Representing Irish Mutations in Distributed Morphology and Optimality Theory

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Abstract[1]

This research develops a novel approach to Irish Consonant Mutation (ICM) by framing these mutations under the theories of Distributed Morphology (Halle & Marantz 1993) and analyzing their effects using Optimality Theory (Prince & Smolensky 1993/2004). Irish Gaelic (henceforth Irish), as well as the other Modern Celtic languages, have a variety of initial phonological mutations which occur in morphosyntactic (and not necessarily phonological) contexts (Fife 2010, Sims-Williams 1998, i.a.). The primary focus of this research is on the mutations that affect word initial consonants. In this paper I show that these mutations are morphemes whose vocabulary items are comprised of autosegmental phonological feature bundles (similar to what has been argued for by Ní Chiosáin 1991, Pyatt 1996, a.o.). These phonological feature bundles are realizations of various inflectional and possibly derivational morphemes which surface as mutation when they interact with other segments in their phonological environments. This analysis permits a simpler system for storing morphemes in the lexicon—one that does not require mutation specifications to be a property of the words that serve as 'triggers' for mutation; nor is there a need to appeal to syntactic structure to derive mutation.

1 Introduction

Irish Mutation occurs in both the verbal and nominal domains. In most cases these mutations are realizations of morphological inflection, which historically took the form of clitics or affixes. These affixes have since lost their phonological segments and presently only phonological features remain to express those morphemes (Sims-Williams 1998, Fife 2010, Ó Baoill 2010, Conroy 2008, a.o.). Synchronically, these morphemes surface as mutation (Lenition or Eclipsis). The following research strives to reinforce this claim and further explain how these phonological alternations can be represented in the lexicon as their own morphemes/Vocabulary Items rather than some phonological property associated with lexical items (Sims-Williams 1998, Ó Baoill 2010, Fife 2010, a.o.) or a process driven by the syntax (Duffield 1997, Iosad 2017, a.o.).

Irish has two main ICM. The first is Lenition, a process in which a consonant is weakened. The primary result of Lenition is that stops become their corresponding fricatives at their given place of articulation or a fricative is debuccalized or deleted. The second mutation is Eclipsis, a process by which a voiceless consonant becomes voiced and/or a voiced consonant becomes its corresponding nasal at its place of articulation. These changes are shown in (1) for each phoneme both orthographically and in IPA.

[1]I would like to thank and acknowledge Matthew Barros and Brett Hyde of Washington University in St. Louis for their help in advising me on this research, which is based on my undergraduate thesis (Pruett 2021). Additionally, I would like to thank Ruth Kramer and Michael Obiri-Yeboah of Georgetown University for their continued support and feedback on this research, as well as the Syntax Reading Group of Georgetown University Linguistics Department and especially Zhousi Luo for the feedback given to me on this paper. Lastly, I would like to thank my Irish teachers Sarah Johnson and Nóirín Ní Shuilleabháin for their input and for their classes from which I took some of the data presented here.

(1)

Orthograph	Phoneme	Lenited Form	IPA	Eclipsed Form	IPA
pa/po/pu	pˠ	pha/pho/phu	fˠ or ɸˠ	bpa/bpo/bpu	bˠ
pe/pi	pʲ	phe/phi	fʲ or ɸʲ	bpe/bpi	bʲ
ba/bo/bu	bˠ	bha/bho/bhu	vˠ or βˠ or w	mba/mbo/mbu	mˠ
be/bi	bʲ	bhe/bhi	vʲ or βʲ	mbe/mbi	mʲ
ma/mo/mu	mˠ	mha/mho/mhu	vˠ or βˠ or w	No Change	No Change
me/mi	mʲ	mhe/mhi	vʲ or βʲ	No Change	No Change
fa/fo/fu	fˠ	fha/fho/fhu	ø	bfha/bfho/bfhu	vˠ
fe/fi	fʲ	fhe/fhi	ø	bfhe/bfhi	vʲ
ta/to/tu	t̪ˠ	tha/tho/thu	h	dta/dto/dtu	d̪ˠ
te/ti	tʲ	the/thi	ç	dte/dti	dʲ
da/do/du	d̪ˠ	dha/dho/dhu	ɣ	nda/ndo/ndu	n̪ˠ
de/di	dʲ	dhe/dhi	ʝ	nde/ndi	nʲ
sa/so/su	s	sha/sho/shu	h	No Change	No Change
se/si	ʃ	she/shi	ç	No Change	No Change
ca/co/cu	k	cha/cho/chu	x	gca/gco/gcu	g
ce/ci	c	che/chi	ç	gce/gci	ɟ
ga/go/gu	g	gha/gho/ghu	ɣ	nga/ngo/ngu	ŋ
ge/gi	ɟ	ghe/ghi	ʝ	nge/ngi	ɲ

These mutations, though, are not purely phonological in nature. Rather, these changes occur in specific morphosyntactic environments (Ó Baoill 2010, Stenson 2020, Duffield 1997, Iosad 2017, a.o.), like specific Tense/Aspect/Mood values in the verbal domain and specific combinations of Case/Number/Gender/Definiteness in the nominal domain.[2].

(2) a. **No mutation in the present tense**
tuig-eann *sí* *Gaeilge* [t̪ˠɪɟən̪ˠ ʃiː geːlʲɟə]
understand-PRES 3.FEM.NOM.SG Irish.FEM.ACC.SG
'She understands Irish'

b. **No mutation in the feminine nominative singular without the definite article**
bean [bʲæn̪ˠ]
woman.FEM.NOM.SG
'a woman'

c. **No mutation in the masculine nominative singular**
fear [fʲærˠ]
man.MASC.NOM.SG
'a man'

d. **Lenition in the past tense**
th*uig* *sí* *Gaeilge* [hɪɟ ʃiː geːlʲɟə]
understand.PAST 3.FEM.NOM.SG Irish.FEM.ACC.SG
'She understood Irish'

[2]Data in this paper comes from a variety of sources. Cited data comes from and is inspired by Stenson 2020 and Ó Baoill 2010. In addition, there is data which comes from examples provided in Irish Language courses I have taken. Said data comes from two native speakers of Munster Irish and Connacht Irish.

e. **Lenition after the definite article for feminine nouns in the nominative singular**
an ***bh****ean* [ənˠ βʲænˠ]
the.DEF woman.FEM.NOM.SG
'the woman'

f. **Eclipsis in the genitive plural**
na ***bhf****ear* [nˠə vʲærˠ]
the.DEF.PL man.MASC.GEN.PL
'the men's'

There are many other situations similar to those given above in (2) which will be further discussed in sections §2 and §3.

The remainder of this paper proceeds as follows: sections §2 and §3 I will discuss the most common situations in which Lenition and Eclipsis apply. Then, in section §4, I will lay out my current analysis and I briefly address previous approaches in describing these phenomena. . I will build off of the previous literature on ICM and construct a framework that unifies some previous approaches under the theories of Distributed Morphology and Optimality Theory. Section §5 concludes.

2 Lenition

Lenition involves two phonological processes. The first process changes the continuancy feature of a consonant (generally this takes the form [-cont.] becomes [+cont.]). This is the change observed in the labial, palatal, and velar stops[3]. The second process is one of debuccalization. This primarily targets coronal consonants and the phoneme /f/. The result is that voiceless coronals become /h/, /f/ undergoes a process of deletion, and /d/ becomes a dorsal fricative (see the examples in (1) for a correspondence between the lenited and unlenited forms). For now, the reader should just be aware that the following generalizations broadly capture the Irish data, but do not account for all the possible alternations. So, Lenition can be captured in the following SPE rules (Chomsky and Hale 1968).

(3) Lenition

a. [-cont.] $\longrightarrow$ [+cont.] / Lenition

b. [+cor.] $\longrightarrow$ [-cor.] / Lenition

Now let us examine some contexts in which Lenition arises in Irish. Lenition in Irish occurs in both the nominal and verbal domains, as stated previously. Generally speaking, Lenition is used in the nominal domain to realize Gender, Number, and Case on nouns and adjectives. In the verbal domain, it is used to denote Tense and possibly Mood[4].

Consider the examples in (4) for instances of Lenition in the Irish Verbal Domain (recall that an *h* after the initial consonant indicates Lenition).

(4) Lenition in the verbal domain

a. **Past Tense: Perfective**

[3]Coronal stops also undergo this change in continuancy. However, they undergo debuccalization as well. As such, they are more complex and do not fit well into this generalization.

[4]The morphosyntactic distinctions between Tense, Aspect, and Mood in Irish are too complex to discuss in this paper. For the purposes of this paper, I will focus primarily on Tense distinctions and leaving open the question of how Tense interacts with Aspect, Mood, and mutation in Irish.

***ch**uaigh sé* *siar* [xuə ʃeː ʃiəɾˠ]
go.PAST 3.MASC.NOM.SG west

'he went westward'[5]

b. **Past Tense: Imperfective**
***ch**eann-aíodh sé* *bláth-anna* [çænˠ̪iː ʃeː bˠɬɑːhənˠ̪ˠə]
buy.PAST-IMPFV 3.MASC.NOM.SG flower-FEM.ACC.PL

'he would buy flowers'

c. **Conditional Mood**
***fh**an-fadh sí* [ɑnˠ̪ˠə ʃiː]
wait.PAST-COND 3.FEM.NOM.SG

'she would wait'

d. **After Negation**
*ní **th**uig-im* *Gaeilge* [nʲiː hɪɟəmʲ geːlʲɟə]
NEG understand-PRES.1.SG Irish.FEM.ACC.SG

'I don't understand Irish'

e. **Relative Clauses**
an múinteoir *a **fh**eic-im* [ənˠ̪ˠ mˠuːnʲtʲorʲ ə ecəmʲ]
DEF teacher.MASC.NOM.SG REL see-PRES.1.SG

'the teacher (whom) I see...'[6]

As shown in the examples in (4), Lenition occurs predominantly in the Past Tense, after negation, and in relative clauses. More specifically, regardless of aspect or mood, all verbs in the Past Tense, whether in a main clause or an embedded clause, occur in the lenited form[7]. Given this generalization, it is reasonable to conclude that the realization of the Past Tense in Irish is, in fact, Lenition and nothing more (aspect and sometimes mood are realized by suffixes). As such, there must be some Past Tense morpheme that results in the surface realization of Lenition (see section §4.2). Furthermore, this analysis can be extended to the negation and relative clause data given in (4) as well.

Having discussed Lenition in the verbal domain, I turn now to Lenition in the nominal domain. Lenition in the nominal domain is much more diverse and expansive than in the verbal domain. That said, all instances of Lenition in the nominal domain are the result of Gender, Number, Case, and Definiteness interactions. All nouns (and pronouns) in Irish have Grammatical Gender (masculine or feminine)[8], Number (singular or plural), and Case (nominative/accusative, genitive, and

[5]Data from Ó Baoill 2010.

[6]Data in examples b, c, and e are from Stenson 2020.

[7]This applies only for consonant initial verbs. For vowel initial verbs, the Past Tense surfaces as a prefix of the form *d'*. Interestingly enough, this prefix also occurs for lenited verbs that begin with /f/. Presumably, since lenited /f/ is silent, the *d'* prefix is added because the deletion of /f/ renders the verb vowel initial in the Past Tense. This interaction between /f/ and the prefix will not be investigated in this paper given space limitations, but this phenomenon should be at least mentioned.

[8]I use Gender in this paper as defined by Kramer 2015. Specifically, the classification of nouns as either masculine or feminine (or any other gender that the language utilizes) is grounded in a semantic core (which for human denoting nouns in many cases can correspond to social gender identity). It is possible that for some human denoting nouns the grammatical gender assigned to that noun does not necessarily correspond with the social gender identity of the person. For example, the word *cailín* 'girl' in Irish is grammatically masculine (Kane et al. 2016). Outside of this core, in some languages, nouns can be assigned grammatical gender arbitrarily. The reader should thus keep in mind that Gender is discussed in its grammatical sense throughout this paper and it does not necessarily correspond to the social gender identity of any human or animate nominal.

dative/prepositional)[9].

Take the examples in (5) of Lenition with feminine nouns.

(5) Lenition with feminine nouns

a. **After the definite article in the nominative/accusative singular**
an ***bh****róg* [ənˠ̪ βˠɾˠoːg]
DEF shoe.FEM.NOM/ACC.SG
'the shoe'

b. **Post-nominal adjectives/other attributives in the nominative/accusative singular**
bróg ***bh****eag*/***ch****apaill*[bˠɾˠoːg βʲæg/xɑpˠɪʌ]
shoe.FEM.NOM/ACC.SG small.FEM.NOM/ACC.SG/horse.MASC.GEN.SG
'a (small/horse) shoe'

As can be seen in (5), feminine nouns in the nominative/accusative singular lenite after the definite article. Additionally, all post-nominal modifiers also lenite if the noun is feminine in the nominative/accusative singular. In addition to these two cases of Lenition with feminine nouns, it should be noted that all nouns, regardless of Gender, lenite after the vocative particle *a* (6). This also goes for any indefinite noun after certain prepositions.

(6) a. *a* ***Mh****áire*/***Sh****eán* [ə mˠɑːɾʲə/çaːn̪ˠ̪]
VOC Mary/Sean.MASC.NOM.SG
'O, Mary/Sean'

b. *do* ***bh****ean*/***ch****ailín* [d̪ˠ̪ə βʲæn̪ˠ̪/xɑlʲiːnʲ]
for woman/girl.FEM/MASC.ACC.SG
'with a woman/girl'

With respect to masculine nouns, Lenition surfaces in the following situations.

(7) Lenition with masculine nouns

a. **After the definite article in the genitive singular**
an ***fh****ir* [ənˠ̪ ɪɾʲ]
DEF man.MASC.GEN.SG
'of the man'

b. **Post-nominal adjectives in the genitive singular and the nominative/accusative plural**
báid ***bh****eag-a* [bˠɑːdʲ βʲægə]
boat.MASC.NOM/ACC.PL small-PL
'small boats'
an ***fh****ir* ***mh****óir* [ənˠ̪ ɪɾʲ βˠoːɾʲ]
DEF man.MASC.GEN.SG big.MASC.GEN.SG
'of the big man'

[9]For nouns, the nominative and accusative cases have collapsed into one and there is no longer any distinction between the two. However, for pronouns there is still a nominative/accusative split. Additionally, the dative case has been referred to elsewhere in the literature as the prepositional case (Fife, Ó Baoill 2010). There is no formal reason for this differentiation. In this paper, I will use the dative to describe this case.

As is evident from (7), masculine nouns undergo Lenition in the genitive singular after the definite article and cause Lenition on the following modifier in the genitive singular and nominative/accusative plural.

It is clear from the data in (5) - (7) that Gender, Number, Case, and Definiteness are distinguished by Lenition in some instances in Irish. For example, in the nominative singular, feminine nouns undergo Lenition but masculine nouns do not. Similarly, in the genitive singular masculine nouns undergo Lenition after the definite article but feminine nouns do not. Finally, masculine nouns in the plural trigger Lenition on the following modifier, whereas feminine nouns do not. It should begin to become clear that Gender, Number, Case, and Definiteness morphemes in Irish can be taken to be Lenition under certain circumstances. And, much like the Past Tense discussed earlier, it should be possible to create morphemes that encode these morphosyntactic distinctions while still triggering Lenition in the phonology.

Finally, before moving on to the other mutation in Irish (Eclipsis) pronouns and occurrences of Lenition must be discussed. Lenition occurs primarily in a single situation for pronouns. Specifically, the singular possessive pronouns trigger Lenition on the following noun (8).

(8) a. *mo* ***mh****adra* [mʸə βʸɑd̪ʸɾʸə]
1.GEN.SG dog.MASC.NOM/ACC.SG
'my dog'

b. *do* ***ch****at* [d̪ʸə xɑt̪ʸ]
2.GEN.SG cat.MASC.NOM/ACC.SG
'your cat'

c. *a* ***bh****ád* [ə βʸɑːd̪ʸ]
3.MASC.GEN.SG boat.MASC.NOM/ACC.SG
'his boat'

BUT

d. *a* *madra* [ə mʸɑd̪ʸɾʸə]
3.FEM.GEN.SG dog.MASC.NOM/ACC.SG
'her dog'

A crucial observation to note at this point concerns the examples in (8c) and (8d). Interestingly enough, even the third person pronoun exhibits the same pattern with respect to Lenition as nouns do (first and second person pronouns make no morphological distinction for masculine and feminine); that is, the masculine pronoun triggers Lenition (8c) but the feminine pronoun does not (8d). This difference provides further evidence that a singular morpheme for the masculine genitive singular can be formulated such that it always results in triggering Lenition. For the plural pronouns, they trigger Eclipsis and they will be discussed in the next section. And so concludes this discussion on the occurrence of Lenition in Irish. Now let us transition to the other Mutation in Irish–Eclipsis.

3 Eclipsis

Eclipsis also involves two phonological processes. The first process changes the nasal feature of a consonant (taking the form [-nasal] becomes [+nasal]). This is the change observed in voiced stops. The second process is one of voicing. This primarily targets voiceless consonants. The result is that a voiceless consonant becomes voiced (see the examples in (1) for a correspondence between the eclipsed and uneclipsed forms). Eclipsis can be captured in the following SPE rules.

(9) Eclipsis

a. [-voi.] ⟶ [+voi.] / Eclipsis b. [-nas.] ⟶ [+nas.] / [+voi.]Eclipsis

Now that the phonological description of Eclipsis has been established, I turn to examining some contexts in which Eclipsis occurs. Eclipsis in Irish occurs in both the nominal and verbal domains, as stated previously. Unlike Lenition, however, Eclipsis is much more limited in its distribution. In the verbal domain, Eclipsis solely occurs after complementizers and when the tense is not Past. Otherwise, in the nominal domain, Eclipsis happens in the dative singular[10] and genitive plural (regardless of Gender). The examples in (10) show instances of Eclipsis in Irish after varying complementizers and for nouns of both Genders in the dative singular and genitive plural.

(10) a. *na* ***bhf****ear/****mb****an*
DEF man/woman.MASC/FEM.GEN.PL
[n̪ˠə vʲærˠ/mˠɑn̪ˠ]
'of the men/women'

b. *an* ***bhf****uil tú* *ag teacht*
COMP.Q COP 2.NOM.SG at come.NMLZ
[ən̪ˠ wɪlʲ t̪ˠuː ɛg tʲæxt̪ˠ]
'are you coming[11]?'

c. *ceap-aim* *nach* ***dt****é-ann* *sé*
think-PRES.1.SG COMP.NEG go-PRES 3.NOM.SG
[cæpˠəmʲ n̪ˠɑx dʲeːn̪ˠ ʃeː]
'I think that he doesn't go'

d. *ar an* ***mb****ord/****gc****apaill*
on DEF table/horse.FEM/MASC.DAT.SG
[ɑrˠ ən̪ˠ mˠɔrˠd̪ˠ/gɑpˠɪʎ]
'on the table/horse'

As can be seen in the examples in (10), Eclipsis occurs on nouns of both Genders after the definite article in the genitive plural (10a) and dative singular (10d). Similarly, Eclipsis surfaces on the verb after the question (10b) and negative subordinate complementizers (10c). This shows that polarity (negative vs. affirmative) and force (declarative vs. interrogative) do not play a role in whether or not the verb that follows is eclipsed or not. That is to say, regardless of the type of complementizer, Eclipsis always occurs on a verb that follows a complementizer in non-past situations (this also holds true for other complementizers like *go*, *dá*, etc.). And so, much like in the discussion of Lenition, morphemes can be constructed such that when they are spelled out they result in Eclipsis. For example, a genitive plural morpheme could have a realization that results in Eclipsis (more on this in section §4). Further evidence that Eclipsis is the universal realization of the genitive plural comes from the plural possessive pronouns, which all trigger Eclipsis on the following noun (11).

[10]Eclipsis only appears after the definite article, otherwise Lenition or no mutation applies depending on the preposition.

[11]In the gloss, NMLZ stands for nominalized. This is because Irish does not have a participle equivalent to 'coming' (this is true for all verbs). Instead, Irish employs a structure whereby the copula is followed by the subject and then a predicate of the form *ag* + verbal noun (the preposition 'at' + nominalized verb).

(11) a. *ár* ***gc****at*
1.GEN.PL cat.MASC.NOM/ACC.SG
[ɑːɾˠ gɑt̪ˠ]
'our cat'

b. *bhur* ***dt****each*
2.GEN.PL house.FEM.NOM/ACC.SG
[βˠʊɾˠ dʲæx]
'your house'

c. *a* ***mb****ád*
3.GEN.PL boat.MASC.NOM/ACC.SG
[ə mˠɑːd̪ˠ]
'their boat'

Now, having outlined the distribution of Lenition and Eclipsis in Irish, I will briefly discuss previous approaches to analyzing these facts and outline this novel approach. Given the length and purview of this paper a full literature review is not possible. As such, the discussion in the next section is not extensive, nor does it touch upon all analyses that have been done. For these reasons, I have provided a few analyses that I find are particularly relevant to the research at hand and leave discussion of further approaches and a lengthy comparison of my approach to said approaches up to future research.

4 Current Approach

This is far from the first work on Irish mutations. A vast literature dating back centuries has grappled with and discussed these aspects of the Irish language. Many have worked on Irish mutations including analyses put forth by Pyatt 1996 & 2003, Ní Chiosáin 1991, Iosad 2017, Green 2006, Duffield 1997, Conroy 2008, among many others[12]. That said, the point of this research is to further the body of literature on this topic and provide a new analysis under a DM and OT framework. Previous approaches to Irish mutation fall into two main groups: syntactic approaches and morphophonological approaches. Syntactic approaches, like those of Duffield 1997, Green 2006, and Conroy 2008, primarily focus on the relationship between functional heads in the syntax (like C, D, T, etc.) and mutation domains. It has been argued that the presence of these functional heads (usually overtly present–Duffield 1997) causes a syntactic process that results in mutation (Lenition for D and T, Eclipsis for C) provided that the functional head trigger c-commands the target of mutation. There is not enough space to address all of these analyses in turn, nor can I give rebuttal to each of these previous approaches to discuss the merits and drawbacks of each approach. That said, this analysis would have trouble accounting for data like that presented in (6) where mutation seems to occur without the overt presence of a functional head C, D, or T.

The other type of approach usually taken for analyzing ICM is a morphophonological one. This type of analysis can take many forms depending on the theory chosen for analysis. For example, some have argued that mutation is a lexical property of the words that serve as triggers for mutation (Iosad 2017, Ó Baoill 2010, etc.). Yet, others have argued that mutation is a realization of autosegmental morphemes comprised of phonological feature bundles (Ní Chiosáin 1991, Pyatt 1996, etc.). In the remainder of this paper I will lay out an approach that builds off of these earlier autosegmental approaches to ICM. I will show that phonological constraint interaction results in

[12]This literature also includes some of the more descriptive work done on Irish mutations like that of Hannahs 2010, Ó Baoill 2010, Stenson 2020, Pruett 2021, a.o.

mutation when certain phonological autosegmental feature bundles are the Vocabulary Items that are spelled out for a given set of morphosyntactic features. The remainder of this section lays out my novel approach to Irish ICM.

This research takes the approach that mutations in Irish are the surface realization of Vocabulary Items which correspond to various morphemes/morphosyntactic features (as is consistent with DM). Primarily, these mutations are the result of Vocabulary Items that are spelled out as autosegmental feature bundles, specifically phonological features, which trigger the surface phonological alternations. This research works under the DM framework for morphology and the OT framework for phonology to explain how these morphemes surface. Given the relationship between mutation and morphosyntax in Irish, a natural question arises concerning how we should represent this information in both the phonology and morphosyntax. If syntax is blind to phonology, then mutation must be a phonological realization of Vocabulary Items inserted after the syntactic derivation is complete (or complete at a given phase[13]). This means that certain nodes in the syntax must correspond to slots where Vocabulary Items are inserted such that the interaction of consecutive Vocabulary Items results in mutation once phonology has applied. This research proposes a set of Vocabulary Items that correspond to the morphemes which trigger mutation. This is akin to the proposals of Ní Chiosáin 1991 and Pyatt 1996 in their work on Irish Phonology and Celtic Mutation respectively. However, unlike those analyses, this research combines the theories of OT and DM in order to account for the surface realizations of these morphemes as opposed to an autosegmental analysis of the data. These morphemes are autosegments in that the phonological features that are the realization of these morphemes can operate independently of segmental phonology. But I assume the phonological computation proceeds in a constraint-based OT model.

4.1 Analysis

In this section I lay out how the patterns described in sections §2 and §3 fit into the theories of DM and OT. First I show how certain morphemes are stored in the lexicon as particular Vocabulary Items in a DM framework. Then, I proceed to show that OT constraint rankings can model how these morphemes interact with the segments that surround them yielding the surface realization of either Lenition or Eclipsis. In this sense I argue that mutation is an epiphenomenon that arises as the result of phonology and is not an intrinsic piece of Irish syntax or morphology. This, therefore, allows for the conclusion to be drawn that neither the Irish lexicon nor Irish syntax require the need to reference/access phonological processes in order to explain mutation. This means that there is no need to posit syntactic operations beyond the widely accepted ones of AGREE and MERGE. Likewise, morphology has no need to access phonology in order for mutation to arise. Mutation is a purely phonological phenomenon.

4.2 Irish Mutation in Distributed Morphology

In section §2 I demonstrated how certain features in the morphosyntax always corresponded to a mutation in the phonological output. For example, Past Tense always surfaces as Lenition or the genitive plural always surfaces as Eclipsis. By mapping morphosyntactic features to phonological feature bundles, it becomes clear how mutation is able to realize such complex morphosyntactic structures. I also showed how Eclipsis and Lenition can be captured by a change in one or more phonological features. As such, it should be possible to map these phonological features to the morphosyntactic features that they realize. Using DM this can be done by formulating Vocabulary Items whose Spell Out is the phonological feature that surfaces as mutation. For example, the genitive plural could be modeled as a morpheme whose Spell Out is [VOICE, NASAL] like in (12).

[13]The intricacies of the syntactic model are not of the upmost importance here. Assuming a Minimalist approach to Syntax (Chomsky 1995, 2000, 2001) Vocabulary Insertion would occur after each syntactic phase is spelled out. That said, I am not sure that this assumption is necessary for this analysis to work.

(12)

$$\begin{bmatrix} \text{DEFINITE} \\ \text{GENITIVE} \\ \text{PLURAL} \end{bmatrix} \longrightarrow \begin{bmatrix} \text{VOICE} \\ \text{NASAL} \end{bmatrix}$$

What (12) shows is that wherever the morphosyntactic features for the genitive plural are present the Spell Out is a morpheme that is [VOICE, NASAL]. And so, when this feature bundle interacts with the next phonological segment that follows it the result will be Eclipsis. A similar type of morpheme triggering Lenition can be formulated like that in (13).

(13)

$$[\ \text{PAST}\ ] \longrightarrow [\ \text{CONTINUANT}\ ]$$

Here, whenever the Past Tense morpheme is present, the Spell Out is [CONTINUANT]. This will result in Lenition on the following segment. In this way, it is possible to formulate morphemes for all of the instances of mutation given in sections §1 through §3 above. For example, take a few more formulations given in (14), like the feminine nominative singular (14a), the masculine genitive singular (14b), the definite dative singular (14c), and the subjunctive (14d).[14]

(14) a.

$$\begin{bmatrix} \text{FEMININE} \\ \text{NOMINATIVE/ACCUSATIVE} \\ \text{SINGULAR} \end{bmatrix} \longrightarrow [\ \text{CONTINUANT}\ ]$$

b.

$$\begin{bmatrix} \text{MASCULINE} \\ \text{GENITIVE} \\ \text{SINGULAR} \end{bmatrix} \longrightarrow [\ \text{CONTINUANT}\ ]$$

c.

$$\begin{bmatrix} \text{DEFINITE} \\ \text{DATIVE} \\ \text{SINGULAR} \end{bmatrix} \longrightarrow \begin{bmatrix} \text{VOICE} \\ \text{NASAL} \end{bmatrix}$$

d.

$$[\ \text{SUBJUNCTIVE}\ ] \longrightarrow \begin{bmatrix} \text{VOICE} \\ \text{NASAL} \end{bmatrix}$$

Now that morphemes and their phonological content have been laid out (both the morphosyntactic feature bundles and phonological feature bundles to which they correspond are stored in the lexicon), it must be shown how OT constraint interaction predicts the outcomes that surface as mutation in Irish. In the next section I will analyze these morphemes under an OT framework to show that basic constraint rankings predict how these morphemes would interact with other segments and how they surface as mutation.

[14]For simplicity's sake, I use subjunctive as the morphosyntactic feature that is realized as Eclipsis for any verb that follows a complementizer. This would imply that complementizers select for verbs in the subjunctive. It is outside the purview of this paper to investigate whether or not this generalization holds. For the purposes of this analysis, however, this does not matter so subjunctive could be replaced by any post-complementizer feature. Furthermore, this analysis hinges on the complementary distribution of this subjunctive and the Past Tense. The true nature of the morphosyntax of the Past Tense and the subjunctive is still an open question for research. Regardless of the stance taken, as long as the subjunctive and the past tense are realized such that Past Tense is more crucial for realization than the subjunctive, the predicted result will arise.

4.3 Irish Mutation in Optimality Theory

In the previous section it was shown that initial mutation in Irish can be captured morphologically using DM. These morphemes are spelled out as autosegmental phonological feature bundles. In this section, I will demonstrate using OT that the surface realization of mutation can be captured by constraint rankings. As stated previously, Lenition can be captured by the presence of a preceding [CONTINUANT] feature and Eclipsis by [VOICE, NASAL]. Since these features are what change under the context of mutation it is reasonable to assume that there should be faithfulness constraints related to these features. Thus, I propose the following IDENTITY constraints (McCarthy 2008) in example (15).

(15) IDENTITY[CONTINUANT] (IDENT[C/V/N])[15]: Assign a violation for every segment in the output whose CONTINUANT/VOICE/NASAL feature specification is different from the input.

Furthermore, in theory, Lenition or Eclipsis could be realized by the insertion of some segment to realize the features in the autosegmental bundle. Similarly, it is just as possible that the grammar simply could delete all non-segmented phonological features resulting in the deletion of said morpheme. Given these possibilities, two other constraints must be employed–DEP and MAX[16].

These constraints give a good foundation for beginning to examine the phonological effects of the morphosyntactic structure laid out in the preceding sections of this paper. To begin let's examine two straightforward derivations using these constraints. In order to compare the results, it makes sense to look at the interaction of the third person possessive pronouns since they all have the same surface realization, *a*, but they differ in which mutation they trigger. The following are the Vocabulary Items to derive 'his/her/their cat' (16).

(16)

$$[\ \text{3RD PERSON}\ ] \longrightarrow \begin{bmatrix} a \\ [\text{ə}] \end{bmatrix}$$

$$[\ \text{CAT}\ ] \longrightarrow \begin{bmatrix} cat \\ [\text{kat}^{\text{y}}_{\text{n}}] \end{bmatrix}$$

$$\begin{bmatrix} \text{MASCULINE} \\ \text{GENITIVE} \\ \text{SINGULAR} \end{bmatrix} \longrightarrow [\ \text{CONTINUANT}\ ]$$

$$\begin{bmatrix} \text{GENITIVE} \\ \text{PLURAL} \end{bmatrix} \longrightarrow \begin{bmatrix} \text{VOICE} \\ \text{NASAL} \end{bmatrix}$$

$$\begin{bmatrix} \text{FEMININE} \\ \text{GENITIVE} \\ \text{SINGULAR} \end{bmatrix} \longrightarrow [\ \text{ø}\ ]$$

Using these Vocabulary Items and the constraints outlined above the following derivations can be done[17].

Table 1

[15]Given that continuancy is only at play for Lenition and nasality and voicing for Eclipsis, in the following derivations the IDENTITY constraints used will only correspond to those which target the feature(s) of interest for any given mutation (i.e., IDENT[C] will not appear in derivations focusing on Eclipsis).

[16]DEP: Assign a violation for every segment in the output which is not present in the input.
MAX: Assign a violation for every feature bundle in the input that does not have a corresponding realization in the output.

[17]For insertion candidates, n will be inserted for [VOICE NASAL] and h for [CONTINUANT].

ə [CONTINUANT] **kɑtˠ̪**	DEP	MAX	IDENT[C]
☞ a. ə xɑtˠ̪			∗
b. ə kɑtˠ̪		∗!	
c. ə h kɑtˠ̪	∗!		

As should be clear from **Table 1**, in order for Lenition to surface in *a chat* 'his cat', IDENTITY[CONTINUANT] must be ranked below both DEP and MAX. Now take the tableau in **Table 2** for the phrase *a gcat* 'their cat'.

Table 2

ə [VOICE NASAL] **kɑtˠ̪**	DEP	MAX	IDENT[N]	IDENT[V]
☞ a. ə gɑtˠ̪				∗
b. ə kɑtˠ̪		∗!		
c. ə n kɑtˠ̪	∗!			
d. ə ŋɑtˠ̪			∗!	∗

From **Table 2** it is clear that in order for voiceless consonants to become voiced under Eclipsis as opposed to also becoming nasal (a possibility given the features in the autosegmental bundle) IDENT[N] must be ranked above IDENT[V]. While this explains the behavior of the voiceless consonants, this does not give us any information about the behavior of voiced consonants. Nor does this ranking provide any insight into the ranking of the other constraints DEP and MAX with respect to IDENT[N]. For this, it is necessary to look at another example of Eclipsis, albeit with the initial consonant voiced. Consider the derivation for the example in (17) below with the relevant DM Vocabulary Items (I am only using the VIs that make up the words needed to derive the mutation, all other words of the sentence are not relevant to the points made here) as well as the OT tableau.

(17) *an* *nglan-ann* *tú* *do* *sheomra*
COMP.Q CLEAN-PRES 2.NOM.SG 2.GEN.SG room.ACC.SG
'do you clean your room?'

$$\begin{bmatrix} \text{COMPLEMENTIZER} \\ \text{QUESTION} \end{bmatrix} \longrightarrow \begin{bmatrix} \textit{an} \\ [\text{ən}^{\text{ˠ}}_{\text{̪}}] \end{bmatrix}$$

$$[\ \text{SUBJUNCTIVE/POST-COMPLEMENTIZER}\ ] \longrightarrow \begin{bmatrix} \text{VOICE} \\ \text{NASAL} \end{bmatrix}$$

$$[\ \text{CLEAN}\ ] \longrightarrow \begin{bmatrix} \textit{glan} \\ [\text{glan}^{\text{ˠ}}_{\text{̪}}] \end{bmatrix}$$

$$[\ \text{PRESENT}\ ] \longrightarrow \begin{bmatrix} \textit{ann} \\ [\text{ən}^{\text{ˠ}}_{\text{̪}}] \end{bmatrix}$$

Table 3

ənˠ̪ [VOICE NASAL] **glanˠ̪-ənˠ̪**	DEP	MAX	IDENT[N]
☞ a. ənˠ̪ ŋlanˠ̪-ənˠ̪			∗
b. ənˠ̪ glanˠ̪-ənˠ̪		∗!	
c. ənˠ̪ n glanˠ̪-ənˠ̪	∗!		

From this example we can establish an overall ranking for Lenition and Eclipsis, so far, with respect to the realization of mutation over insertion or deletion. This ranking is given in (18).

(18) a. DEP, MAX » IDENTITY[CONTINUANT] = Lenition
b. DEP, MAX » IDENTITY[NASAL] » IDENTITY[VOICE] = Eclipsis

If only it were as simple as this to explain Irish ICM. While these constraints cover the difference between voicing and nasality in Eclipsis and accounts for the change in Lenition, one must ask if this is the only way to account for the data. Take (19) for example.

(19) *bróg bheag*
shoe small
'a small shoe'

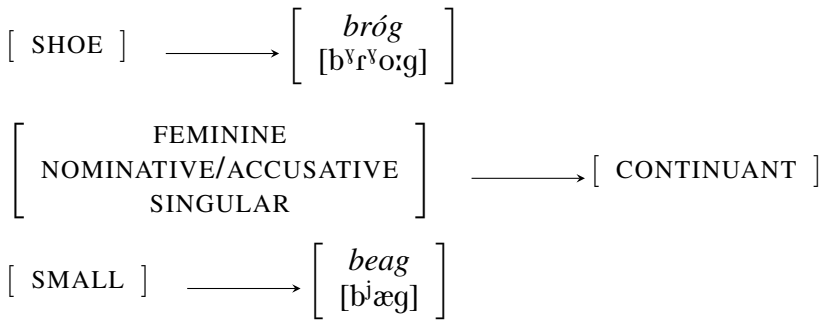

Table 4

bʸɾʸoːg [CONTINUANT] **bʲæg**	DEP	MAX	IDENT[C]
a. bʸɾʸoːg βʲæg			*
b. bʸɾʸoːɣ bʲæg			*
c. bʸɾʸoːg bʲæg		*!	
d. bʸɾʸoːg h bʲæg	*!		

As can be seen in **Table 4**, if the word before the mutation morpheme ends in a phoneme that can undergo Lenition and the word following the mutation morpheme begins with a phoneme that can undergo Lenition, then the constraints that we have at the present moment cannot determine an optimal candidate. As such, another constraint must be introduced to account for the fact that mutation is realized at the start of the following word and not the end of the preceding one. To find such a constraint it is important to consider in which direction the autosegmental features are docking (McCarthy & Prince 1995). It is clear in all instances of mutation that the features dock to the left edge of the word directly to its right. In other words, it docks to the left edge of the following word. This behavior can be captured in the following featural ALIGNMENT constraint (McCarthy & Prince 1995, McCarthy 2008).

(20) ALIGN[Feature, Left](ALIGN[L]): Assign a violation for every instance of an autosegmental feature in the input that is not aligned at the left edge of a word in the output.

With this new constraint it is possible to achieve the desired optimal candidate for **Table 4** seen below in **Table 5** with the new constraint.

Table 5

bʸɾʸoːg [CONTINUANT] **bʲæg**	DEP	MAX	ALIGN[L]	IDENT[C]
☞ a. bʸɾʸoːg βʲæg				*
b. bʸɾʸoːɣ bʲæg			*!	*
c. bʸɾʸoːg bʲæg		*!		
d. bʸɾʸoːg h bʲæg	*!			

With this additional constraint it is possible to derive a final overall ranking to capture the phonological behavior of mutation in Irish (see example (21)). I will note that this section has left out discussion of the coronal phonemes and /f/ mentioned in section §2. The reason for this is that the coronals require phoneme specific constraints that target just the set of coronal consonants (e.g. d̪ˠ becomes ɣ) and for lack of space these cannot be discussed here. That said, since those constraints only affect the outcome of a single segment and is not a property of mutational behavior *per se*, it can be assumed that they have no bearing on the overall ranking established here to account for Lenition and Eclipsis and should be investigated further in subsequent research. The ranking for Lenition and Eclipsis in Irish can be captured as follows[18].

(21) a. DEP, MAX, ALIGN[LEFT] » IDENT[CONTINUANT] = Lenition
b. DEP, MAX, ALIGN[LEFT] » IDENT[NASAL] » IDENT[VOICE] = Eclipsis

4.4 Results

This research has argued for an analysis of Irish Initial Consonant Mutation (Lenition and Eclipsis) in which morphemes are spelled out as bundles of phonological features which cause phonological mutation under a DM and OT framework. Specifically, Lenition is triggered by morphemes that are spelled out as [CONTINUANT] and Eclipsis is spelled out as [NASAL VOICE]. An OT analysis of the phonology of these mutations shows that Irish has IDENTITY constraints as the lowest ranked in any derivation. I argue that mutation in Irish is a purely phonological phenomenon and happens independent of the morphosyntax. That is, mutation in Irish is no different than any other morphophonological alternation whereby morphemes have different realization because of their phonological environment. In this sense mutation is epiphenomenal in that it only surfaces as a result of morphophonological alternation and not as a result of some intrinsic property of Irish morphosyntax. This is different than other theories that argue for a more complex system whereby mutation cannot be explained by phonology alone and must require some sort of morphosyntactic property in order to explain the distribution of mutations in Irish. Furthermore, to the best of my knowledge, this research is first in analyzing Irish ICM under a DM and OT framework.

5 Conclusion

In this paper I have established a new analysis of Irish Initial Consonant Mutations using a Distributed Morphology and Optimality Theory framework (the first of such approaches to the best of my knowledge). This research combines different aspects of previous approaches to Irish mutation, especially those by Ní Chiosáin 1991, Pyatt 1996 & 2003, i.a., who have examined the autosegmental nature of mutation morphophonology in Irish, in order to establish a new way of looking at Irish mutation (and possibly Celtic mutation in general). This research has shown that initial mutation in Irish can be captured by a set of morphemes whose spelled out Vocabulary Items correspond to autosegmental phonological feature bundles. Furthermore, this research demonstrates that these feature bundles interact with the surrounding segments in their phonological environments resulting in overt mutation. These alternations are the product of the interactions as subject to the constraint rankings outlined in (21) above. By ranking ALIGNMENT, DEP, & MAX above IDENTITY constraints the correct surface forms are achievable.

Future work would ideally capture more aspects of Irish mutation using this approach. Preliminary investigation suggests that further OT constraints can be used to explain the behavior of the coronal phonemes and /f/ when undergoing mutation. Additionally, it is possible that this approach

[18]Note there are two rankings here because there are two separate phonological processes. They are not separate rankings in the sense of Cophonologies (Inkelas & Zoll 2007).

is compatible with a Phase Theory of Syntax (Chomsky 2000 & 2001) and as such mutation domains can be established through phases. Open questions surrounding how this approach extends outside of Irish Gaelic are possible as well. For instance, it would be interesting to extend this approach to the other Celtic Languages. Finally, this research makes the prediction that Lenition and Eclipsis are productive in Irish; something that is worth exploring in an experimental capacity.

REFERENCES

Chomsky, N. 1995. The Minimalist Program Cambridge, MA: The MIT Press.

Chomsky, N. 2000. Minimalist Inquiries: The Framework. In *Step by Step: Essays in Minimalist Syntax in Honor of Howard Lasnik*. 89-155.

Chomsky, N. 2001. Derivation by Phase. MIT Occasional Papers in Linguistics 18.

Chomsky, N. & M. Halle. 1968. *The Sound Pattern of English*. New York: Harper & Row.

Conroy, K. 2008. Celtic Initial Consonant Mutations - nghath and bhfuil?. MA: Boston College.

Duffield, N. 1997. Configuring Mutation in Irish. *Canadian Journal of Linguistics* 42. 75-109.

Fife, J. 2010. Typological Aspects of the Celtic Languages. In *The Celtic Languages*, ed. by M. J. Ball & N. Müller, 3-27. Abingdon, UK: Routledge Taylor & Francis Group.

Green, A. 2006. The Independence of Phonology and Morphology: The Celtic Mutations. *Lingua* 116. 1946-1985.

Halle, M. & A. Marantz. 1993. Distributed Morphology and the Pieces of Inflection. In *The View from Building* 20, ed. by K. Hale & S. J. Keyser, 111-76. Cambridge, MA: MIT Press.

Hannahs, S. J. 2011. Celtic Mutations. In *The Blackwell Companion to Phonology*, ed. by M. van Oostendorp, C. Ewen, E. Hume & K. Rice, 2807-2830: Blackwell Publishers.

Inkelas, S. & C. Zoll. 2007. Is Grammar Dependence Real? A comparison between cophonological and indexed constraint approaches to morphologically conditioned phonology. *Linguistics* 45. 133-171.

Iosad, P. 2017. Celtic Mutations. In *Oxford Bibliographies Online Datasets*.

Kane, F., R. Folli & C. Sevdali. 2016. Irish Genitive Phrases The Pseudo-Construct State. *Rivista di Grammatica Generativa* 38. 173-185.

Kramer, R. 2015. *The Morphosyntax of Gender*. Oxford Academic Publishers.

McCarthy, J. 2008. *Doing Optimality Theory: Applying Theory to Data*. Blackwell Publishers.

McCarthy, J. & A. Prince. 1995. *Faithfulness and Reduplicative Identity*.

Ní Chiosáin, M. 1991. Topics in the Phonology of Irish. Amherst, MA: University of Massachusetts.

Ó Baoill, D. 2010. Irish. In *The Celtic Languages*, ed. by M. J. Ball & N. Müller, 163-229. Abingdon, UK: Routledge Taylor & Francis Group.

Prince, A. & P. Smolensky. 1993/2002/2004. *Optimality Theory: Constraint Interaction in Generative Grammar*, ed. R.U.C.f.C. Science & U.o.C.a.B.C.S. Department. Blackwell Publishers.

Pruett, J. 2021. Reconciling Diachronic and Synchronic Analyses of Lenition and Eclipsis in Irish Gaelic: An Optimality Theoretic Approach. St. Louis, MO: Washington University in St. Louis.

Pyatt, E. 1996. An Integrated Model of the Phonology and Syntax of Celtic Mutation. Cambridge, MA: Harvard University.

Pyatt, E. 2003. Relativized Mutation Domains in the Celtic Languages. *University of Pennsylvania Working Papers in Linguistics* 9.

Sims-Williams, P. 1998. The Celtic Languages. In *The Indo-European Languages*, ed. by A. G. Ramat & P. Ramat. Routledge Taylor & Francis Group.

Stenson, N. 2020. *Modern Irish A Comprehensive Grammar*. New York: Routledge.