

Phantom Phonology and Aperture Positions

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1. Introduction

Modern Irish features the following "bizarre" phenomenon, known as *MUTATION*.¹ The Modern Irish word that is pronounced with initial [p] in (1a) is pronounced with initial [f] when following the possessive pronoun *a* 'his' in (1b):

- (1) a páipéar p = [p] 'a paper'
 b a pháipéar ph = [f] 'his paper'

Moreover, the word that is pronounced with initial [f] in (2a) is realized without an initial consonant in (2b):

- (2) a fata f = [f] 'a potato'
 b a fhata fh = Ø 'the potato' (masc.sg.gen)

In phonology, the difference between /p/ and /f/ is traditionally characterized by the *manner* feature [continuant]: plosives involve complete closure in the vocal tract and are specified as '[-continuant]', fricatives, on the other hand, are articulated with a lesser degree of stricture in the vocal tract and are specified as '[+continuant]'. On the basis of additional mutation facts from a variety of languages, I will propose in this paper that the feature [continuant] is a phonological phantom: it does not exist.

The change from plosive to fricative in the examples under (1) and from fricative to absence of the segment in (2) is an example of a cross-linguistically common process called 'Lenition'. In section 2, it will be shown that it is difficult to capture Modern Irish Lenition in a phonological rule which makes use of the manner feature [continuant]. In the rest of the paper I will then argue that the consonantal changes in Modern Irish, like other types of Mutations in a variety of unrelated languages, can be better understood when seen from the point of view of Steriade's (1991) A(perture)-Positions.

Section 3 briefly introduces the notion of Aperture Positions. Plosives have two A-Positions (one indicating complete lack of aperture in the vocal tract and one indicating release), and fricatives have one (for release). We subsequently explain how Modern Irish Lenition can be accounted for as a process involving *deletion* of

¹ I would like to thank the editors of this volume and an anonymous reviewer for useful comments.

an initial Aperture Position. We will suggest in section 4 how this account may be implemented in the recently developed framework of Optimality Theory (OT).

The account we advocate in this paper for the phenomenon of Modern Irish Lenition is supported by the fact that it also explains consonant alternations in other languages. In Finnish, for instance, long plosives are realized as short plosives, while short plosives are realized as continuants. Section 5 demonstrates that these changes are best explained as involving *deletion* (or, in OT terms, *underparsing*) of an Aperture Position.

In West Atlantic languages, on the other hand, we often find that continuants are realized as plosives and in native American languages short plosives are sometimes realized as long plosives. These alternations are accounted for in section 6 as *insertion* of an Aperture Position.

Section 7 goes on to show a different kind of mutation in Modern Irish, viz. one that involves voicing of voiceless plosives and nasalization of voiced plosives. To explain this phenomenon we consider Rice's (1993) proposal concerning a node called 'Sonorant Voice' (SV) which may characterize voicing of plosives and of sonorants. The mutation process described immediately above is analyzed as association of SV to one Aperture Position.

Combinations of the two types of mutation are also attested, for instance, in some languages mutation may involve insertion of an Aperture Position and association of SV and section 8 shows that Southern Paiute Prenasalization is a case in point.

2. *Scalar Changes from Plosive to Fricative and from Fricative to Deletion*

Modern Irish Lenition is a process that typically involves the manner of articulation. Consonants that change their manner of articulation in certain non-phonological environments in Irish are presented in (3). Consonants that do not alternate are the coronal nasal /n/ and the liquids /l,r/.

(3) Modern Irish Lenition²

underlying	surface form	underlying	surface form
p	f	f	Ø
t	h	s	h
k	X		
b	v		
d	ɣ		
g	ɣ		
m	w		

² Palatalization is distinctive in Irish, but is ignored here.

As an example of a phonological approach in which the feature [continuant] plays a predominant role, consider Ní Chiosáin's (1991) analysis of Modern Irish Lenition. The changes alluded to above are accounted for by her by a so-called 'feature fill-in' rule. Some segments are underlyingly unspecified for certain features which may be 'filled in' by a phonological rule or else by a redundancy rule. Plosives, for instance, are assumed to be unspecified for the feature [continuant], the fricative /f/ is assumed to be specified as '[+continuant]', while /h/ is only specified as '[-son]':

- | | | |
|---|---|------------------------|
| (4) a /p,t,k,b,d,g/
[-son, +cons] | b /f/
[-son, +cons]

[+cont] | c /h/
[-son] |
|---|---|------------------------|

In environments where Modern Irish Lenition does not apply, a redundancy rule inserts the feature-value '[-continuant]' for plosives and '[+continuant]' for /h/. In environments where Lenition applies, however, for instance in (1b), the value '[+continuant]' is inserted by the Spirantization rule, i.e. the rule in (5) below:

- (5) Spirantization³
- $$\begin{array}{c}
 [w_d \quad \alpha \\
 | \\
 [\quad] \rightarrow [+continuant]
 \end{array}$$

The sound /f/ undergoes the spirantization rule vacuously, because it is underlyingly specified as '[+continuant]', (see 4b). For this case, Ní Chiosáin (1991:51) proposes a default rule 'Total Deletion', which only applies when the Spirantization rule applies vacuously. This seems theoretically "suspect". In this vein, Kelly (1989) points out that "this segment obviously poses problems for any theory which claims that lenition is the result of a single feature alternation since other distinguishing representations are required to successfully delete only this segment". I would not address this point, however, if I did not think a solution is available. The source of the problem concerning a phonological account of spirantization of plosives and deletion of /f/ seems to be the assumed existence of the feature [continuant] in Feature Geometry and Underspecification theories. I will not here point out the many other problems that are related to this feature: it is more interesting to discuss an alternative and to consider how we can formally capture the difference between plosives and fricatives without the use of the feature [continuant]. To this end, I will first consider in section 3 a recent proposal by Steriade (1991) to represent plosives

³ For the t ~ h and s ~ h alternations, Ní Chiosáin proposes a different rule, which is not relevant to the discussion here.

3. Aperture Positions

(6) a Closure (A_0) ~ total absence of oral airflow
 b Fricative (A_{fric}) ~ degree of oral aperture sufficient to produce a turbulent airstream
 c Approximant (A_{max}) ~ degree of oral aperture insufficient to produce a turbulent airstream

(7) a Plosive b Fricative
 A_0 A_{release} A_{release}

(8) a Plosive \rightarrow Fricative;
 $A_0 A_{rel} \rightarrow A_{rel}$
 b Fricative \rightarrow deletion
 $A_{rel} \rightarrow \emptyset$

One of the explicit goals of Prince & Smolensky's (1993) framework of *Optimality Theory* (OT) is to deny the existence of phonological rules which apply

to underlying representations. Instead, they propose a set of ordered phonological constraints on surface representations. Of the potentially infinite number of possible surface representations, the one that violates the least high-ranked constraints is selected as the optimal surface form. The phenomena that are discussed within OT are related to harmony processes, reduplication, stress and place assimilation. So far, little attention has been paid to scalar changes in the manner of articulation of consonants. Gahl (1994) has recently discussed Welsh Lenition as a prosodic constraint on Aperture Nodes, and in the present section I will propose an analysis of Irish Lenition in OT.

As examples (9b), (10b) and (11b) illustrate, Irish Lenition applies to word-initial consonants only. It thus exhibits a typical 'alignment effect' in the sense of McCarthy & Prince (1993):⁴

- | | | | | |
|------|---|----------|-----------|------------|
| (9) | a | peann | p = [p'] | 'a pen' |
| | b | a pheann | ph = [f'] | 'his pen' |
| | | | | |
| (10) | a | feoil | f = [f'] | 'meat' |
| | b | a fheoil | fh = Ø | 'his meat' |
| | | | | |
| (11) | a | póg | p = [p'] | 'kiss !' |
| | b | phóg mé | ph = [f'] | 'I kissed' |

In section 3 we saw that a plosive has two Aperture Positions. In Modern Irish Lenition environments, word-initial plosives are realized as fricatives, i.e. as segments which have one Aperture Position. There thus seems to be a constraint which does not allow the word-initial Aperture Position to be parsed in Lenition environments. The deletion process in (8) can be 'translated', so to speak, into a constraint called 'Non-align': "no Aperture Position allowed at the edge of a particular domain". The fact that the first Aperture Position is not aligned to the left edge of a stem means that it remains unparsed. This is indicated by '<A>' in the tableau below.

The optimal candidate of a string in a lenition environment is the one which minimally violates the morphological constraint 'Non-align an A-position' at the left edge of a stem ('Non-Align' (A,Left, Stem,Left)) and the prosodic constraint 'Parse A-Position', ranked in that order. For *a pheann* 'his pen', the input form has two Aperture Positions, i.e., /p/ is represented as (A A). In the optimal surface form, however, the initial Aperture Position is not parsed and /p/ is thus realized as the fricative [f]:

⁴ Palatalization of labial consonants is indicated here by [p'] and [f'].

(12)

<i>a pheann</i>	Non-Align	Parse A-Pos	<i>a fheoil</i>	Non-Align	Parse A-Pos
a [A A eann]	*!		a [A eoil]	*!	
☞ a [<A> A eann]		*	☞ a [<A> eoil]		*
a [<A><A>eann]		* *!			

Now that we have sketched an analysis of one Lenition process; that is, the one in Irish, section 5 tries to find independent support from another language with a similar (but not exactly the same) process, viz. Finnish.

5. *Scalar Changes from "A₀ A₀ A_{rel}" to "A₀ A_{rel}" and from "A₀ A_{rel}" to "A_{rel}"*

In Finnish (Vainikka 1988), we find that single plosives are realized as continuants in the onset of a non-initial closed syllable (see 13b), while geminate plosives are realized as single plosives in the same environment (see 14b):

- (13) a tapa p = [p] 'custom' (nom)
b tavan v = [w] 'custom' (gen)

- (14) a lappu pp = [p:] 'piece of paper' (nom)
b lapun p = [p] 'piece of paper' (gen)

In some dialects, the inessive suffix *-ssä* has changed to *-sä*. According to Skousen (1972:571), this suffix still induces gradation even though it does not close the preceding syllable. Conversely, some suffixes which close a preceding syllable do *not* change the form of the onset consonant in that syllable. Examples of possessive suffixes that close a preceding syllable, but which do not trigger gradation of <t> are presented in (15c-f) (Skousen 1972:572):

- (15) a käteni 'my hand'
b kätesi 'your (sg) hand'
c kätensä 'his hand'
d kätemme 'our hand'
e kätenne 'your (pl) hand'
f kätensä 'their hand'

With respect to geminate consonants, consider that plosives in coda position are generally unreleased. In Steriade's framework an unreleased plosive is represented

as 'A₀'. The geminate consonant in (14a) may be analyzed as a sequence of an unreleased plosive in coda position and a released plosive in onset position, that is, as 'A₀ A₀ A_{rel}'. Spirantization of single plosives and degemination of geminate plosives in Finnish can be analyzed in the same way as the Lenition process in Modern Irish. I propose here that the gradation processes in (13b) and (14b) involve deletion of the initial 'A₀' position of the 'A₀ A_{rel}' consonant at the edge of a domain (here the left edge of the second syllable) and reduces the consonant to 'A_{rel}'. In (14b), resyllabification groups the 'A₀' closing the first syllable together with the 'A_{rel}' opening the second syllable, resulting in an 'A₀ A_{rel}' consonant:

	underlying form	Finnish Gradation	surface form
(16) a	A ₀ + A ₀ A _{rel}	→	A ₀ A _{rel} (halut + ten → haluten)
b	A ₀ A _{rel}	→	A _{rel} (saa + ten → saaDen) ⁵

So far, we considered Modern Irish Lenition and Finnish Consonant Gradation. They are both consonant weakening processes which we analyzed as deletion of an Aperture Position of the consonant that undergoes the process. The reverse process, i.e., consonant strengthening, is also attested. We consider below whether these processes can be analyzed as insertion rather than deletion of an Aperture Position.

6. Changes from "A_{rel}" to "A₀ A_{rel}" and from "A₀ A_{rel}" to "A₀ A₀ A_{rel}"

In some West Atlantic languages, for instance the Gomba dialect of Fula (Lieber 1987), we find that stem-initial continuants are sometimes realized as plosives (see examples 17a-c) and in native American languages, for instance Shoshonean Southern Paiute (Sapir 1930), single affix-initial plosives are often realized as geminates (see 18):

- (17) Fula continuant → plosive
 a fow- 'hyena' → **p**owal 'little hyena'
 b waa- 'monkey' → **baa**ði 'monkeys'
 c γim- 'person' → **gi**mdo 'person' (sg)
- (18) Paiute plosive → geminate
 movi + pi → movi**ppi** 'nose' (absolute form of noun)

These alternations can all be accounted for as *affixation* of an A-position indicating closure. In Fula, one Aperture Position is affixed to the original Aperture Position

⁵ 'D' represents a sonorant flap (Vainikka 1988).

for release so that continuants are realized as plosives. In Southern Paiute, an Aperture Position is affixed to the two Aperture Positions which are carried by the underlying plosive so that the plosive is realized as a geminate (compare the representation of geminate consonants as carrying three Aperture Positions as suggested for Finnish in 16a).

- (19) Fula Spirantization: continuant → short plosive
 Arelease → *A₀ Arelease*
- (20) Paiute Gemination: plosive → geminate
 A₀ Arelease → *A₀ A₀ Arelease*

7. Changes from Voicelessness to Voicing and from Voicing to Sonority

Now consider as another type of consonant alternation that the plosive /p/ is voiced in a Modern Irish nasalizing environment in (21b), while /b/ is realized as the nasal [m] in the same grammatical environment in (22b):

- (21) a peann p = [p'] 'pen'
 b a bpeann bp = [b'] 'their pen'
- (22) a bó b = [b] 'cow'
 b a mbó mb = [m] 'their cow'

Following Rice (1993), I will assume that when voiced obstruents and sonorant consonants form a natural class in a language, they are specified by 'Sonorant Voice' (SV) rather than by the features '[voice]' and '[sonorant]'. With respect to SV consider that Aperture Positions, which, according to Steriade (1991), may be anchoring nodes for other features, enable us to characterize a three-way contrast among plosives. For Modern Irish, I suggest that one SV node associated to one A-position is interpreted as voicing. An SV node associated to two A-positions (indicating the closure and release phase of plosives respectively) indicates nasality:



- (23) a /p/ b /b/ c /m/
- A₀ Arel* *A₀ Arel* *A₀ Arel*
- | \ /
- SV SV

The scalar change from /p/ to [b] in (21b) and from /b/ to [m] in (22b) is accounted for here as *association* of an SV node to an initial consonant when the appropriate context is met. If the initial consonant is a voiceless plosive, SV associates to the

Aperture Position indicating release. If the initial consonant already has one SV node, the SV node associates to the other remaining Aperture Position. If the initial consonant is a nasal, association of SV applies vacuously.

In Optimality terms: the optimal candidate of a string in a nasalizing environment is the one which minimally violates the morphological constraint 'Align SV at the left edge of a stem' ('Align' (SV, Left, Stem, Left)) and the lower ranked Faithfulness constraints which ensure that the input closely corresponds to the output:

(24)

<i>a bpeann</i>	Align [SV	Faith- fulness	<i>a mbó</i>	Align [SV	Faith- fulness
a [A A eann] [<SV>	*!		a [A A ó] [<SV> SV	*!	
 a [A A eann] [SV		*	 a [A A ó] [SV SV		*
a [A A eann] \ / [SV		* *!			

Consonant alternations between voiceless and voiced plosives and/or between voiced plosives and (pre)nasals involve *association* of an SV node at a certain edge of a domain. Conversely, consonant alternations may involve *delinking* of an SV node (for instance when voiced plosives are devoiced).

8. Conclusion

This paper considered consonant alternations which, on the surface, may seem "spectacular" (Rotenberg 1978) or "bizarre" (Lieber 1987). They are illustrated by the following schematic representations of labial consonant changes which are conditioned by morphological or syntactic environments in various languages:

- (25) a p → f; f → ∅ (e.g. Modern Irish Lenition)
 b pp → p; p → w (e.g. Finnish Gradation)
- (26) a f → p (e.g. Fula Fortition)
 b p → pp (e.g. Southern Paiute Geminization)
- (27) p → b; b → m (e.g. Modern Irish Nasalization)

These (sometimes scalar) mutations become much less "spectacular" or "bizarre" when we recognize that Aperture Positions and Sonorant Voice are involved. The scalar changes exemplified in (25a-b) involve deletion (or underparsing) of an Aperture Position, while the non-scalar changes in (26a-b) involve insertion (or affixation) of an Aperture Position for closure. The consonantal changes in (27) are analyzed by me as association of SV to an Aperture Position.

We may also expect to find processes which combine deletion or insertion of an Aperture Position and association of SV. These processes are in fact attested. In (18), we saw that affix-initial short plosives are sometimes realized as geminate plosives after certain lexical items in Southern Paiute. According to Sapir, the same affix is sometimes realized as a prenasal after other lexical items:

- (28) Paiute short plosive → prenasal
 $a\gamma o + pi \rightarrow a\gamma ompi$ 'tongue' (absolute form)

This phenomenon may be explained as insertion of an Aperture Position and simultaneous association of SV as illustrated below:

- (29) $A_0 Arel \rightarrow A_0 A_0 Arel$
 $\quad \quad \quad |$
 $\quad \quad \quad SV$

The theory proposed here rules out the possibility that the following scalar consonant alternations are attested within a single system of Consonant Mutation because they cannot be analyzed as involving either deletion or insertion of an Aperture Position or (additional) association of SV:

- (30) a $*f \rightarrow p$; $p \rightarrow b$
 b $*f \rightarrow b$; $b \rightarrow p$

Aperture Positions are independently argued for by Steriade (1991) and an SV node is motivated by Rice (1993). A combination of these two proposals provides us with a theory which makes falsifiable predictions and is restrictive enough to account for the group of attested consonant alternations.

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