

*Mutation in Celtic*¹

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The Celtic languages are characterized by an elaborate system of alternations of word-initial segments, traditionally known as ‘consonant mutations’. Although historically they arose from across-the-board phonological sandhi, they are now deeply embedded in morphosyntactic processes. They are relatively phonologically coherent, but also non-concatenative, and sensitive to a wide range of lexical, morphological, syntactic, and semantic factors. As a result, Celtic mutations present an important test bed for theories of word structure and its interactions with both phonology and morphology. This chapter describes the principal mutation patterns across the Celtic languages, and aims to pinpoint those questions that are of particular importance for theoretical progress.

1 Introduction: Celtic mutations and non-concatenative morphology

The initial consonant mutations of the Celtic languages have attracted significant interest from theoretical linguists not only because of the apparent rarity of the phenomenon, but also because of the way in which they integrate information from distinct components of grammar. Especially striking is mismatch between the relatively restricted range of phonological exponents — even the most complex system, that of Modern Breton, involves at most five different ‘grades’, most of which have visibly different effects only in a modest subset of language’s segments — and the fact that mutations function as exponents of numerous morphological and syntactic distinctions.

Celtic mutations are particularly important to theorists as an example of an elaborate system of non-concatenative exponence, which potentially deals a fatal blow to piece-based, Item-and-Arrangement theories of morphology. Indeed, proponents of alternative models often cite Celtic mutations precisely in this capacity (e.g. [S. R. Anderson 2015](#), [Stewart 2016](#)). Equally noteworthy, however, is the research programme exploring the proposition that such non-concatenative exponence is not probative, because it can after all be derived by a combination of concatenating phonological material and the action of regular phonological rules. [Bermúdez-Otero \(2012\)](#) dubs it ‘Generalized Non-Linear Affixation’; for examples beyond Celtic mutations, see, for instance, [Stonham \(1994\)](#); [Bye & Svenonius \(2012\)](#) [Zimmermann \(2017\)](#). In this chapter, I make two principal arguments. First, and more narrowly, I contend that the piece-based approach is not as hopeless a tool for analysing Celtic mutations as it is sometimes made out to be. Second, and more generally, I argue that the analysis of Celtic mutations is highly sensitive to numerous background assumptions regarding both phonological and morphosyntactic architectures, and therefore it is exceedingly difficult to construct decisive empirical arguments in favour of either approach. If such truly probative arguments are to be found at all, it will be in a framework that pays due attention to the architectural affiliation of the multifarious phenomena covered by the traditional label of ‘mutation’

An adequate analysis of initial mutation requires an explicit account

of both its exponence — the phonological changes involved — and the morphosyntactic circumstances in which they are triggered. I offer a fairly detailed account of the former in section 2, and give an overview of the contexts where they occur in section 3. Section 4 briefly discusses what morphosyntactic objects are targeted by mutation. In section 5 I give an overview of cases where the target of mutation is not adjacent to its trigger, and section 6 discusses whether it is possible to implement the mutations within the phonological grammar. Finally, I summarize and evaluate the different approaches to mutation in section 7.

2 Approaching Celtic initial mutations

Observationally, the so-called ‘initial mutation’ systems of the Celtic languages involve alternations affecting the initial segments of words in a wide range of contexts, which often have to be described with reference to morphology or syntax. To take an example from Modern Welsh, the word *cath* ‘cat’ can occur in several forms, differing solely in the initial consonant: [k^ha:θ] in isolation (and in many syntactic contexts), but [ga:θ] in a sequence like *y gath* ‘the cat’, [ŋ^ha:θ] in a phrase like *fy nghath* ‘my cat’, and [χa:θ] in *a chath* ‘and a cat’. In the same contexts, the noun *tref* ‘town’, appears as [t^hre:v] in isolation, as [dre:v] in *y dref* ‘the town’, as [ŋ^hre:v] in *fy nhref* ‘my town’, and as [θre:v] in *a thref* ‘and a town’. For the sake of explicitness, I will adopt the terminology of Merrill (2018). He defines a mutation *grade* as ‘the set of consonants² which can appear in a particular grammatical environment or set of environments’: in the Welsh case, there are four grades, represented in these two items as the aspirated stops [t^h k^h], the voiced stops [t d], the voiceless nasals [ŋ^h ŋ^h], and the voiceless fricatives [θ χ]. Further, Merrill defines a mutation *series* as ‘the set of consonants that can alternate within a given morpheme’: in the Welsh example, the morpheme for ‘cat’ is associated with the series [k^h g ŋ^h χ], and the morpheme for ‘town’ with the series [t^h d ŋ^h θ].

In this section, I will present the descriptive generalizations about the phonological alternations included in the mutation systems of the (Insular) Celtic languages. Mutation systems are found both in both subgroups of Celtic: Brythonic (Welsh, Cornish, and Breton) and Goidelic, or Gaelic (Irish, Scottish Gaelic, and Manx), and ultimately go back to processes of sandhi that acted both within and across word boundaries. Compare a Proto-Celtic form like **bukk-os* ‘goat-NOM.SG’, with initial *b*, with *to bukk-ūi* ‘to goat-DAT.SG’, with **b > v* in intervocalic sandhi, yielding present-day alternations like Irish *boc ~ do bhoc*, Welsh *bwch ~ i fwch*.

A note of caution is in order regarding the nature of the data. In many cases, the description focuses on prescriptive standards. Their mutation system is broadly representative of the patterns in most traditional varieties of each language. Where the description concerns languages of earlier periods (as well as the special cases of Cornish and Manx³), the full range of variation observed in the written sources cannot, of course, be covered here. Furthermore, the social and demographic changes affecting the communities where Celtic languages are spoken in the present day have also led to changes in the functioning of mutation, often interpreted as attrition of the traditional patterns. In this paper I will generally overlook these issues for reasons of

² More precisely, segments: as we shall see, the Celtic mutation systems also involve vowels (and possibly other kinds of phonological objects).

³ Most descriptions of these languages build primarily on written attestations from the mediaeval and/or early modern period. For some discussion of the patterning of mutation in Revived Manx, see Lewin (2016).

focus (but see, for instance, Jones 1998, Adger 2017, Kennard 2019).

2.1 Notation

The languages all have their separate descriptive traditions and terminology for the initial mutations. To highlight the similarities across the systems, and simplify the presentation of the data, I will use a notation borrowed from King (2003) and adapted to the other Celtic languages. Where a lexical item consistently triggers a mutation, I will use the relevant symbol after the item; where a word has undergone the mutation, I will place the symbol before it. I will use the following symbols:

- The degree symbol $^{\circ}$ for the mutation grade associated with triggers that were vowel-final in Proto-Celtic, generally called *lenition*, except in the case of Welsh, where it is referred to as the *soft mutation*
- The superscript symbol n for the mutation grade associated with triggers that ended in nasals in Proto-Celtic, called the *nasal mutation* in the case of the Brythonic languages in practice only Welsh, as it has been all but entirely lost in Breton and Cornish but *eclipsis* in the case of the Gaelic languages.
- The superscript symbol h for the ‘aspirate mutation’ of Welsh and the ‘spirantization’ of Breton, where it is triggered by triggers that primarily used to end in Proto-Celtic *s. In the Gaelic languages, this symbol will be used for the so-called *s-sandhi*, which only affects initial vowels.
- The superscript symbol p for ‘provection’, a mutation pattern limited to Breton and Cornish that involves the devoicing of consonants.

2.2 Welsh

The mutation system of Welsh (table 1) as usually described involves four grades: the unmutated form, the soft mutation, the nasal mutation, and the aspirate mutation. The system is shown in. An empty cell indicates that the consonant in that grade is identical to the unmutated consonant.

Unmutated	Soft mutation	Nasal mutation	Aspirate mutation
<i>p</i> [p ^h]	<i>b</i> [b]	<i>mh</i> [m ^h]	<i>ph</i> [f]
<i>t</i> [t ^h]	<i>d</i> [d]	<i>nh</i> [n ^h]	<i>th</i> [θ]
<i>c</i> [k ^h]	<i>g</i> [g]	<i>ngh</i> [ŋ ^h]	<i>ch</i> [χ]
<i>b</i> [b]	<i>f</i> [v]	<i>m</i> [m]	
<i>d</i> [d]	<i>dd</i> [ð]	<i>n</i> [n]	
<i>g</i> [g]	∅	<i>ng</i> [ŋ]	
<i>m</i> [m]	<i>f</i> [v]		
<i>ll</i> [l̪]	<i>l</i> [l]		
<i>rh</i> [r ^h]	<i>r</i> [r]		

Table 1: Initial mutation in Welsh

A number of comments are in order. First, initial *g*- alternates with zero before both vowels and consonants. Second, some (but not all) triggers of aspirate mutation also trigger the insertion of a *h*- (known as ‘*h*-sandhi’) before an initial vowel in the following word: *ei* ^h*chath* ‘her cat’ (*cath*), *ei*

^h*hafal* ‘her apple’ (*afal*). Some items trigger only *h*-sandhi, but not aspirate mutation. Third, some items trigger what is known as ‘limited soft mutation’, which is identical to the soft mutation, except that *ll*- and *rh*- are unaffected. Fourth, in some varieties items like *e^h* ‘her’ affect word-initial sonorants *l*-, *r*-, and *w*-, which are essentially excluded from the native lexicon, but are found in English borrowings like *lamp*, *radio*, and *wats* ‘watch’, as well as initial *m*- and *n*-. It is not immediately obvious whether these forms are best seen as examples of the aspirate mutation or of *h*-sandhi. Fifth, a very small number of items trigger what is known as ‘mixed mutation’, which is identical to the aspirate mutation for the voiceless stop series, but to the soft mutation otherwise.

The mutation system of Welsh is relatively well-behaved phonologically. In particular, the nasal and aspirate grades are largely unproblematic: the nasal grade involves all oral stops becoming nasals whilst keeping their place and [spread glottis] specification; in the aspirate grade, [spread glottis] stops become homorganic fricatives. The soft mutation is the most complicated. Stops show a chain shift: ‘[spread glottis] stops → voiced stops → voiced fricatives’. The expected output of this process for *g*- is [ɣ], but instead the segment is deleted; however, since there is no [ɣ] in the language the rationale at least appears relatively clear.

The behaviour of sonorants in the soft mutation grade presents more problems. Initial *m*- [m] becomes a voiced fricative *f*- [v], but initial *n*- [n] does not become the corresponding *dd*- [ð], even though *dd*- is found in the language, and is a possible output of soft mutation. (Initial [ŋ] is not possible in unmutated forms.) Two further changes appear phonologically isolated: the voiceless lateral fricative *ll*- [ɬ] alternates with *l*- [l], and the voiceless rhotic *rh*- [r^h] alternates with [r]. It is tempting to treat *ll*- as the [spread glottis] counterpart of *l*-, setting up a parallel to *rh*- ~ *r*- alternation, as a kind of ‘sonorant voicing’ subpattern. However, this move cannot be supported, in particular since other patterns of Welsh morphophonology where sonorants alternate with their [spread glottis] counterparts do not show a *ll* ~ *l* alternation: *gwan* ‘weak’ ~ *gwanháu* ‘to weaken’, *byr* ‘short’ ~ *byrháu* ‘to shorten’ but *cul* ‘narrow’ ~ *culháu* ‘to narrow’ (**cullau*).

2.3 Breton and Cornish

The mutation system of the modern Breton dialects is the most complex in terms of the number of phonological patterns involved. The changes summarized in table 2 present the overall broad picture as found in the handbooks and the written language. The main grades involved are lenition, spirantization, and provection, or hardening, as well as the ‘mixed mutation’ or ‘lenition-and-provection’: as in Welsh, the latter essentially consists of different grades being applied in different series.

Unmutated	Lenition	Spirantization	Provection	Mixed mutation
<i>p</i> [p]	<i>b</i> [b]	<i>f</i> [f]		
<i>t</i> [t]	<i>d</i> [d]	<i>z</i> [z]		
<i>k</i> [k]	<i>g</i> [g]	<i>c’h</i> [x]		

Table 2: The mutation system of Breton

Unmutated	Lenition	Spirantization	Provection	Mixed mutation
<i>b</i> [b]	<i>v</i> [v]		<i>p</i> [p]	<i>v</i> [v]
<i>d</i> [d]	<i>z</i> [z]		<i>t</i> [t]	<i>t</i> [t]
<i>g</i> [g]	<i>c'h</i> [h] ∅ before [w]		<i>k</i> [k]	<i>c'h</i> [h] ∅ before [w]
<i>m</i> [m]	<i>v</i> [v]			<i>v</i> [v]

Phonologically, the lenition and spirantization grades at first glance appear similar to those of Welsh. In lenition, stops undergo a similar chain shift, and *m* (but not *n*) also becomes a fricative. There are some further adjustments ascribable at least partly to inventory structure. Notably, the soft mutation of *g*- usually results in [h], due to the absence of surface [ɣ]; however, the spirantization of *k*- generally results in [x] rather than [h]. There is no counterpart in Welsh to the different behaviour of *g*- before [w] vs. in other contexts. Finally, the spirantization of *t*- always results in the voiced *z*-, not (as might be expected) in the voiceless *s*-

There is additional dialect variation. In many varieties (but not in the written standard), vowel-initial words are prefixed with [h] in provection contexts.⁴ In a small number of dialects such as Bothoa (Humphreys 1972) this extends also to sonorant-initial words, so [o mə:b] ‘your (pl.) son’ (written *ho^p mab*). In many, if not most, dialects where it is found, the mixed mutation / ‘lenition-and-provection’ involves not just the spirantization of consonants other than [d] but also their devoicing, so that *b*- becomes *f*- rather than *v*-: that is to say, while in the codified system shown in table 2 different series undergo *either* lenition *or* provection in the ‘mixed mutation’ contexts, in these varieties provection applies to the *outcome* of lenition.

⁴ Contrast Welsh, where the contexts for *h*-sandhi overlap with those for spirantization.

Two important dialectal patterns have a particular bearing on the morphological description of mutations; both can also be quite confusingly described in the specialist sources, so it is worth spending some time on disentangling them.

The first of is the phenomenon of ‘new lenition’. This development affects the voiceless fricatives [f s ʃ x] (primarily in northern varieties), which turn into their ‘voiced counterparts’ between a vowel and/or a sonorant. Crucially, ‘new lenition’ affects not only word-internal fricatives but also word-initial fricatives following sonorant-final proclitics. It therefore creates alternations like *chadenn* ‘chain’ ~ *ar jadenn* ‘the chain’, *da jadenn* ‘to a chain’. Proclitics such as *ar* ‘the’, *da* ‘to’ can themselves be triggers of the mutations seen in table 2, especially of lenition. As a result, the alternations triggered by clitics on voiced fricatives are sometimes taken to be part of mutation system (see e.g. the descriptions in Trépos 1966, Press 1986). However, as pointed out already by Jackson (1967), all triggers of this purported mutation are in fact sonorant-final clitics, so it is better to treat it as a regular process of postlexical sandhi voicing within clitic groups.

A second complication concerns the interaction of initial mutations with the distinction between ‘fortis’ and ‘lenis’ consonants, which involves many of the same segments as the mutation system. Without going into too much phonological detail, ‘fortis’/‘lenis’ is fundamentally a distinction in quantity, which is visible primarily in word-medial position after a stressed vowel:

‘fortis’ consonants block the lengthening of preceding stressed vowels (as in *tennañ* ‘to drag’ with ‘fortis’ [n] and short [e]) and ‘lenis’ ones do not (as in *prenañ* ‘to buy’ with ‘lenis’ [n] and long [e]). In general, this distinction is contrastive primarily for the sonorants [n l r]; among the obstruents, it is redundant, with voiceless stops and fricatives behaving as ‘fortis’ and voiced stops and fricatives being ‘lenis’.

However, in some varieties of Breton, particularly those of the Léon dialect group spoken in the north-west of Brittany (two descriptions that note this are *Falc’hun* 1951, *Carlyle* 1988), the ‘fortis’/‘lenis’ distinction applies also word-initially position: initial consonants are always ‘fortis’ in the unmutated, spirantized, and protracted grades and ‘lenis’ when undergoing lenition. Furthermore, the ‘fortis’/‘lenis’ distinction in sonorants also extends to initial position, and the same distribution of ‘fortis’ and ‘lenis’ grades applies, giving some additional series in the mutation system.

The mutation system in these varieties is represented as in table 3, with ‘fortis’ consonants in upper case and ‘lenis’ in lower case. (The table abstracts away from minor details like the possible ‘new lenition’ of the outcomes of spirantization.)

Unmutated	Lenition	Spirantization	Provection
P	b	F	
T	d	S	
K	g	X	
B	v		P
D	z		T
G	h		K
M	v		
N	n		
L	l		
R	r		

Table 3: The mutation system of Breton, with fortis/lenis contrast

In this system, the alternation between ‘fortis’ and ‘lenis’ initial sonorants presents a parallel to the [t̪] ~ [l] and [r̪^h] ~ [r] patterns of Welsh.⁵ Furthermore, the maintenance of ‘lenis’ voiced stops as the lenition grade of voiceless stops as distinct from unmutated voiced stops means that there is *no* chain shift in Breton mutation, as distinct from Welsh. This creates classical minimal pairs such as *e^obas* [e ‘ba:s] ‘his cough’ (from *pas* [Pa:s] ‘cough’ with lenition) vs. *he^hbas* [e ‘Ba:s] ‘her stick’ (from *bas* [Ba:s] ‘stick’ with no mutation: *he^h* ‘her’ is a spirantization trigger, but the spirantization grade is identical to the unmutated grade for voiced stops). In Welsh, by contrast, it is usually assumed that the *b-* in unmutated *ei^hbara* ‘her bread’ is identical to the outcome of soft mutation in *ei^oben* ‘his head’, creating the chain shift.

It is commonly assumed that the non-chain-shifting system is historically older (see especially *Jackson* 1953). There is little experimental evidence either for the distinction in Breton or for the identity of mutated and unmutated stops in Welsh.⁶ The recent findings by *van Sluis* (2019) indicate, however, that there may be some orthographic evidence for this system in

⁵ Indeed, there are many dialects especially in the south-east where the fortis/lenis system mostly follows the simpler pattern outlined above, but the rhotics at least do participate in the mutation system. The fortis rhotic is usually realized as voiceless ([t̪] or [χ]). As in Welsh, the resulting [r] ~ [r̪] alternation is part of the lenition mutation pattern in these dialects.

⁶ The duration measurements in *Falc’hun* (1951) are based on a small number of tokens from the author’s own speech. The description by *Carlyle* (1988) is purely auditory. *Kennard & Lahiri* (2017) report no durational difference between mutated and unmutated [t] and [d] for traditional speakers, but their study is limited to just that consonant in one mutation context, and in any case the speakers are from around Quimper in central Brittany, rather than

medieval Welsh.

It is worth spending some time on these issues not just for the sake of completeness: as we shall see in section 6.3, the existence or otherwise of a chain shift has a bearing on the phonological analysis of the phenomena, which in turn significantly influences the morphological approach.

For completeness, table 4 shows the outline of the mutation system as shown (not always very consistently) in Middle Cornish manuscripts (not all spelling variants are shown). The phonetic values are, of course, reconstructions.

Unmutated	Lenition	Spirantization	Provection	Mixed mutation
<i>p</i> [p]	<i>b</i> [b]	<i>f</i> [f]		
<i>t</i> [t]	<i>d</i> [d]	<i>th</i> [θ]		
<i>k</i> [k]	<i>g</i> [g]	<i>gh</i> [x]		
<i>b</i>	<i>v</i> [v]		<i>p</i> [p]	<i>f</i> [f]
<i>d</i>	<i>th</i> [ð]		<i>t</i> [t]	<i>t</i> [t]
<i>g</i> [g]	∅, <i>w</i> [w]		<i>k</i> [k]	<i>gh</i> [x], <i>wh</i> [hw]
<i>m</i> [m]	<i>v</i> [v]			<i>f</i> [f]

Table 4: Mutation in Middle Cornish

It will be seen that the system is essentially identical to that of those Breton dialects where the mixed mutation consist of provection applied to the output of lenition. The sole exception is initial *g*-: where it derives from historical *gw*-, the *w* is lost in the unmutated form in some contexts but restored under lenition, creating apparent alternations like *gos* ‘blood’ ~ *the* °*wos* ‘your (sg.) blood’ (Welsh *gwaed* ~ *dy* °*waed*). In other cases, *g*- straightforwardly alternates with zero.

Both Cornish and Breton lack a counterpart to the Welsh nasal mutation. There are very minor exceptions: in Breton, the word *dor* ‘door’ appears with the definite article as *an nor*; similarly, in Cornish texts we find *an nor* for ‘the earth’ from *dor* ‘earth, ground’.

2.4 The Gaelic languages

The mutation systems of the Gaelic languages are simpler than those of Brythonic in terms of the number of grades (with only two or three basic ones), but are quite complex in terms of both the number of series and the phonological patterns involved. Table 5 shows the system of initial mutation in the Irish dialect of Cois Fhairrge (belonging to the Connacht dialect group) as described by De Bhaldraithe (1945, 1953); this pattern is representative of the codified standard, and is close to the ‘maximal’ system as found across other Gaelic varieties. (Note that unlike the Brythonic languages, Gaelic spelling systems show mutation of most consonants explicitly.)

The two generally recognized grades are lenition and eclipsis. The two ‘minor’ patterns are the so-called *t*- and *h*-sandhi. In table 5, I posit two separate grades corresponding to the former. Despite both involving the consonant [t^h], they are in fact quite different: they are triggered by different items, and involve different mutation series. Specifically, *t*-sandhi₁ is a minor

modification of the lenition grade, different only in its effect on initial *s*-, whereas *t*-sandhi₂ (‘prevocalic *t*-sandhi’) prefixes a [t^h] to initial vowels, but does not affect other segments.

Unmutated	Lenition	Eclipsis	<i>t</i> -sandhi ₁	<i>t</i> -sandhi ₂	<i>h</i> -sandhi
<i>p</i> [p ^{h(i)}]	<i>ph</i> [f(i)]	<i>bp</i> [b(i)]	<i>ph</i>		
<i>t</i> [t ^{h(i)}]	<i>th</i> [h(i)]	<i>dt</i> [d(i)]	<i>th</i>		
<i>c</i> [k ^{h(i)}]	<i>ch</i> [x(i)]	<i>gc</i> [g(i)]	<i>ch</i>		
<i>b</i> [b(i)]	<i>bh</i> [v(i)]	<i>mb</i> [m(i)]	<i>bh</i>		
<i>d</i> [d(i)]	<i>dh</i> [ɣ(i)]	<i>nd</i> [N(i)]	<i>dh</i>		
<i>g</i> [g(i)]	<i>gh</i> [ɣ(i)]	<i>ng</i> [ŋ(i)]	<i>gh</i>		
<i>m</i> [m(i)]	<i>mh</i> [v(i)]		<i>mh</i>		
<i>f</i> [f(i)]	<i>fh</i> [∅(i)]	<i>bhf</i> [v(i)]	<i>fh</i>		
<i>s</i> [s(i)]	<i>sh</i> [h(i)]		<i>ts</i> [t ^{h(i)}]		
<i>l</i> [L(i)]	<i>l</i> [l(i)]		<i>l</i> [l(i)]		
<i>n</i> [N(i)]	<i>n</i> [n(i)]		<i>n</i> [n(i)]		
∅(i)V		<i>n</i> -V [N(i)]		<i>t</i> -V [t ^{h(i)}]	<i>h</i> -V [h(i)]

Table 5: Initial mutations in Cois Fhairrge Irish

Characteristic of the Gaelic languages is a phonemic distinction between so-called ‘broad’ and ‘slender’ consonants. Its phonetics is complex, but the phonological patterns are similar. In table 5 the palatalization symbol <*i*> is used to signal slender consonants, whilst broad consonants are left unmarked. This transcription omits much of the phonetic detail,⁷ which also differs significantly across other Gaelic varieties.

Further phonological complexities deserve comment. First, as in Breton, many Gaelic languages make a distinction between ‘fortis’ and ‘lenis’ laterals, coronal nasals, and rhotics, in addition to the broad/slender distinction (table 5 uses the same typographical convention as table 3, with capital letters for ‘fortis’ sonorants). Again, the phonetics of this distinction is complex, with significant variation across the Gaelic languages. The system in table 5 is among the most conservative and symmetrical,⁸ but this is relatively rare: the systems are often more complex.

Phonologically, the more notable features of the system include the chain shift in eclipsis (*p*- → *bp*- [b] → *mb* [m]) and the apparently subtractive pattern of the lenition of *f* to zero, spelled *fh*-; see, however, below for the significance of the ∅(i) notation used here. Note also that, unlike the Brythonic languages, many of the changes involved in initial mutation (especially lenition) do not preserve the major place of articulation of the consonant (*s*- → *sh*- [h], *t*- → *th*- [h], *d*- → *dh*- [ɣ]).

The ‘*t*-sandhi’ and ‘*h*-sandhi’ grades may appear peripheral, insofar as they only affect words that are vowel-initial or begin with the consonant *s*-. However, it is appropriate to treat them as part of a larger system of patterns that involve initial ‘slots’ that are not filled with segmental material in some mutation grades, but are not empty strings.

To show this, we need to consider first the phonology of vowel-initial words (Gussmann 1986, Ní Chiosáin 1991, C. Anderson 2016, Morrison 2020a). Word-initially, both back and front vowels are possible. Such items

⁷ For example, phonological [sⁱ] is phonetically [ʃ] or [ç] (this is universal in the Gaelic languages); phonological [hⁱ] can be realized as either [h] or [xⁱ]; broad [v] is usually [w] at least before vowels in Cois Fhairrge Irish.

⁸ Even so, Cois Fhairrge Irish lacks the fortis-lenis distinction in rhotics, which is relatively well preserved in Scottish Gaelic (cf. Musil 2019).

may be preceded by consonant-final proclitics, such as the definite article *an* or the past tense marker (*d'* in varieties of Irish). Crucially, the final consonant of such proclitics can be broad or slender, and this is a lexically specific property of the word: *an t-each* [ən'tʰiːax] 'the horse' but *an t-alt* [ən'tʰaltʰ] 'the joint'; *an t-im* [ən'tʰiːm] 'the butter' but *an t-aol* [ən'tʰiːl] 'the lime'. To store this information, an empty consonantal slot has to be posited in front of the vowel: it carries the secondary articulation, which is only able to surface in the presence of the proclitic.

Crucially, the outcome of the lenition of *f*- is not an empty string, but rather the empty slot with the secondary articulation: when the proclitic triggers lenition of an *f*-initial word, the palatalization of the final consonant matches the palatalization of the *f*-. *san ʰhómhar* 'in the autumn' with broad [n] but *san ʰhéar* 'in the grass' with slender [nʲ] (unmutated *fómhar* ['fu:wər], *féar* [f̪e:r]).

The necessity of empty slots before vowel-initial words, then, allows us to understand *h*-sandhi and *t*-sandhi₂ as separate grades within the system, rather than as prefixation of the relevant consonants to initial vowels (as they are usually treated). This analysis readily accounts for a peculiar property of the *h*-sandhi grade in the Gaelic languages: its complementary distribution with other mutations. It has long been observed that *h*-sandhi is a kind of 'non-lenition', in that all items that trigger *h*-sandhi on vowel-initial words fail to trigger lenition on consonant-initial words, and all non-leniting, non-eclipsing proclitics trigger some kind of sandhi on vowel-initial words.⁹ This pattern follows directly if the *h*-sandhi is a mutation grade like the others, where the outcome is identical to the unmutated grade for all series other than the empty slot.

Scottish Gaelic shows an important difference from Irish and Manx in respect of the status of eclipsis. Many descriptions (e.g. [Clement 1983](#)) recognize 'nasalization' as a separate mutation series on the Irish model: it usually involves the prefixation of [N(i)] to vowel-initial (really empty-consonant-initial) words and a range of non-neutralizing effects on following stops that can involve voicing of the stop, the appearance of breathy voicing, and coalescence of the stop with the nasal (for a description of the dialect variation in this area, see [Bosch & Scobbie 2009](#)). However, this variation is *also* observed in nasal-stop sequences *within* a word. This indicates that (as argued, for instance, by [Ó Maolalaigh 1995–1996](#), [Scouller 2017](#)) the Scottish Gaelic 'nasalization' is rather the phonetic implementation of the sequence of a (fortis) nasal and the following consonant within a word: the non-neutralizing, variable nature of the phenomenon indicates that it is likely best analysed as some kind of complex gestural overlap. Morphologically, then, Scottish Gaelic nasalization is best viewed as the concatenation of a prefixed /N/ (see also [Oftedal 1956](#), [Morrison 2020a](#): section 5.2.3), rather than as part of the mutation system.

3 *Triggering the mutations*

We turn now to the question of what kind of context can trigger consonant mutations. Although the foregoing discussion gives some examples of what is possible, determining the place of mutations in grammatical architecture

⁹ In practice, this is almost always *h*-sandhi, with the exception of the lexical item *an* 'the.MASC.NOM.SG', which triggers prevocalic *t*-sandhi (*an fear* 'the man' but *an t-am* 'the time')

requires a fuller overview of this issue.¹⁰

¹⁰ For previous approaches to typologizing mutation triggers, see Ball & Müller (1992: pp. 6–8) and Iosad (2010).

3.1 *Unrestricted triggers*

The most straightforward type of trigger is what Ball & Müller (1992) refer to as a ‘pure lexical trigger’, that is to say a lexical item that categorically requires a following word (*modulo*, of course, any exceptions such as mutation-resistant words, section 6.2) to appear in a particular grade. This kind of mutation is found in all Celtic languages, and in fact many triggers of this kind are cognate, such as the lenition-triggering 3SG.M possessive proclitic (Welsh *ei* [i], Breton *e*, Cornish *y*; Irish, Scottish Gaelic *a*, Manx *e* [ə] < Proto-Celtic **esyō*) or the preposition ‘to’ (Welsh *i*, Breton *da*, Cornish *dhe*, Irish, Scottish Gaelic *do*, Manx *da* < Proto-Celtic **to*). This kind of situation is also the most straightforwardly amenable to a piece-based analysis: a triggering ‘particle’ can simply form part of the lexical representation of the trigger, so that, for instance, the Irish preposition *do* is simply stored as underlying /də/ (whatever the precise interpretation of /ə/).

3.2 *Morphosyntactic triggers*

The class of triggers discussed in the previous section is closed: the triggers in question are usually functional elements like pronouns, determiners, complementizers, ‘particles’ and the like. However, initial mutations can also occur in environments describable in general morphological or syntactic terms, without reference to specific lexical items.

One such context, common to all the systems, is the lenition (soft mutation) of adjectives following feminine singular nouns (in the nominative case in the Gaelic languages):

- (1) a. *merch* °*fach* (**bach*)
 gir_{F.SG} small
 ‘a small girl’ [Welsh]
- b. *merc’h* °*vihan* (**bihan*)
 girl_{F.SG} small
 ‘a small girl’ [Breton]
- c. *caileag* °*b*(h)eag*
 girl_{F.SG} small
 ‘a small girl’ [Scottish Gaelic]

A related phenomenon concerns the mutation of dependent nouns. All Celtic languages show head-initial word order within an NP: the Brythonic languages lack morphological case, and use apposition to express dependency relations, whereas the Gaelic languages retain a morphological genitive case. In Brythonic, feminine singular heads mutate a dependent noun in the case of generic readings but not with possessive or specific readings: Breton *un* °*daol*_{F.SG} °*goad* ‘a wooden table’ with mutation but *tro*_{F.SG} *kêr* ‘a tour of the city’ (Favereau 2001: pp. 153). Similarly, in Welsh Thomas (1996: pp. 320–322) distinguishes between compounds like *ystafell*_{F.SG} °*fyw* ‘living room’, NPs with an adjectival reading (and adjective-like soft mutation on the

dependent) like *ystafell* °*bwyllgora* ‘committee room’ and possessive NPs with no mutation like *ystafell maer* (*°*faer*) *y dref* ‘the town mayor’s room’ (see also Morgan 1952: pp. 68–71).

In the Gaelic languages, the lenition of dependent nouns is driven by an even more complex set of considerations, and there is clearly a great deal of variation. Very roughly, lenition is expected in genitive nouns after any plural noun that ends in a slender consonant (*buidéil*_{M.PL} °*bhainne* ‘bottles of milk’)¹¹ and after feminine singular nouns unless they are themselves in the genitive (*deor*_{F.SG} °*bhainne* ‘a drop of milk’); in addition, definite nouns (both inherent definites like proper names and contextually definite ones) also undergo lenition: *foireann* °*Dhoire* ‘[the] Derry team’, *mac* °*fhear an tí* ‘the son of the man of the house’ (all examples from Na Bráithre Críostaí 1960). However, numerous exceptions are given to this basic rule even in prescriptive sources, and Ó Cearúil (2016) provides a book-length study of the variation observed in both written sources and dialects on this point.

In cases such as those discussed in this section so far, the morphosyntactic context is driven at least partly by the properties of the lexical items involved such as their gender and case. However, mutation can also be driven by very general ‘constructional’ considerations.

Perhaps the most prominent example of this is the Welsh ‘direct object mutation’. The name derives from the fact that the first word in the object constituent in a VSO clause with a finite verb undergoes soft mutation:

- (2) °*Bryn-odd* *Gwen* °*lyfr-au yn y siop*
 buy-PST.3SG Gwen book-PL in the shop
 ‘Gwen bought books in the shop’

Based on examples such as these, it has been argued (Zwicky 1984, Roberts 2005) that the soft mutation on *llyfrau* is due to a clitic assigning accusative case. The literature on the phenomenon is extensive (for ample discussion, see Ball & Müller 1992: chap. 6, Borsley, Tallerman & Willis 2007: chap. 7); here, it should be sufficient to say that it is now widely recognized that ‘direct object mutation’ may be a special case of a more general phenomenon whereby any phrasal constituent triggers soft mutation on a following phrase (the triggering constituent is underlined in the following examples):

- (3) a. *Mae* *ganddi* °*gî*
 be.PRES.3SG with.3SG.F dog
 ‘She has a dog’
 b. *Gwel-wyd* *yn yr °ardd* °*gî*
 see-IMPERS.PAST in the garden dog
 ‘A dog was seen in the garden’
 c. *Mae* *’r cí yn* *cyflym* °*red-eg*
 be.PRES.3SG the dog PROG quick run-VN
 ‘The dog runs quickly’

¹¹ Although this generalization might seem phonological, it could be reformulated in terms of the inflectional class of the head noun, since only a restricted group of nouns form their plural by palatalizing the final consonant.

In each case, if the underlined constituent does not precede the one targeted by mutation, mutation is absent (so *Mae cî ganddi* ‘She has a dog’; *Gwelwyd cî yn yr °ardd* ‘A dog was seen in the garden’; *Mae’r cî’n rhedeg yn °gyflym* ‘The dog runs quickly’).

Another example of a ‘constructional’ mutation trigger is common across the Celtic languages, namely mutation of nouns by a preceding adjective. Normally, adjectives follow nouns (and their mutation is regulated by the gender, number, and other features of the head). Especially in the Brythonic languages,¹² a small number of adjectives (e.g. Welsh and Breton *holl* ‘all’, Welsh *prif* ‘chief’, *dirprwy* ‘deputy’) obligatorily precede the noun; a somewhat wider group either precede or follow the noun, sometimes with a difference in semantics or pragmatics (e.g. Welsh *gwir* ‘true’ preposed, ‘correct’ postposed; *prin* ‘incomplete’ preposed, ‘rare’ postposed; Breton *pell* ‘far’, *berr* ‘short’). In general, whenever an adjective precedes the noun, the noun undergoes soft mutation irrespective of its gender and number: Welsh *hen °ddyn*_{M.S.G.} ‘an old man’, Breton *pell °broioù*_{M.PL.} ‘faraway countries’.¹³ An additional complication to the pattern, found in both Welsh and Breton, is that when adjectives are inflected for comparison, they precede the noun much more freely, and do not trigger lenition in this case: Welsh *talach gwraig* (**talach °wraig*) ‘a taller woman’, Breton *brasañ plijadur* (**brasañ °blijadur*) ‘the biggest pleasure’ (for some discussion of this pattern, see Tallerman 1999).

3.3 Morphosyntactically restricted triggers

Lexical and morphosyntactic factors can also interact. Particularly common is the situation when a mutation trigger only has a visible effect in some morphosyntactic contexts. The classic example, common to all present-day Celtic languages, is mutation by the article.¹⁴ For at least some number-case slots in the paradigm, the surface form of the article is the same irrespective of the gender of the complement noun.¹⁵ In all the languages, the feminine singular form of the article triggers lenition: Welsh *y °gath*_{F.S.G.}, Irish *an chat*_{F.S.G.} ‘the cat’. The masculine singular form triggers either the unmutated grade (Welsh *y cî*_{M.S.G.} ‘the dog’) or a different mutation (Irish *an t-am*_{M.S.G.} ‘the time’, Breton *ar °c’hazh*_{M.S.G.} ‘the cat’). More complicated conditioning is possible: for instance, in Breton lenition is additionally triggered by the definite article on plural masculine nouns (*ar °baotred* ‘the boys’), as long as they are not formed with the suffix *-où* (*an testoù* ‘the witnesses’ rather than **an °destoù*); a formal analysis of this pattern in Distributed Morphology is offered by Mondon (forthcoming).

Ball & Müller (1992) dub this category ‘categorially restricted triggers’, and interpret it as a restriction put on mutation by the morphosyntactic property of the target. However, it is probably more appropriate to view these restrictions as driven by the morphosyntactic properties of the context more generally: consider, for instance, the case of Irish *gan* followed by a verbal noun: it is a lenition trigger when it is a preposition, but not a lenition trigger when it is a negative complementizer embedding a non-finite clause.¹⁶

¹² In the Gaelic languages, adjective preposition is much more constrained, and not always clearly distinguished from compounding; for relevant discussion, see section 3.4.

¹³ Stammers & Deuchar (2011) argue such effects are epiphenomena of frequency and lexical organization rather than being specific to borrowings (see also Hammond et al. 2020).

¹⁴ Only Breton has an indefinite article; its mutation behaviour is identical to the definite article.

¹⁵ In the Gaelic languages, masculine and feminine forms of the article do differ in the GEN.SG (masculine *an*^o/, feminine *na*^h). The Brythonic languages have no case and no gender agreement for the article.

¹⁶ This is the prescriptive rule given by Na Bráithre Críostaí (1960); the examples are from Cois Fhairrge, although in many dialects *gan* is no longer a productive lenition trigger.

- (4) a. *dúirt sé leis gan f(*h)an-acht deireannach*
 say.PST he to.3SG.M NEG stay-VN late
 ‘He told him not to stay late’ (De Bhaldraithe 1953: p. 192)
- b. *fear gan °phós-adh*
 man NEG marry-VN
 ‘an unmarried man’ (De Bhaldraithe 1953: p. 259)

The situation is similar to that of the gender and related restrictions on mutation by the article, but clearly has little to do with the category of the target.

3.4 Phonological restrictions: segmental structure

In addition to morphosyntactic factors, mutation also interacts with phonological structure. The best known case of this is the ‘coronal restriction’ in the Gaelic languages. The usual presentation of the rule is that mutation triggers ending in a coronal consonant fail to trigger either lenition or (where applicable) eclipsis if the target starts with another coronal: Irish *an° d(*h)eoir*_{F.SG} ‘the drop’, *aon° t(*h)each* ‘one house’, *ar an° (*d)talamh* ‘on the ground’.¹⁷

This kind of ‘homorganic blocking’ is both somewhat wider in scope than this description implies and much more variable. A more general homorganicity restriction could be posited in view of (at least prescriptively) attested rules such as the absence of lenition after *um°* ‘about’ on labial-initial words in Irish: *um° m(*h)aidin* ‘in the morning’: given that most other closed-class lenition triggers end in a coronal, the restriction to the item *um* seems accidental.¹⁸ For example, Ó Sé (2000: p. 64) records a possible lack of lenition of labials after the 1SG object/possessive pronoun *m’* ([ə̃m bu:ə̀lə̃] for standard *do mo °bhualadh* ‘hitting me’) in Corca Dhuibhne.

Similar examples are found in Breton. Most notably, the article (which appears as *an*) fails to trigger lenition of initial *d-* even when other coronals do lenite: *an °doenn*_{F.SG} ‘the roof’ (*toenn* ‘roof’) but *an delienn*_{F.SG} (**an zelienn*) ‘the leaf’. Similarly, as discussed by Stump (1987), in some varieties of Breton initial labials (in practice only *p-*) fail to undergo spirantization if the trigger is also labial-final: *em^h penn* (**fenn*) ‘in my head’, *da^{m^h} prenañ* (**frenañ*) ‘to buy (for) me’.

Since lenition in the Gaelic languages generally turns coronals into dorsals or glottals, the homorganicity restriction is usually treated as a requirement for coronals to be followed by coronals (e.g. Green 2008), and thus as a special case of geminate inalterability (cf. Honeybone 2005). However, the slightly broader view taken here suggests that the inalterability requirement actually targets clusters where the product of mutation becomes a fricative, even if there is no disagreement in place (as in Breton *an° *zelienn*). Framing it as a constraint on place also fails to capture the fact that it can also target eclipsis, where the blocked outcome does not violate homorganicity. This suggests that the restriction is fundamentally input-oriented rather than output-optimizing: once a sequence is established as subject to inalterability via featural similarity (e.g. as in the analysis by Ní Chiosáin (1991), who implements this via merger of the Place nodes of two segments adjacent within a domain), manner changes are prohibited.

¹⁷ No such homorganic restriction applies to Scottish Gaelic ‘eclipsis’, which is unsurprising if it is a phonetic sandhi process. The homorganic restriction also does not apply to eclipsis in Munster Irish (Ua Súilleabháin 1994: p. 511).

¹⁸ Although this rule is given by Na Bráithre Críostaí (1960), actual historical usage after *um* is more variable.

Further, it is worth pointing out that the homorganic restriction, whilst it appears phonological, is not fully transparent on the surface. For example, the Scottish Gaelic negation *cha*^o fails to lenite initial *d*- (variably), *t*-, *s*- (although not the sonorants *l*-, *n*-, *r*-) despite only showing the allomorph *chan*^o before a vowel, including a vowel derived by lenition of *f*- (Cox 2017):

- (5) a. *cha* °*c**(*h*)*uir sinne corrag orra*
 NEG put.FUT 1PL.EMPH finger on.3PL
 ‘We will not touch them’
 (Corpas na Gàidhlig 2014–: text 102003)
- b. *cha*(**n*) *dùin mi e*
 NEG close.FUT 1SG 3SG.M
 ‘I will not close it’ (Cox 2017: p. 63)
- c. *chan eil sgot aige mu dheidhinn sin*
 NEG be.PRES piece at.3SG.M about that
 ‘He does not have a clue about that’ (Cox 2017: p. 232)
- d. *chan fhàg-ainn air a’ bhòrd e*
 NEG leave-1SG.SUBJ on the table 3SG
 ‘I would not leave it on the table’ (Cox 2017: p. 232)

A different phonological restriction on the application of mutation comes from Breton. As we saw in section 2.3, the lenition mutation involves voiceless stops becoming voiced stops, and voiced stops (and *m*-) becoming fricatives. This pattern is seen with all closed-class mutation triggers. The only mutation pattern that involves an open class of triggers in Breton is the lenition of adjectives following feminine singular nouns. Here, obstruent-final nouns trigger lenition only of voiced stops and *m*-, but not of voiceless stops. Vowel- and sonorant-final nouns, on the other hand, trigger the entire pattern.

- (6) a. *ur vrozh pounner* (**bounner*)
 a skirt heavy
 ‘a heavy skirt’
- b. *ur vrozh vihan* (**bihan*)
 a skirt small
 ‘a small skirt’
- c. *ur vamm bounner* (**pounner*)
 a mother heavy
 ‘the fat mother’
- d. *ur vamm vihan* (**bihan*)
 a mother small
 ‘a small mother’ (Favereau 2001: p. 152)

The ‘failure’ of mutation in *ur vrozh pounner* is only apparent: the fact that *mamm* ‘mother’ does trigger lenition in the same context, as well as the action of lenition on voiced initials, indicates that the morphosyntactic

conditions for mutation triggering are met here. Iosad (2014) argues that the voiceless stop in the adjective is the product of phonological computation, and specifically of how the mutation-triggering autosegment interacts with preceding obstruents and sonorants; we will return to this issue in section 7.

3.5 Mutation and domain structure

In some instances, mutation has been argued to be constrained (or indeed triggered) by the boundaries of prosodic or morphosyntactic domains. As described by Kervella (1946), mutation caused by unrestricted triggers like prepositions may (optionally) fail if the target NP has ‘heavy’ postposed modifiers:

- (7) a. *war °doenn*
 on roof
 ‘on a roof’
 b. *war toenn/°doenn an ti*
 on roof the house
 ‘on the roof of the house’

Pyatt (2003) interprets this in terms of prosodic structure: in her analysis, if *toenn an ti* ‘the roof of the house’ is parsed as a single prosodic phrase, to which *war* ‘on’ is adjoined, the prosodic phrase boundary blocks lenition; the alternative phrasing [*war° doenn*] [*an ti*] permits mutation. This analysis nicely captures the apparent optionality of this ‘heavy-NP’ effect, deriving it from optionality in phrasing.

Irish shows an apparently opposite effect in the triggering of lenition by prepositions like *ar°* ‘on’, with mutation failing in phrases with certain bare nouns like *barr* ‘top’: *ar barr* ‘above’ but *ar °bharr an tí* ‘on top of the house’. However, the lack of mutation in such cases is exceptional and is connected with nonspecific reference, or even idiomatic meaning (*dóigh* ‘way, method’, *ar dóigh* ‘excellent’), so they are probably best treated as lexicalized adverbial constructs.

Issues like productivity and degree of lexicalization, which could perhaps be formalized via (morphosyntactic) domain structure, also arise with patterns such as coronal inalterability (see section 3.4). As described by Ó Curnáin (2007: pp. 1717–1724), the probability of the coronal restriction being applied increases with the degree of productivity: common items like the definite article and productive prefixes such as *an-* ‘very’ and *sean-* ‘old’ obey the generalizations, lenition can optionally apply with less productive prefixes like *bán-* ‘light (of colour)’ and *glan-* ‘intensifier’, and almost always applies despite the presence of coronal conditioning with less productive prefixes such as *ard-* ‘higher’ and all *-r-* final prefixes. It is plausible that this can be formalized using some notion of boundary strength, but whether this boundary is prosodic or morphosyntactic is less clear. As we saw in section 3.2, similar issues arise around mutation in noun-noun constructions, where variation in mutation behaviour correlates in understudied ways with semantic and morphological coherence.

A small body of work relates mutation to prosodic phrasing rather than

syntactic constituency: in particular, **Hannahs (1996)** offers an interpretation of Welsh ‘direct object mutation’ in terms of prosodic phrase structure.

3.6 *Zero triggers?*

Finally, it is worth specifically considering the issue of mutations that do not appear to have overt triggers. It is useful to consider two subclasses of this phenomenon.

One example is the Welsh ‘affirmative particles’ (complementizers) *mi*^o and *fe*^o. They occur before a finite lexical verb in affirmative root clauses, and trigger soft mutation. They also have segmentally empty variants, which still trigger soft mutation on the verb. (In fact, the same is true of complementizers with other types of force: both the interrogative *a*^o and the negative *ni*^{h/o} can be similarly dropped, leaving behind their mutating effects.) Clearly, this can be seen as a special case either of a morphophonological trigger or of construction-based mutation.

Slightly less straightforward is purely ‘functional’ mutation, which is not tied to particular syntactic frames or morphological categories, and never requires an overt trigger. Across the Celtic languages, a common type of this phenomenon is presented by ‘adverbial’ mutation: certain kinds of items undergo lenition whenever they have an adverbial (often, but not necessarily, temporal or spatial) function. The clearest example of this is the application of soft mutation to NPs to create adverbs in Welsh, as in *°ddydd Llun* ‘on Monday’ (*dydd Llun* ‘Monday’) — this usage is somewhat variable in texts (**Morgan 1952**: chap. 12), but is essentially codified in standard Welsh (**Thomas 1996**: pp. 432). Note that the application of this mutation does not depend on the adverbial’s place in the clause, but solely on its function.¹⁹

Trigger-free lenition of adverbials and adjuncts is less widespread in the other languages, but is nevertheless found, at least diachronically. For example, in the Gaelic languages many lexical adverbs have undergone lenition historically (already in the Middle Irish period, cf. **Breatnach 1994**: pp. 238), as in *choíche* ‘(n)ever’ (Old Irish *caidchi*), *thuas* ‘above’ (Old Irish *t-uas*); Iorras Aithneach *timpeall* ~ *thimpeall* ‘around’ (Old Irish *timchell*) and many others. In Breton we find, for instance, *bennak* ‘whatever’ from earlier *pennac*.

Similarly, many prepositional forms have become ‘permanently lenited’, cf. Old Irish *fri* ‘towards, against’ > Scottish Gaelic *ri*, Old Irish *for* > present-day *a(i)r*, Old Irish *tar* ‘across’ > Irish *thar*. A similar development occurs in the Brythonic languages, where we find Welsh *gan*, Breton *can* from earlier **kant-*; Breton *da-*, Cornish *dhe*, Welsh *i* (via a *ð*-initial form) ‘to’ from *do-*. Indeed, the mutation and sandhi behaviour of such items in both Welsh and Breton — both adverbials and prepositions — gives reason to treat the mutation as still being synchronically active rather than fully lexicalized (see **Iosad 2017**: pp. 213–215).²⁰

4 *The targets of mutation*

So far, our discussion has focused on the *triggers* of mutation. In this section, we turn to the question of what morphological object is targeted by the

¹⁹ The only qualification is that this mutation is dispreferred (but still possible) clause-initially in more conservative registers.

²⁰ This mutation is likely part of a general trend towards the lenition (in a broad sense) of initial consonants in functional items, which has been active throughout the history of the Celtic languages. This weakening does not always agree with the workings of the mutation system: thus, the preposition/preverb *do-* ‘to’ derives from Proto-Celtic **to-* even in Old Irish, which did not undergo **t > d* lenition. Other Gaelic examples are the complementizer ‘that’ (Irish *go*ⁿ, Scottish Gaelic *gu(n)* < Old Irish *co(n)-* and the preposition ‘without’ (present-day *gan*, *gun* < Old Irish *cen*).

relevant phonological changes. We have assumed that the alternations happen at the left edge of an inflectionally complete word, once it is found in a context that triggers a mutation. Mutation of this kind is always in evidence on the left edge of the word, irrespective of its internal structure. This is seen most clearly when the word contains a prefix: consider Welsh *adrodd* ‘to report, relate’, *ei^h hadrodd* with the 3SG.F possessive/object clitic; *ailadrodd* ‘to reiterate’ with the prefix *ail-*, mutated *ei^h hailadrodd* rather than **ei^h ailhadrodd*. Celtic mutation is thus local in the sense that it always occurs on the left edge of its target, rather than on some non-peripheral constituent.

What kind of morphosyntactic object is targeted by mutation? At the very least, it is clear that mutation can occur on the left edge of items smaller than the word. There are at least two contexts where this occurs. First, mutation can be triggered by prefixes on whatever morpheme follows them.²¹ In this case, the prefixes usually behave like proclitic triggers, in that the mutation they trigger is an arbitrary lexical property. Most prefixes trigger lenition, like the Irish intensive *an^o-* (*an-mhaith* ‘very good’ from *maith* ‘good’) and Welsh negative *di-^o* (*digartref* ‘homeless’ from *cartref* ‘home’), but a few trigger other mutations, like the Welsh negative *anⁿ-*, as in *anhrefn* ‘disorder’ from *trefn* ‘order’. Most prefixes trigger *some* kind of mutation, although non-mutating prefixes can be found, for instance, in Old Irish.

The existence of prefix-triggered mutations indicates that whatever morphological operation is responsible for mutations must also be able to target items smaller than the word. This is, of course, quite unproblematic in piece-based accounts, since the trigger can just be a chunk of phonological material associated with the prefix. However, a second kind of mutation ‘below the word’ presents a complication. Specifically, in most Celtic languages there is a rule whereby in head-final compounds the final element undergoes lenition (similarly to the preposed-adjectives rule): Welsh *canhwyllbren* ‘candlestick’ (*cannwyll* ‘candle’, *pren* ‘piece of wood’), Irish *glaschaint* ‘cross-talk’ from *glas* ‘green/blue’ and *caint* ‘talk’. Certainly for the older stages of both Brythonic and Goidelic, this kind of compounding is productive (Stifter 2015), and so the class of triggers is open. In the present-day languages, head-final compounding and its attendant mutation pattern is essentially restricted to the coining of neologisms, so the issue is less pressing. However, the fact that compounding involves an open-ended group of mutation triggers is an *explanandum*. If mutation is concatenative, where does the trigger come from? Is it a kind of compound linker like Germanic *-s-* or Slavic *-o-* (cf. Massam 1983)?²² If it is not concatenative, how is it triggered by compounding?²³

Mutation can also target constituents larger than the word: the following Welsh examples show this with an adjective with a preposed modifier (mutation triggered by a feminine singular noun) and with ‘direct object mutation’ triggered on an NP-initial adjective.²⁴

- (8) a. *problem* *°dra difrifol*
 *problem*_{F,SG} *quite serious*
 ‘quite a serious problem’

²¹ In the present-day Celtic languages, it is rare to have more than one prefix per word, so in practice the target is almost always the (first) root. Old Irish had a rich system of prefixes (particularly in verbs), which can be stacked, and in these cases a prefix can trigger a mutation on a following prefix (at least historically: synchronically the system can be very opaque): *com-art* ‘struck’ (3SG.PRET of *con-oirg*) but *frith-chom-art* ‘offended’ (3SG.PRET of *fris-oirg*) with prefix *frith^o-* ‘against’ triggering lenition on *com-* ‘with’ (Thurneysen 1946, headwords cited following Toner et al. 2007–). However, some prefix stacking with mutation triggered on a prefix is also possible in modern Irish dialects: *fior-°dheá-°dhéanta* ‘very well done’ (Ó Curnáin 2016).

²² Historically, a linker *-o* element (cognate with the Slavic one) is precisely the source of this behaviour.

²³ A useful parallel could perhaps be drawn to changes in tonal accent and *stød* patterns associated with compounding in North Germanic (cf. Basbøll 2003, Wetterlin 2010)

²⁴ The mutation on the noun is triggered by the preposed adjective, not by ‘direct object mutation’. The adverb *tra* is an aspirate mutation trigger, but this has no visible effect on an initial *d-*.

- b. °Wel-odd hi °wir °wyneb yr arwr
 see-PST.3SG she true face the hero

‘She saw the true face of the hero’

This may lead us to think of mutation triggers as clitics, and perhaps more narrowly ‘special clitics’ (in the sense of Zwicky 1977), which attach to entire constituents. Ideally, then, the analysis of mutation needs to be consistent with our view of these phenomena — whether as ‘phrasal affixes’ (Klavans 1985, S. R. Anderson 2005) or ‘edge morphology’ (e.g. Halpern 1995, Stump 2001, Bermúdez-Otero & Payne 2011).

To summarize this section, the target of mutation is normally the left edge of the word, but very similar changes can also apply to morphemes within the word, and sometimes the context for mutations can be described with reference to entire constituents. Of course, this does not necessarily mean that mutation is not a morphological operation: it may very well be that the correct analysis requires for words at certain edges of constituents to have particular kinds of morphological marking implemented as mutation. To understand the nature of these operations better, in the next section we consider the very important question of whether trigger and target have to be adjacent. So far we have been assuming that they do, but in fact there are numerous examples where at least apparently mutation occurs at a distance.

5 Trigger-target adjacency and trigger competition

5.1 Non-local mutation in Irish

One frequently discussed case comes from Irish, where the numeral *dhá* ‘two’ normally triggers lenition on the following noun, but when it is preceded by a possessive pronoun that triggers a different grade (such as *aⁿ* ‘their’ or non-leniting *a^h* ‘her’), the noun appears in the grade required by the possessive pronoun:

- (9) a. *dhá* ° *°bhád*
 two boat
 ‘two boats’
 b. *aⁿ* ° *°mbád*
 3PL.POSS boat
 ‘their boat’
 c. *aⁿ* ° *dhá* ° *°mbád*
 3PL.POSS two boat
 ‘their two boats’
 d. *a^h* ° *dhá* ° *°háit*
 3SG.F.POSS two place
 ‘her two places’

This is the prescriptive rule as described in grammars such as Na Bráithre Críostaí (1960), in which *dhá* appears entirely inert: it is neither affected by the preceding possessive pronoun nor able to trigger mutation in the

following noun. The situation in present-day dialects is more variable and complicated. Some descriptions agree with the general system (to take one example per major dialect area, see, for Cois Fhairrge, *De Bhaldraithe 1953*: p. 286, for Corca Dhuibhne, *Ó Sé 2000*: p. 73, for Tory Island, *Hamilton 1974*: p. 189), but there is also some variation. For instance, the detailed study of Iorras Aithneach Irish by *Ó Curnáin (2007*: p. 9.97) shows that *dhá* can both be affected by the appropriate mutation triggered by the preceding possessive pronoun (appearing as [ɲɑ:] with eclipsis or [gɑ:] in the unmutated grade) and trigger lenition on the noun, ‘overriding’ the mutation of the possessive pronoun. In particular, *Ó Curnáin* reports the existence of a pattern where the numeral both undergoes the mutation required by the possessive pronoun and triggers it on the noun, as in [ə ɲɑ: nɑ:v̥] *a nngá n-n-áit* ‘their two places’ (for expected *aⁿ dhá n-n-áit*), on which see more in section 5.4.²⁵

5.2 Breton non-local spirantization

A second well-known case of non-local mutation is presented by spirantization in Breton. Brought into the theoretical literature by *Stump (1988)*, it was recently carefully discussed by *Mondon (2020)*. It is largely parallel to the Irish case of *dhá*: the items involved, principally *holl* ‘all’, normally trigger lenition, but when they are preceded by a spirantization trigger, the noun undergoes spirantization instead:

- (10) a. *va^h ^hzud*
 1SG.POSS
 ‘my people’
 b. *an holl^o ^odud*
 the all people
 ‘all the people’
 c. *va^h holl^o ^hzud*
 1SG.POSS all people
 ‘all my people’

The parallel with Irish is not fully exact, however: in particular, whereas Irish *dhá* ‘transmits’ whatever mutation effect (eclipsis, *h*-sandhi) the possessive has, the Breton nonlocal pattern is restricted to spirantization: the possessive pronoun *ho^p* ‘your (pl.)’, which triggers provection, or the non-mutating *hon* ‘our’ and *o* ‘their’, do not have this effect.

5.3 Mutation at a distance

There are several well-recognized cases in which a mutation is triggered non-locally, but which are clearly special cases of an otherwise local mutation. Most prominently, mutation by feminine singular nouns applies to all adjectives in a sequence, not just to the one immediately following the noun:

²⁵ It is worth noting that the pattern of non-local mutation, although established in the Middle Irish period (*Bergin 1932*), is absent from Scottish Gaelic, where the noun is always lenited by a preceding *d(h)à* ‘two’. This is consistent with the analysis of Scottish Gaelic ‘nasalization’ as a phonological sandhi process, and therefore strictly local to the trigger, rather than a more morphologically embedded process like Irish eclipsis.

- (11) a. *spideog °bheag °bhídeach* [Irish]
 robin_{FEM} small tiny
 ‘a tiny little robin’
 b. *cath °fawr °goch* [Welsh]
 cat_{FEM} big red
 ‘a big red cat’

This pattern, however, is described as ‘exceptional and not obligatory’ (*exceptionnel et facultatif*) for Modern Breton by Favereau (2001: p. 152).

For Irish, both prescriptive (*Na Bráithre Críostaí* 1960) and some descriptive (e.g. *De Bhaldráithe* 1953: p. 267) sources describe a pattern where a mutation trigger that precedes several conjoined targets triggers mutation on all of them:

- (12) a. *roimh° °Dhia ná °Mhuire* [written Irish]
 before God nor Mary
 ‘before neither God nor Mary’
 b. *idir° °fhear agus °bhean* [Cois Fhairrge Irish]
 between man and woman
 ‘both man and woman’

Similar, if more rarely attested, are cases where a modifier undergoes mutation triggered by a head that is embedded in a phrasal construction and hence separated from this modifier. Ó Curnáin (2007: p. 1694) gives examples such as the following from Iorras Aithneach:

- (13) a. *bean tí °mhaith*
 woman_{F,SG} house.GEN_M good
 ‘a good hostess’
 b. *ag cur amach °mhón-a*
 PROG put.VN out peat-GEN.SG
 ‘putting out peat’ (Ó Curnáin 2007: p. 1754)

The mirror image pattern is reported from Donegal Irish by (Ó Siadhail 1989: p. 117):

- (14) *Gaeilge iontach °mhaith*
 Irish language_{F,SG} extremely good
 ‘very good Irish’

Here, the adjective undergoes mutation after a feminine singular noun despite the intervening adverb.

5.4 Mutation persistence

Some descriptions of Irish dialects note a phenomenon dubbed ‘continued mutation’, in which a word that ordinarily is not a trigger, but stands in

a context where it should undergo some mutation (usually lenition), also ‘transfers’ the mutation onwards to the next word (even if the mutation does not have visible effects on the word itself). Examples from Corca Dhuibhne Irish are given by Ó Sé (2000: p. 64):

- (15) a. *°bhris ar °fhoighne °dhuine acu*
 break.PST on patience_F person_m.GEN at.3PL
 ‘They lost patience’
- b. *°choimeád-aidís ina° lá °shaoire é*
 see.PST-3PL.HAB in:3SG.M.POSS day_M feast_F.GEN 3SG.ACC
 ‘They used to see him on his holidays’

Ordinarily, the genitive nouns in *foighne duine* ‘patience [with] people’ and *lá saoire* ‘holiday’ do not undergo lenition, but in these examples it occurs, according to Ó Sé (2000) because the head nouns are lenited by the preceding item (see also Ó Siadhail 1989: pp. 116–118, and especially Ó Curnáin 2007: 1732–1735 for more discussion).

5.5 Trigger conflict

Some of the cases discussed in this section instantiate potential conflicts between triggers, that is to say contexts that meet the structural description of more than one mutation rule (Ball & Müller (1992: pp. 185–191) refer to this as the ‘mutation-mutation interface’). The examples considered here are notable precisely because the requirements of a less local trigger override those of a closer one. Of course, the reverse situation is also attested. So, for example, in Welsh a local trigger like a proclitic triggering nasal or aspirate mutation will take precedence over a non-local grammatical trigger like a feminine singular head:

- (16) *cath °dew a °hchoch (*°goch)*
 cat_{F.SG} fat and red
 ‘a fat and red cat’

Consider also the following data from Irish. Adjectives undergo lenition after certain kinds of constructions, even if they linearly follow items that ordinarily require them to be unmutated. Examples are numeral phrases and stative constructions with the preposition *i* ‘in’:

- (17) a. *an °bheirt °fhear °bheag-a*
 the two man.SG_M small-NOM.PL
 ‘the two small men’ [written Irish]
- b. *nuair a °bhí tú i do °ghasúr °bheag °bhídeach*
 when be.PST you in POSS.2SG boy small tiny
 ‘when you were a tiny little boy’ (Ó Curnáin 2007: p. 1734)

In both cases, the adjective is preceded by what is at least morphologically a masculine singular noun, which do not ordinarily trigger lenition. Since

the boundary of the construction is closer to the target than the boundary of the immediately preceding noun, this can also be construed as an example of a more local context ‘winning out’.²⁶

A third logical possibility in case of trigger conflict that we have not yet considered is that, given the right consonant, *both* mutations will be able to apply. This arguably occurs in the case of the Breton mixed mutation, as discussed in section 8 below.

²⁶ Historically, the noun is not the (non-leniting) nominative but the dative, which did trigger lenition in a regular manner.

6 Phonology and morphology in mutation exponence

Before we finally address the question of whether mutation can be analysed in a piece-based framework, we need to discuss whether such an analysis can be made to work on the phonological side. It is therefore worth exploring both the reasons why an analysis that puts most of the burden of deriving the segmental changes onto the phonology is attractive, and the reasons why it might not be feasible.

6.1 The challenge of phonological regularity

Despite their complexity, by and large the mutation systems of the Celtic languages are phonologically relatively coherent. Almost overwhelmingly, they can be analysed by taking one of the grades as the underlying representation, and deriving the other grades by applying (usually only a few), often quite simple, rewrite rules.

It is worth highlighting that this coherence is not a trivial matter: after all, there is no *a priori* reason why the systems should *not* involve arbitrary correspondences between segments. As we saw in section 2, we can usually identify a single grade as underlying or ‘unmutated’: this is the grade that allows us to predict the others unambiguously. Across the Celtic languages, the lenition grade cannot be underlying because initial [v] in this grade can correspond to either [m] or [b] in the unmutated grade, and in most languages there are patterns of deletion ([g] in Welsh, [f] in the Gaelic languages) that make some words (notably vowel-initial ones) in the lenition grade ambiguous. Similar ambiguities are observed in other grades: in Breton voiceless stops in provection correspond to voiced or voiceless unmutated stops; in Welsh spirant mutation initial [f] is ambiguous between unmutated [f] and [p^h]; and in all languages with some version of nasal mutation/eclipsis initial [m] and [n] can either be unmutated nasals or oral stops. Logically, this kind of one-to-many relationship is not inevitable, and indeed typologically (cf. Iosad 2010, Merrill 2018) we do find cases like (some varieties) of Fula (S. R. Anderson 1976), where no single grade allows us to unambiguously derive the others.

There is some evidence that Celtic mutation systems do not tolerate such arbitrariness. When ambiguities arise that threaten the identification of a single underlying grade, they are often removed. For example, all Celtic languages, at least until recently, would borrow words with initial *v-* with either *m-* or *b-*, given the absence of unmutated initial *v-* prior to extensive contact with languages like English and French. There are numerous developments where vowel-initial words are treated as if they were mutated

forms of *g-* or *f-* initial ones or vice versa, both in borrowings (e.g. Welsh *gonest* ‘honest’, or cf. Scottish Gaelic *uinneag* ‘window’ with Irish *fuinneog* < Old Norse *vindaugr*) and in other developments (Scottish Gaelic *fosgail* ‘open’, Irish *oscail* < Old Irish *oslaicid*).

In addition to the existence of unambiguous underlying representations, any account of mutation should also address the phonological coherence of the changes. For the most part they can be expressed relatively simply, at least if our calculus is based on the number of featural changes. For instance, in Welsh nasal mutation all oral stops alternate with nasals at the same place of articulation and with the same specification for [\pm spread glottis]. This can be described by the following rule:

(18) [$-$ continuant $-$ lateral] \rightarrow [$+$ nasal]

This regularity is taken (commonly, albeit often implicitly) to provide sufficient justification for a phonological approach over a morphological one: bringing to bear the full power of morphology with its ability to establish arbitrary correspondences appears to result in a significant degree of missed generalization.

6.2 *The challenge of productivity*

Celtic mutations are also considered to fall within the purview of phonological computation because they are generally productive. Specifically, whenever the triggering conditions are met, the appropriate grade of the word will always be chosen.²⁷

However, this statement is not entirely watertight. In most languages, some items form exceptions from general mutation patterns. Common examples include proper nouns such as personal names and placenames. Borrowings more generally are often ‘resistant’ to mutation. This is sometimes related to the degree of integration, but it is clear that it cannot be the whole story: for instance, in Welsh the words *braf* ‘fine’ (ultimately from French) and *gêm* ‘game’ are codified as resisting mutation despite being perfectly well-integrated.²⁸

In any case, even if we set such items aside, it is common to find items that resist mutation for no clear synchronic reason. Examples from Irish are *d-* initial forms of the Irish verb *abair* ‘say’, such as *dúirt* ‘say.PAST’ and *déarfaidh* ‘say.FUT’, which resist lenition (and in some, but not all, cases also eclipsis). No mutation applies to functional items like the pronoun *cibé* ‘whoever’, the possessive clitics *mo*° ‘my’ and *do*° ‘your (sg.)’, and the quantifier *gach* ‘every’ (*faoi*° *g(*h)ach cloch* ‘under every stone’). There is not always a principled reason why this should be the case: the explanation is likely ultimately historical,²⁹ but the synchronic grammar also needs to accommodate the exceptions. From a strictly formal perspective, forms like *dúirt* should represent a separate series within the mutation system (with [d] across all grades), just like, strictly speaking, we need to posit separate grades to account for isolated cases of ‘nasal mutation’ in Breton and Cornish (section 2.3). This is not a move that should be taken lightly: in particular, we should note that it creates unresolvable ambiguity that prevents us from identifying the ‘unmutated’ grade as underlying per the discussion

²⁷ As noted earlier, we focus here on ‘traditional’ and codified systems. The system of mutation often undergoes significant change, often interpreted as attrition, under conditions of bilingualism, language loss, and heritage language maintenance: for some discussion of mutation in these kinds of contexts, see, for instance, Dorian (1977); Timm (1985); Hennessey (1990); Jones (1998); Boon (2014).

²⁸ Stammers & Deuchar (2011) argue such effects are epiphenomena of frequency and lexical organization rather than being specific to borrowings (see also Hammond et al. 2020).

²⁹ For example, in the case of *dúirt* the initial *d-* originates not from initial historical *d-*, as in most cases, but from a preverb, which underwent different changes as part of the complicated development of the Middle Irish verb *at-beir* ‘say’ (perfect *at-rubairt* > (*a*)*dubhairt* > *dúirt*)

in section 6.1. Even more involved are cases like Scottish Gaelic *mi* ‘I’ (Cox 2017: p. 59), which resists lenition except after forms of the copula *cha*^o (negative) and *bu*^o (past). Most current scholarship treats such cases as marginal exceptions, but they still need an account.

Still, by and large mutation appears to be, on the face of it, both productive and phonologically coherent. Both of these are the hallmarks of a phenomenon that should be ascribed to the effect of phonological computation. In the next section we turn to a discussion of how this analysis might work.

6.3 Deriving mutations phonologically

Any approach that derives mutation within the phonology is able to deal quite straightforwardly with the twin challenges of productivity and phonological coherence: these, after all, are exactly the motivations for applying it in the first place. In this section we examine the principal difficulties that these approaches encounter from the perspective of phonological theory.

First, the assumption of phonological coherence, taken for granted in section 6.1, is not entirely safe. The changes are not always either featurally consistent or uniform across series. Consider Irish lenition, which involves the following changes:

- Stop to fricative with no (or very minor) change of place or laryngeal specification: $p \rightarrow ph$ [f], $b \rightarrow bh$ [v], $c \rightarrow ch$ [x], $g \rightarrow gh$ [ɣ];
- Stop to fricative, change of place from coronal to glottal: $t \rightarrow th$ [h];
- Stop to fricative, change of place from coronal to dorsal: $d \rightarrow dh$ [ɣ];
- No change of manner, change of place from coronal to glottal: $s \rightarrow sh$ [h];
- Deletion (or, rather, removal of all features other than secondary place): $f \rightarrow fh$;
- Nasal to oral fricative, labials only: $m \rightarrow mh$ [v];
- Whatever featural change captures the change from fortis to lenis l, n, r ;
- No change to initial h (which is rare) or empty consonant.

Similarly, the mixed mutation of Breton (as represented in the written language) involves:

- Deletion in $gw \rightarrow g$;
- Devoicing in $d \rightarrow t$;
- Stop to fricative with preservation of place: $b \rightarrow v$;
- Stop to fricative with devoicing and change of place from dorsal to glottal: $g \rightarrow c'h$ [h];
- Nasal to oral fricative, labials only: $m \rightarrow v$;
- No change to other consonants (including n , which does not change to z)

To some extent, these inconsistencies can be independently motivated from other properties of the languages' phonology. For instance, the mapping from [d] to [ɣ] in Irish lenition could be analysed as an across-the-board change from coronals to glottals, with [ɣ] being output instead of the expected [h] by some version of Structure Preservation. Similarly, Breton [g] → [h] could be due to the absence of [ɣ]. Still, in some cases the featural inconsistency appears irreducible: there is no clear phonological reason

why *d* cannot mutate to *z* in Breton mixed mutation in parallel with *b* and (*mutatis mutandis*) *g*, especially given that this is exactly what occurs in lenition.

The classical statement of the piece-based approach is the analysis of Hamp (1951), framed within a version of North American structuralism, entirely skirts this issue. Hamp posits a dedicated ‘morphophonological’ level of representation containing units that are entirely abstract and undergo arbitrary modification as they are converted into phonemic representations. The alternation between Welsh *cath* ‘cat’ and *y °gath* ‘the cat’ is produced by the fact that the morphophonological representation of the definite article *y* in this context contains the ‘lenition’ morphophoneme *L*. The morphophonological representation /əLkəθ/ is then converted into phonemic /əgaθ/.

The abstract, diacritic nature of such morphophonemes makes them poorly compatible with views of phonological architecture that have formed the mainstream of generative phonology (cf. Kisseberth 1969, Kilbury 1976). Under these approaches, both classes of segments involved in phonological rules and the changes they effect are generally described in terms of distinctive features, which are themselves usually treated as phonetically grounded (for an overview, see Mielke 2011). As we have seen, not all Celtic mutations submit easily to this kind of analysis. First, the segments that undergo mutation are not always easy to describe as a featural grouping. The classic example here is Brythonic lenition, where any class that includes both /b/ and /m/ (which undergo lenition) must also include /n/ under almost any mainstream feature theory, yet /n/ remains unaffected. It is not always possible to reanalyse this failure of lenition by appealing to independent phonotactic restrictions: lenition of /n/ would be expected to produce /ð/ (in Welsh and Cornish) or /z/ (in Breton), which are definitely available within the mutation system. Second, the changes within a grade can be phonologically coherent, but do not have to be. Perhaps especially problematic are the cases of subtractive mutation or deletion, as in the lenition of Welsh *g*- and Irish *f*-.

The fundamental problem for phonological approaches to mutation discussed so far is that under widely shared theoretical assumptions it is impossible to effect the changes in a single fell swoop. Keeping to those assumptions requires ‘disaggregating’ the mutations into multiple rules, which, in turn, raises further issues: is it an accident that these rules are implemented as a single block? How is ordering to be resolved? For example, as we observed several times in section 2, some mutations appear to involve chain shifts within a single grade. Within rule-based phonology in particular, the standard analysis of a chain shift requires the rules to stand in counter-feeding order. Other kinds of specific ordering might also be required to get the correct results, for example where non-uniformity in the phonological changes involved is accounted for with rules targeting the illicit outcomes of the ‘main’ mutation rule (for instance, deletion of the notional [ɣ] produced by lenition of *g*- in Welsh). How can this be achieved? The simplest, but also theoretically the least restrictive, way is to simply state the ordering extrinsically (as done, for instance, by Rogers 1972, Willis 1990, Kibre 1997). Extrinsic ordering, however, is now generally seen as undesirable, so other

options have also been explored. For instance, the analysis of Pyatt (1997), which is set within a Distributed Morphology framework and implements the mutations via readjustment rules, achieves the necessary ordering by appeal to Pāṇinian specificity: rules targeting narrower segmental classes are assumed to apply first.

Another alternative is to reconsider the assumptions that drive the difficulty. The adoption of phonetically grounded distinctive features has precluded scholars from integrating abstract ‘morphophonemes’ into the phonological computation despite their ability to effect the relevant changes by a single rule. However, a reframing of subsegmental structure makes it potentially possible to still view mutations as a coherent process. In particular, it is widely recognized that the relationship between mutation grades in the Celtic languages can often be stated as increasing or decreasing the ‘strength’ or ‘sonority’ of the consonants involved. A theory of phonological representations that formalizes this scale, and movement along the scale, might have an advantage over the traditional view of features. In particular, such an approach can unify apparently disparate featural changes, notably including the lenition of the ‘fortis’ sonorants /L N R/ in the Gaelic languages — segments that do not even have a consensus representation in mainstream featural theory. Furthermore, an operation of stepping along a multi-valued scale automatically derives chain shifts, without any recourse to ordering. For this reason, analyses of Celtic mutation systems in phonological frameworks that operate with strength/sonority scales directly have been proposed numerous times: some examples are Griffen (1985) and Gnanadesikan (1997). A different approach to subsegmental representations that also relies on a direct formalization of ‘strength’ in featural structure is provided by the ‘element’ tradition, which has produced a rich seam of work on Celtic mutations (e.g. Ó Dochartaigh 1978, Ewen 1982, Grijzenhout 1995, Cyran 2010)

Another approach that leverages more elaborate subsegmental representations to account for mutations relies on the autosegmental turn in phonology from the late 1970s (Massam 1983, Lieber 1983, 1987, Ní Chiosáin 1991, Swingle 1993, Wolf 2007). This view combines the piece-based view of mutation triggering that goes back to structuralist work like that of Hamp (1951) with mainstream developments in featural theory. Under this view, the trigger is an autosegmentalized piece of phonological structure, similar to the abstract ‘morphophoneme’ but instead composed of the same kinds of features that segments consist of. The phonological computation has access to tools that can effect the changes without excessive recourse to extrinsic or intrinsic ordering, due to constraints on how the floating structure of the trigger combines with that of the target. In more recent versions of this approach (Iosad 2014, Breit 2019), the driver of mutation is phonologically conditioned allomorphy of the *trigger*: the different changes arise because the triggering lexical item has a number of competing exponents, which are chosen by subcategorization sensitive to the shape of the target. This approach has several advantages. First, it explains why mutation rules act as a block: all variants of a single grade are produced by a single lexical item. Second, no ordering is required to derive the phonological patterns, since at any one time only a single allomorph of the trigger is present. Third, the

system is able to account for arbitrarily complex systems: although this is, in a sense, trivial due to the power of arbitrariness in subcategorization, it appears inevitable in the face of problems facing all other phonological approaches.

What this discussion should make clear is that the answer to the question of whether a piece-based analysis is feasible ends up being highly sensitive to our phonological assumptions. Consider, for instance, once again the issue of chain shifts, which raise a number of problems. The first is the quality of the data. As discussed particularly in section 2.3, it is not always clear whether the mutation actually involves a chain shift: for example, Breton lenition has been described as both chain-shifting (/p/ → /b/ → /v/) and as two separate, non-overlapping processes (fortis /P/ → lenis /b/ and fortis /B/ → lenis /v/). If the latter description is correct, we have a case of incomplete neutralization — possibly even morphologically driven incomplete neutralization. This matter is in need of much more study, as the available results are conflicting: for instance, [Welby, Ní Chiosáin & Ó Raghallaigh \(2016\)](#) find some, albeit weak, evidence for incomplete neutralization in Irish eclipsis, whilst [Morrison \(2020b\)](#) find that mutation in Scottish Gaelic results in complete neutralization (see also [Ussishkin et al. 2017](#)).

Another problem is the more general approach to chain shifting. As noted earlier, phonological theories take very different approaches to this phenomenon, often bundled under the general heading of ‘opacity’ (cf. [Bye 2011](#)), with no consensus in sight.

Finally, the phonological plausibility of the piece-based approach to mutation depends very strongly on our assumptions about the subsegmental representations involved. For example some featural theories are able to capture the scalar aspects of mutation systems ([Griffen 1985](#), [Gnanadesikan 1997](#)), whilst in others it is more difficult to formalize the pattern of mutations in a unified way (although cf. [Rice 1993](#)). Any phonological analysis of mutations raises a whole host of representational issues, such as the correct interpretation of the laryngeal contrast in obstruents or the ‘fortis’/‘lenis’ distinction in sonorants. Some narrowly phonological, yet theoretically fundamental, commitments can seem difficult to square with the patterning of mutation. For instance, any theory of featural structure that operates with privative (unary) features or primes *a priori* appears unsuited to a concatenative analysis of mutation if the pattern, in featural terms, involves the loss (truncation) of such primes.³⁰

To summarize the discussion, then, phonological theory does not allow us to definitively rule out (or rule in, for that matter) a piece-based analysis of Celtic mutation: although no consensus analysis has been identified, we cannot conclusively establish that it is impossible, either.

7 The nature of initial mutation in Celtic

Given all of the above, what are the main approaches to the place of mutation in grammatical architecture? In this section, we will discuss three main approaches in light of the kinds of trigger and target restrictions we have considered. The main focus of the discussion will be on how well each

³⁰ However, see [Iosad \(2014\)](#) for one approach that aims to handle the problem; more generally, see [Bye & Svenonius \(2012\)](#); [Trommer & Zimmermann \(2014\)](#); [Zimmermann \(2017\)](#) for concatenative analyses of truncation.

approach handles the phonological patterns, the nature of the trigger and target, and the interaction with other components of the grammar.

7.1 Concatenative analyses

This remains the most common approach to Celtic mutations, particularly in work approaching them from phonological theory. As we discussed in section 6, most mutations present significant challenges to a phonological analysis, but it has not been firmly established that such an analysis is impossible.

This approach can clearly cope with unrestricted lexical triggers like prepositions: the mutating ‘morphophonemes’ can simply be assumed to part of the triggers’ lexical representation. In the case of triggers with morphological and syntactic restrictions, a relatively brute-force approach is to posit segmentally identical allomorphs with different mutating properties: although this might appear inelegant, drawing a distinction between a feminine singular form /ə°/ for the definite article in Welsh and the ‘elsewhere’ form /ə/³¹ is arguably not different from positing /ən°/ vs /nəʰ/ for the masculine and feminine genitive singular articles in Irish. This approach is also often consistent with the historical developments: the pattern arises because the masculine article descends from **sindos* and the feminine from **sindā*, a vowel-final form triggering sandhi lenition.

³¹ Ignoring for now the segmental allomorphy of the article, to which we will return.

However, not all patterns of mutation are quite as easily amenable to piece-based analysis. Particularly problematic are mutations that cannot be easily described via a closed list of triggers. Consider, for instance, the mutation of adjectives by feminine singular nouns. This could be analysed by positing a /°/ morphophoneme at the end of every relevant noun. The problem with this solution is less that it looks inelegant (since the connection between feminine singular and lenition is essentially accidental) and more that such nouns do not necessarily trigger mutation on other targets, including, notably, dependent nouns within the same NP. In fact, the very example we just used, the Welsh definite article, provides a strong argument against an overly trigger-centred approach to mutation: the F.S.G article (like a few other items) triggers so-called ‘limited soft mutation’ on following nouns (that is, it fails to mutate *ll-* and *rh-*), but regular soft mutation on following adjectives (Morgan 1952: pp. 12–17, Thomas 1996: pp. 689): *y llaw*_{F.S.G} ‘the hand’ but *y °lom aelwyd*_{F.S.G} ‘the poor hearth’ (with adjective-noun order). Unless we posit different allomorphs of the F.S.G article that depend on the structure of the following NP, it is not clear why the same item should show different mutation behaviour.

One solution that addresses this particular problem ties mutation to the exponence of particular morphosyntactic features on the target itself, rather than to (accidental) adjacency on the part of the trigger. So in Welsh *cath °fawr* ‘big cat’, the presence of the /°/ trigger on /*mawr*/ ‘big’ is due to the presence of a F.S.G specification in the morphosyntactic context. A further advantage of an analysis along these lines, if it can be made empirically adequate, is that it allows for various patterns of non-local mutation (section 5), as well as complicated morphological conditioning of mutation (for examples, see Iosad 2014, Breit 2019, Mondon 2020,

forthcoming). Clearly, however, such analyses are highly sensitive to morphological assumptions: for example, Breit (2019) argues that the soft mutation trigger on Welsh adjectives spells out a [FEM SG] *a* head. While this allows him to explain the behaviour of adjective mutation, the analysis requires a different view of gender agreement in adjectives like *gwyn* 'white.M.SG' vs. *gwen* 'white.F.SG', since this allomorphy, unlike mutation, is preserved in prenominal position. In his analysis, the latter kind of gender agreement is an instance of root allomorphy, whose details are highly controversial.

Despite this progress, some of the mutations triggered by open classes of triggers remain problematic. Perhaps the most acute issue is the Welsh 'direct object mutation'. As noted previously, some analyses (Zwicky 1984, Roberts 2005) ascribe it to a Case-assigning morpheme, which is, of course, very compatible with a piece-based approach to mutation. Unfortunately, as we have seen, this syntactic analysis is contested: in particular, under the so-called 'XP Trigger Hypothesis', this mutation is triggered at the start of any phrasal constituent that is c-commanded by its left-adjacent phrasal constituent. If some version of this is correct, it is difficult to see what would trigger the insertion of the necessary phonological material.

Another example is the mutation of postnominal adjectives in Irish in numeral phrases and in 'i + POSS + N' stative constructions. One could posit some kind of case or number specification (either on the noun to produce a leniting suffix or on the adjective itself) to account for the mutation of adjectives in these contexts; whilst technically possible, it might seem circular to explain mutation by introducing morphosyntactic processes for which there is no evidence other than mutation.

Given all these difficulties with a purely piece-based approach to mutations, it is not surprising that alternative approaches have been proposed in the literature. It is to them that we now turn.

7.2 Mutation and features

In this section and the next one we will consider approaches that reify mutation as a process available to the morphology, by directly formalizing the different mutation grades (like 'lenition', 'nasal mutation' etc.) as features (or other feature-like specifications) directly involved in building word structure.

One version of this approach, current in much generative literature dedicated to the phonology of mutation, uses diacritic features like [LENITION] in the structural description of the phonological rewrite rules (cf. Rogers 1972, McBrearty 1979, Kibre 1997, Pyatt 1997), essentially recapitulating the diacritic 'morphophonemes' of Hamp (1951). Morphologically, then, the status of such features is not different from the phonological triggers discussed in the previous section; however, the architectural status of these diacritic features and their relationship to phonological computation remains rather unclear.

In the traditional view embodied by the approaches considered so far (cf. section 4), mutation applies to the output of morphology. The inflectional paradigm of Welsh *cath* includes *cath*_{SG} and *cathod*_{PL} (however that paradigm is constructed); the fact that each member of this set has

four distinct alternants (*cath*, ^o*gath*, ⁿ*ngath*, ^h*chath*, and respectively for the plural) is due to a different part of the grammar.

If this assumption is relaxed, and ‘mutation features’ are treated similarly to other morphological and syntactic featural specifications, then the triggers of mutation, however conceived, are simply exponents of these features. Along these lines, [Gorrie \(2011\)](#) analyses the patterns of adjective mutation in a Scottish Gaelic dialect using a ‘morphophonological feature’ [LENITED], which is assigned to words based on a combination of morphosyntactic factors within the DP. However, [Gorrie \(2011\)](#) still does not equate mutation features with morphosyntactic ones, because they do not carry any semantic information: they serve merely as formal devices to mediate morphophonological exponence that is influenced by morphosyntax but not part of the productive phonological computation.

7.3 *Mutation as morphology*

Here, we discuss proposals that integrate mutations even more directly into the morphology. One such framework is developed by [Green \(2006, 2007\)](#). He argues that mutation is, essentially, an inflectional category like any other, so that mutation ‘inflection’ coexists, orthogonally, with other kinds of inflection. Thus, for a Welsh noun the inflectional paradigm consists of items marked [SG], [SG SOFT], [SG NASAL], [SG ASPIRATE], [PL], [PL SOFT] and so on. From a phonological perspective, the shape of each cell in the paradigm is already ‘pre-compiled’ (cf. [Hayes 1990](#)) in the morphology and so present in the underlying representation. Green conceives of the triggering of mutation as being akin to morphosyntactic subcategorization requirements.

This approach has a number of advantages. The immediate motivation for it is the inability of the phonological component to implement the mutations. As we have seen, the patterns can be quite irregular and demonstrate properties reminiscent of phonological opacity, which parallel Optimality Theory — Green’s framework of choice — cannot account for. Devolving the work of generating the alternants to morphology also opens up space for exceptions like non-mutating items. Mutation at a distance is similarly reduced to morphosyntactic processes manipulating mutation features. (It is perhaps notable, however, that while mutation features readily enter subcategorization relations, ‘mutation agreement’ appears very rare, although see section 5.4.)

Furthermore, although phonology does not participate in the creation of the mutation alternants, it can influence their distribution. [Green \(2006\); \(2007\)](#) envisages that the choice of mutation alternant is demanded by an OT constraint MUTAGREE, which is interspersed with (and can be outranked by) phonological constraints.

Similar to Green’s is the approach taken by [Stewart \(2004\)](#), which is even more elaborate in its embrace of morphology over phonology as the locus of mutational changes. Stewart emphatically rejects an Item-and-Arrangement view of morphology and develops a realizational framework with a large autonomous component dedicated to establishing the purely formal structure of paradigms. He envisages several points in the course of the derivation

where a choice of mutation grade is available: first, in the construction of word-forms within an inflectional paradigm (where mutation is included in stem formation); second, derivation and compounding (where a mutation operation participates in the formation of *bases*); third, inflectionally complete words may have several *shapes*, chosen based on the morphological or syntactic context above and beyond the word's inherent inflectional features. Since morphology in this view is fundamentally realizational rather than concatenative, phonological difficulties are largely absent due to the availability of a powerful morphological computation.

8 *Conclusion: mutation and non-concatenative morphology*

We have now arrived at the question that determines the fundamental importance of Celtic mutations for morphological theory. Given how complex they are both in terms of their phonological exponence and how deeply enmeshed their triggering is with the morphosyntactic component of the grammar, do they justify a retreat from a strictly piece-based, concatenative view of morphology towards a more powerful framework with arbitrary, non-concatenative operations?

The big question for proponents of a phonological view of mutation is whether it is possible for all the changes to be implemented solely with reference to a piece of structure, given what we know about how phonological computation works. Such an analysis must be able to handle phenomena such as featural change, mutation resistance, apparent opacity, and deletion/truncation. In section 6, we saw that while these issues are no doubt challenging, it may be somewhat premature to entirely give up on this enterprise.

A non-concatenative view of mutation, in turn, also faces a number of important questions. First, it must address the issues of regularity and productivity (sections 6.1 and 6.2). The fundamental difficulty here is that even if mutation is a morphological process, it is a purely formal one: the devices offered to account for mutations are not productive exponents of some grammatical category but usually arbitrary restrictions on paradigmatic structure. In this respect, they may be reminiscent of formal devices like morphemes — and, just like morphemes, it is not clear that such formal restrictions should be viewed as productive.

For this reason, many proponents of morphological approaches view mutation as fundamentally a matter of the lexicon. This 'precompiled' approach is, in a way, already implicit in the grade-based organization of the data offered in section 2, and an early analysis along these lines is proposed by Ellis (1965). In more recent years, both Stewart (2004) and Hannahs (2013) have suggested that more elaborate models of lexical storage can cast light on this conundrum, by treating the mutation grades as essentially lexically stored whilst still allowing for a degree of productivity.

What kind of empirical evidence might be used to distinguish the two approaches? One possible source is theoretically informed psycholinguistic enquiry into the lexical organization of mutated forms; some results are presented by Boyce, Browman & Goldstein (1987) and Ussishkin et al. (2017). A second, hitherto perhaps underappreciated, source is a more

elaborated view of the architectural properties of mutation. Such an approach should address the major weakness of our current understanding of Celtic mutation, which lies in the more or less implicit view that all mutations happen in the same component of grammar. This assumption is problematic for both phonological and morphological approaches to mutation.

Phonologically, we have seen that mutation cannot feasibly be handled ‘in one fell swoop’, and indeed ‘the same’ mutation might behave differently in different phonological or morphological contexts.³² More elaborate theories of phonology-morphology interaction are likely to be necessary to address these issues. On the morphological side of the ledger, we face the necessity of a theory of how mutation can interact with phonology. If morphology happens prior to phonology, then mutation should be blind to the effects of phonological computation; conversely, if we view phonology and morphology of mutation as interacting with each other, this interaction should be consistent with our view of this interface.

It is, in fact, demonstrably not the case that mutation belongs to a single component. At least some instances of phenomena traditionally included in mutation systems are simply due to the effects of (postlexical) phonology. We have already mentioned Scottish Gaelic eclipsis and Breton ‘new lenition’ as examples of phonological phenomena that should not be included alongside other mutations. Another example is provided by Breton ‘provection’, which combines devoicing of obstruents and prefixation of [h] to sonorants (and vowels). Iosad (2017) argues that it is not a morphosyntactically driven mutation but simply the manifestation of a segmental [h]; furthermore, he shows that the so-called ‘mixed mutation’ in many Breton varieties is an epiphenomenon of a regular lenition trigger containing this segmental [h], which exerts a phonologically regular devoicing effect on the product of lenition.

Particularly important are cases where mutation is demonstrably not ‘done’ by a very late stage in the derivation. One very clear example is the possibility for mutation to depend on prosodic phrasing, as discussed in section 3.5.

Iosad (2014) shows that ‘late resolution’ is necessary in the case of Breton adjective lenition (section 3.4). Its absence after obstruent-final nouns cannot be attributed to morphological causes; at the same time, we cannot ascribe the apparent ‘failure’ of voiceless stop to undergo voicing to regular sandhi phonology, since the phonological behaviour of such consonants is distinct from unmutated ones. This indicates that the outcome of mutation processes is not fully resolved within the word, and moreover subject to regular phonology at the postlexical stage. Furthermore, while the proposals of Iosad (2014) are couched within a particular set of assumptions about phonological features, the analysis offers some evidence not only that it is possible to analyse truncation — often cited as a decisive argument against piece-based analyses of mutation — as an epiphenomenon of affixing phonological material but also that this is in fact a desirable approach to the pattern, since the triggering autosegment remains visibly active in the phonology when truncation (i.e. mutation) fails.

Hannahs & Tallerman (2006) draw attention to another case in Welsh: the negative complementizer *na(d)* triggers ‘mixed mutation’, which involves,

³² See the discussion of ‘limited soft mutation’ in Welsh in section 7.1, or the discussion of ‘full’ and ‘restricted’ spirantization in Breton in Iosad (2014).

crucially, deletion of initial *g-* before a vowel. In this circumstance, the complementizer takes its prevocalic allomorph: *na °allai fe* ‘that he could not’ rather than **nad °allai fe*. This contrasts with the definite article *y(r)*, which resolves its prevocalic/preconsonantal allomorphy *after* mutation (*yr °ardd* ‘the garden’). The architectural consequences of the analysis of facts such as these should be particularly important for an integrated approach.

In summary, despite significant progress in our understanding of both phonological and morphological aspects of Celtic mutations, a definitive conclusion on their precise architectural status remains elusive. It is certainly too early to claim with certainty that these phenomena vindicate particular approaches to morphology and morphophonology. Apart from more empirical data from both phonetic and psycholinguistic perspectives (work that is increasingly urgent given the sociolinguistic fragility of the speaker communities), what is needed is a careful, theoretically informed disentangling of the numerous factors that, simultaneously or sequentially, influence the realization of word-initial consonants in the Celtic languages.

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