (adapted from Hannahs & Tallerman 2006: 808).

Hannahs and Tallerman use staggered insertion to account for these different interactions with mutation, specifically as proposed by Emonds (2002) outside of the DM framework. Emonds (2002) argues for three stages of insertion: Deep Insertion, of items with purely semantic features including nouns, verbs and adjectives; Syntactic Insertion, of items with syntactic features that still contribute to LF; and Late Insertion, occurring at PF and consisting of items without either type of feature. This is a materially different proposal to that of Bobaljik (2000) in the DM framework, being conditioned by feature content rather than hierarchical structure, but it accounts for the ordering problems associated with mutations in a similar way. Hannahs and Tallerman propose that mutation occurs before Late Insertion in this scheme, but after the other two stages. This gives the derivations in Figure 16, Figure 17 for the two cases outlined above.

The way in which DM with cyclic insertion as above would account for these is different. In DM, the case of *y* ∼ *yr* allomorphy is entirely unproblematic: we simply propose a Phonological Readjustment rule such as *yr* → *y* / _#C which operates after mutation, as in Figure 18.[7]

However, it is now the *na(d)* case which is problematic, in the sense that one could not propose a Phonological Readjustment rule to delete *d* before a consonant, or conversely insert it before a vowel, without incorrectly predicting **nad ofynnodd*. This is the same ordering paradox as for *fC*-initial verbs, whereby the mutation caused by the trigger destroys the information which conditions the form of the trigger. Implicit in Hannahs and Tallerman's derivation in (45) is that the form of *na(d)* is conditioned by the phonological form of the following verb, which has

[7] Here I propose that *yr* is the underlying form which is readjusted to *y*, rather than the reverse, because of the existence of the third allomorph *'r*.

Output of Vocab. Ins.	yr{L} gardd	yr{L} glasog
Soft mutation	yr ardd	yr lasog
yr → *y* / _#C	–	y lasog
Output	*yr ardd*	*y lasog*

Figure 18 DM derivations of *yr ardd*, *y lasog*.

UR	yr gardd	yr glasog	nid galwodd
/g/ → [ɣ] (Soft mutation)	yr [ɣ]ardd	yr [ɣ]lasog	nid [ɣ]alwodd
nid → *ni* / _#C	–	–	ni [ɣ]alwodd
[ɣ] → ∅	yr ardd	yr lasog	ni alwodd
yr → *y* / _#C	–	y lasog	–
SR	*yr ardd*	*y lasog*	*ni alwodd*

Figure 19 Derivations of *yr ardd*, *y lasog*, *ni alwodd* (adapted from Ball & Müller 1992: 97).

already been inserted at an earlier stage (Deep Insertion). This is a subcategorisation-like approach as in Paster (2009), rather than one based on surface naturalness (P>>M), even though the surface pattern achieved (avoiding consonant clusters, or conversely avoiding vowel hiatus) is arguably a 'natural' one in all except the edge cases such as *na ofynnodd*. In a DM reformulation of (45), we would have phonological conditioning during Vocabulary insertion as follows (where I represent the abstract feature bundle as NA for ease):

(33) Insertion of NA
1. NA → *nad* / _#V
2. NA → *na* (Elsewhere Case)

This correctly derives *nad aeth* and *na ddylai*, and also derives *na ofynnodd*, because the phonological form of the verb is still the radical *gofynnodd* at the stage at which NA is inserted.

Ball & Müller (1992: 93-97) give an alternative analysis, proposing an intermediate stage [ɣ] in the soft mutation of /g/ which is subsequently deleted later in the derivation. The differing phonological behaviours of *yr* and *ni(d)* (a main-clause negative marker, which behaves like *na(d)*) are derived from the ordering of the rules *nid* → *ni* and *yr* → *y* before and after the deletion of [ɣ] respectively, as in Figure 19.

However, this is incompatible with DM[8], since a context-free phonological rule such as [ɣ] → ∅ obligatorily takes place after all Phonological Readjustment rules, and so the rule *yr* → *y* / _#C could not be ordered after it. Furthermore, the

[8] At least, when sticking to Pyatt's (1997) assumptions

postulation of an intermediate [ɣ] (corresponding to the historical reflex of lenited /g/) arguably suffers from empirical issues similar to those discussed by Tranel (1981) (see section 2.4), since it is never realised on the surface; I therefore reject this analysis in favour of one using staggered insertion.

4.6 Discussion

In section 2.4 I considered whether the plausibility of the proposed phonological analysis of *d'fhreagair* might be different in a hypothetical Irish′, where the required autosegmental mechanisms are not otherwise warranted by the phenomenon of secondary place assimilation; it seems that the case of *na ofynnodd* in Welsh fulfils this role. Consider a phonological analysis of *na ofynnodd* using similar mechanisms to those in section 2: we could propose that soft mutation deletes the melody of /g/ and 'leaves behind' an empty timing slot, and that the d-deletion rule for *nad* is able to use this timing slot as a conditioning environment. However, without any existing process analogous to Irish secondary place assimilation to independently warrant this timing slot analysis, it truly is *ad hoc*: we would be proposing a highly abstract intermediate stage only in order to overcome a single type of ordering problem. Late Insertion in DM, on the other hand, gives an explanation which does not introduce any additional abstract representations, by separating the phonological content of elements from their morphosyntactic behaviour in the derivation. If economy of representation is desirable, then I argue that the DM model is to be preferred in the Welsh case. We must therefore determine the extent to which this is relevant to the Irish case. There is clearly a sense in which the mutations of Irish and Welsh, and indeed of all the Insular Celtic languages, are the 'same' type of process, since all originate from morphologised sandhi phenomena and exhibit the same phonological arbitrariness with respect to their triggers. In the interest of cross-linguistic explanatory adequacy, we might want to use the same resources to deal with similar ordering problems in each language, and thereby minimise the number of competing explanatory mechanisms in use. Therefore, since the Welsh ordering paradox is incompatible with the phonological analysis outlined in section 2, a single analysis of both Welsh and Irish under DM as described above could be neater, and provide more insight as to how we can model the interaction of mutations with other parts of the grammar.

A potential objection to the DM analysis is that it requires the insertion of *d'* to be conditioned on the phonological environment of a following {V, /f/}, where V is any vowel. This disjunction is not a natural class, as there exists no phonological feature or set of features which uniquely specifies these segments to the exclusion of all other segments in the inventory, and so for this reason one could argue that the environment is stipulative. Indeed, this is an issue raised by Nevins (2011) regarding Paster's subcategorisation approach to PCSA overall, which merely lists the phonological environments for insertion arbitrarily even if the allomorphy is to some extent phonologically optimising. However, such 'unnatural' classes are well-attested in the phonological systems of the world's languages, as comprehensively

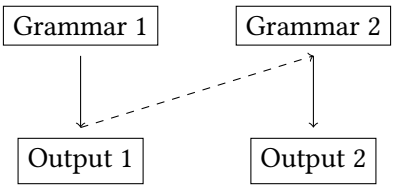

Figure 20 Schema of acquisition through abduction.

detailed by Mielke (2008); moreover, in the following section I suggest a historical analysis which could justify this unusual disjunction.

5 Historical Development and Acquisition

Another perspective that can be brought to bear on the decision between these two analyses is a historical one – that is, what historical and acquisitional pathways could have led to the system as it is observed now, and which analysis could they more plausibly lead to?

In the DM analysis I proposed an 'unnatural' conditioning environment for *d'*-insertion: _#{V, /f/}. However, in all cases except for *fC*-initial verbs, this rule is identical to one which deletes *d'* before a consonant after lenition – as proposed by Pyatt (1997) (subsubsection 3.2.3). This rule is ostensibly more phonologically 'natural', referring to a natural class (consonants) as its conditioning environment, and leading to a less marked outcome, by avoiding initial consonant clusters. Plausibly, a diachronic pathway to the current distribution could have begun with this more natural rule, which later changed and encompassed the edge case of *fC*-initial verbs. The transition between these two grammars can be analysed fairly simply by an abductive model of reanalysis. In such a model, reanalysis occurs because there is no direct link between the grammars of one generation and the next; rather, the child must form a grammar via abduction from the outputs of the previous generation, along with whatever innate principles are available. Figure 20 represents this schematically.

When the acquired Grammar 2 accounts for all or nearly all of the input produced by Grammar 1 and received by the acquirer, yet is somehow different to Grammar 1, a reanalysis has occurred, and the new grammar is liable to start producing new surface patterns not produced by Grammar 1. This model is usually applied to syntactic change, but has also been successfully applied to phonological rule change (see e.g. Andersen 1973).

In this case, let us propose a Grammar 1 along the lines of Pyatt's (1997) analysis, with some Phonological Readjustment rule *d'* → ∅ / _#C taking place after lenition, and a Grammar 2 as set out in section 4. As shown in Figure 21, the vast majority of past tense forms are generated by both grammars; only *fC*-initial verbs are generated by Grammar 2 (*d'*-insertion then lenition), but not Grammar 1 (lenition then deletion).

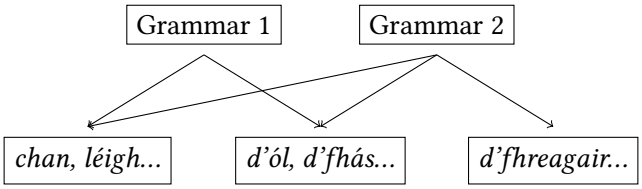

Figure 21 Coverage of hypothetical initial and final grammar.

The number of *fC*-initial verbs is relatively small (see Appendix) and so may not be particularly salient in the input. Thus, it is plausible that a child, faced with the outputs of Grammar 1, would instead hypothesise Grammar 2, which gives the same coverage for nearly all verbs, and effect change only in the small minority of *fC*-initial verbs. This change is reminiscent of other cases of phonological rule inversion, as first analysed by Vennemann (1972), with a rule of deletion before a consonant becoming its complement, a rule of insertion before a vowel. The difference here, of course, is the addition of /f/ into the conditioning environment, which I argue to be a relatively minor change and one well-motivated by the /f/ $\sim \varnothing$ surface alternations caused by lenition. Of course, this explanation relies on the existence and attestation of such a Grammar 1, which would have generated forms such as *fhreagair*, *fhliuch*; more extensive historical analysis, beyond the scope of this discussion, would be required to test this hypothesis. The fact that the original full particle *do* existed in past tense formations until relatively recently, and still persists among some older speakers, would likely complicate the picture further. I propose this change only as a potential pathway by which the conditioning environment _#{V, /f/} could have developed out of a previous phonologically-motivated one.

Such a pathway is harder to formulate for the phonological analysis in section 2. In general, it appears as though not much consideration was given to the acquisition or historical development of latent segments in the autosegmental phonology literature of the 1970s onward; in any case, Gussmann (1986) and Ní Chiosáin (1991) did not consider it. The autosegmental analysis of *d'* requires the spontaneous postulation of a latent segment in order to account for a relatively small number of exceptional verbs. As such, it is arguably a greater 'leap' for the child to make during acquisition, involving the creation of a new abstraction on the basis of presumably rather infrequent evidence (the small number of *fC*-initial verbs). Again, the extent of this 'leap' is also dependent on the robustness of secondary place assimilation as a productive process, since this provides the floating features and associated timing slots that permit the latent segment analysis of *d'*.

There is also the possibility that orthographic norms played a role in the development of this distribution. In *An Caighdeán Oifigiúil*, the first official written standard of Irish, the following is prescribed:

> **d'** roimh Bhriathar
> Cuirtear *d'* roimh ghuta nó *fh-* san áit a mbeadh séimhiú ar chonsan

> san Aimsir Chaite [...], e.g. *d'fhreagróinn*; [...] *an cheist a d'fhreagair sé.*

> **d'** before a verb
> *d'* is placed before a vowel or *fh-* in the place where there would be lenition on a consonant in the Past Tense [...] e.g. *d'fhreagróinn* ['I would answer']; [...] *an cheist a d'fhreagair sé* ['the question that he answered']. (Rannóg an Aistriúcháin 1958, translation LM)

The statement that *d'* appears before a vowel or <fh> unambiguously captures its distribution in orthographic (but not phonological) terms, as lenited <f> is always represented with the unpronounced <fh>; of course, the difficulty of representing this in the spoken grammar is the focus of this discussion. As argued by (Tranel 1981) in his analysis of French protective schwa (section 2.4), orthographic conventions can have influence on phonological rule formation, and so it is possible that this prescriptive norm had such an influence in Irish; again, further analysis and comparison of spoken and written historical records would be needed to investigate this.

6 Conclusions

I have presented two competing analyses of a problematic case of phonologically conditioned allomorphy in the Irish verbal domain: one phonological, based on the dissociation between the timing and melodic tiers in autosegmental phonology, and one morphological, using the mechanism of Vocabulary insertion in Distributed Morphology to account for apparently paradoxical ordering effects. Both analyses appear to account for the observed data, and offer an improvement over previous ones by Armstrong (1975) and Pyatt (1997); the drawbacks of my proposed analyses are more theoretical in nature. The phonological analysis requires the postulation of a latent segment which is near-unique in Irish, which could constitute an unnecessarily abstract and empirically challenging solution. The morphological analysis, on the other hand, fits well with Pyatt's existing DM model of initial mutations by using the mechanism of cyclic Vocabulary insertion, but requires the postulation of an unusual conditioning environment {V, /f/}. Depending on one's theoretical perspective, this unnatural class may render this analysis undesirable. A significant advantage of the latter analysis, however, is in relating this ordering paradox to similar ones in Welsh, and as such providing an arguably more satisfying account of the interaction of Celtic mutations in general with other parts of the grammar. Furthermore, the use of cyclic insertion in DM in this analysis demonstrates another promising use of DM to model PCSA: several of Paster's (2009) predictions for PCSA in subcategorisation models – phonological non-optimisation, stem-based conditioning and inward-sensitivity – are properties exhibited by the behaviour of *fC*-initial verbs in Irish, and are also natural consequences of Bobaljik's (2000) instantiation of DM. These analyses of this case, and similar cases in Welsh, thus contribute to the overall picture of DM as an effective model for capturing context-sensitive allomorphy; as a result, I favour this approach on the basis of theoretical

consistency and explanatory power. Subsequent analysis of the changing usage of *do*/*d'*, as well as of the productivity of secondary place assimilation, may be able to shed more light on the points of theoretical contention discussed for both analyses, and tip the scales further in one direction or the other.

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Appendix

Here I give a non-exhaustive list of *fC*-initial verbs with their attested past tense forms in the *Nua-Chorpas na hÉireann*, a 30-million-word corpus of Irish texts accessed here through SketchEngine (Kilgarriff, Rundell & Uí Dhonnchadha 2006), as well as some other examples found elsewhere on the Internet.

From *Nua-Chorpas na hÉireann*:

fliuch 'wet' (18 tokens):
'**D'fhliuch** an Mharóg a bhosa mar is é a bhí dáiríre'

flosc 'excite' (1 token):
'mar bhí siad lán de dhúthracht agus **d'fhlosc** chun oibre agus chun athruithe'

freastail 'attend' (522 tokens):
'**D'fhreastail** sé ar chúig cinn de na naoi gcruinniú'

freagair 'answer' (1543 tokens):
'Nach í féin a thit ar a cosa i gceart nuair a **d'fhreagair** sí an fógra sin'

fréamhaigh 'take root' (2 tokens):
'agus **d'fhréamhaigh** sé de réir a chéile ar fud na tire'

friotháil 'expect' (1 token):
'**D'fhriothálfaí** fós orthu, bíodh is go mbeadh fanacht acu leis' (N.B. conditional impersonal form)

From other sources:

> *frioch* ‘fry’:
> ‘**d’fhrioch** sé iad i ngréisc’[9]
>
> *frainceáil* ‘be frank’:
> ‘agus a **d’fhrainceáil** sé.’[10]

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[9] https://www.cogg.ie/wp-content/uploads/eureka_irish_9.7.pdf
[10] https://ga.wikipedia.org/wiki/%C3%9As%C3%A1ideoir:MALA2009/%C3%93r%C3%A1id_Gettysburg