Phonological Opacity and Icelandic Preaspiration

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Abstract

This paper explores the relationship between constraints on syllable contact and the emergence of so-called preaspirated stops in Icelandic. It is a well-known fact of Icelandic phonology that, when followed by a sonorant, a stop loses its aspiration. However, there are two patterns. When followed by /l, n, m/, a stop surfaces with `preaspiration', i.e. as a sequence of [h] + plain stop. When followed by /j, v, r/, the result is a plain stop preceded by a long vowel. The most promising approaches to this problem have attributed the dierence between the two patterns to dierences in syllabication, due to language-specic constraints on syllable contact. The argument is that the dierence between the two patterns lies in the amount of sonority rise within the dierent clusters, i.e. that consonant clusters that rise too much in sonority (apirated stop + /j, v, r/) cannot cross a syllable boundary and will therefore emerge as complex onsets preceded by a long vowel. Preaspirated stops, on the other hand, have nothing to do with syllable contact and emerge in the surface structure for independent reasons.

I propose that laws of syllable contact are in fact also the main motivation behind the emergence of preaspirated stops in Icelandic, along with constraints on glottal activity in stressed syllables. The two patterns arise due to dierent rankings of specic syllable contact constraints relative to other phonological constraints in the system. I furthermore demonstrate that preaspirated stops are the result of an opaque interaction of phonological constraints and can therefore not be derived within the framework of classic OT.

Phonological Opacity and Icelandic Preaspiration

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1 Introduction

It is a well-known fact of Icelandic phonology that a stop loses its aspiration when followed by a sonorant. However, there are two patterns. When followed by /l, n, m/, a stop surfaces with preaspiration, i.e., as a sequence of [h] + plain stop, as shown in (1):

(1)	*epli*	/ep^{h}lɪ/	[ɛhplɪ]	'apple'
	batna	/pat^{h}na/	[paht̪na]	'get better'
	seytla	/seit^{h}la/	[seihtla]	'seep'
	ekla	/ek^{h}la/	[ɛhkla]	'shortage'
	opna	/op^{h}na/	[ɔhpna]	'open'
	vakna	/vak^{h}na/	[vahkna]	'wake up'

When followed by /j, v, r/, the stop loses its aspiration and is preceded by a long vowel, as shown in (2):

(2)	*titra*	/t^{h}ɪt^{h}ra/	[t^{h}ɪːtra]	'tremble'
	lepja	/lep^{h}ja/	[lɛːpja]	'drink'
	tepra	/t^{h}ep^{h}ra/	[t^{h}ɛːpra]	'prude'
	skrökva	/sk^{h}rœk^{h}va/	[skrœːkva]	'lie'
	sitja	/sit^{h}ja/	[sɪːtja]	'sit'
	flysja	/flisja/	[flɪːsja]	'peel'

The most promising approaches to this problem have attributed the difference between (1) and (2) to differences in syllabification, due to language-specific constraints on syllable contact that only affect the forms in (2) (Vennemann 1972, Gouskova 2004). In this paper I propose that laws of syllable contact are in fact also the main motivation behind the emergence of preaspirated stops in Icelandic, along with the phonological patterns of aspiration as well as stress. The difference between (1) and (2) lies in different degrees of syllable contact violations, not the presence and absence of such violations.

The paper will proceed as follows: Section 2 gives some background information about the Icelandic language, with the consonant inventory presented in Section 2.1 and prosodic structure discussed in Section 2.2. The distribution of aspirated segments in Icelandic is discussed in Section 3 and various aspects of syllable contact are touched upon in Section 4. A new analysis of Icelandic preaspirated stops is given in Section 5 and final remarks are found in Section 6.

2 Background

2.1 Consonant Inventory

The Icelandic consonant system consists of 18 phonemic consonants, presented in Table 1.[1]

In addition to the consonants shown in Table 1, Icelandic has 12 allophonic consonants. Most notably, every sonorant consonant in the language, i.e., [l], [m], [n] and [r], has an aspirated counterpart which surfaces before an underlying aspirated stop (or in word-initial position as a result of an underlying /h + sonorant/ cluster).

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[1] It is not entirely clear that [ɣ] should be treated as a phonemic consonant rather than an allophone of /k/ but that issue is not relevant to arguments made in this paper so it will be left unresolved.

	Labial	Dental	Alveolar	Palatal	Velar	Glottal
Plosive	p p^h		t t^h		k k^h	
Nasal	m		n			
Fricative	f	θ	s		ɣ	h
Approximant	v	ð		j		
Lateral			l			
Trill			r			

Table 1: Phonemic consonants in Icelandic.

2.2 Basic Aspects of Prosodic Structure

Icelandic allows various types of syllables (V, VC, (CC)CV(C)) and here it will be argued that complex codas do *not* occur in the language. Primary stress is always on the initial syllable and all stressed syllables are bimoraic. Vowel length is non-contrastive; vowels are long in open stressed syllables and short otherwise, as shown in (3):

(3) *mala* /mala/ [maa.la] 'grind'
binda /pɪnta/ [pɪn.ta] 'bind'

This can be captured in an Optimality Theory framework by applying the following constraints:

(4) ONSET — A syllable must have an onset.
STRESS-TO-WEIGHT — Stressed syllables must be heavy (bimoraic).
NOLONGVOWEL — Assign one violation mark for each instance of a long vowel in the output.
NOCODA — Syllables are open.

ONSET outranks STRESS-TO-WEIGHT because otherwise the intervocalic consonant would surface in coda position to satisfy the bimoraic requirement on stressed syllables, as in candidate (5b). STRESS-TO-WEIGHT outranks NOLONGVOWEL, allowing the vowel to be lengthened in an open syllable. Finally, NOCODA is outranked by NOLONGVOWEL, ensuring that word-medial consonant clusters are heterosyllabic in surface structure.

(5) Intervocalic consonants surface in onset position.

Input: /mala/	ONSET	STRESSTOWEIGHT	NOLONGVOWEL
a. ☞ maa.la			*
b. mal.a	*!		
c. ma.la		*!	

(6) Codas are preferred over complex onsets.

Input: /pɪnta/	NOLONGVOWEL	NOCODA
a. ☞ pɪn.ta		*
b. pɪɪ.nta	*!	

3 Distribution of Aspiration

Icelandic distinguishes between two kinds of unvoiced stops: aspirated /p^h, t^h, k^h/ and plain /p, t, k/. In the southern dialect, which is spoken by the vast majority of Icelanders and will be the subject of this paper, the difference between aspirated and plain stops is neutralized word-internally and word-finally, limiting the occurrence of aspirated stops to word-initial position only.

(7) Aspiration is lost following an open syllable.

tapa	/t^{h}ap^{h}a/	[t^{h}aa.pa]	'lose'
lak	/lak^{h}/	[laa.k]	'sheet'[2]
betra	/pet^{h}ra/	[pɛɛ.tra]	'better'

This pattern and others that have to do with aspiration can be captured using the following OT constraints:

(8)

MAXASP	Do not delete aspiration.
MAXASP[ONS]$\acute{\sigma}$	Do not delete aspiration in stressed syllable onsets.
OCP[ASP]	Assign one violation mark for each instance of adjacent aspirated segments in output.
RELEASE	Assign one violation mark for each instance of an unreleased aspirated stop in output (i.e., occurring before an obstruent).
*ASP	Assign one violation mark for each instance of aspiration in output.
*ASP[ONS]	Assign one violation mark for each instance of aspiration in a syllable onset.
MAXCONTINUANCY	Do not delete manner features.
MAXPLACE	Do not delete place features.

(9) Aspiration is lost following an open syllable.

Input: /t^{h}ap^{h}a/	MAXASP[ONS]$\acute{\sigma}$	*ASP[ONS]	MAXASP
a. ☞ t^{h}aa.pa		*	*
b. t^{h}aa.p^{h}a		**!	
c. taa.pa	*!		**

Outside of the stressed syllable, aspirated segments can only appear in coda position in the southern dialect of Icelandic.

(10)

múlatti	/mulat^{h}t^{h}ɪ/	[muu.lah.tɪ]	'mulatto'
gamalt	/kamalt^{h}/	[kaa.mḁl.t]	'old, neuter'

As a result of this restriction, and the fact that consonant clusters are generally heterosyllabic in Icelandic, aspiration must always surface on the *first* segment in a cluster of two word-medial consonants, regardless of underlying structure. If the coda consonant happens to be a stop, some or all of the stop's oral features are lost in the surface structure due to an independent constraint against the appearance of aspirated stops in pre-consonantal position (RELEASE).

(11) Word-medial aspirated stops surface as an aspirated fricative or sonorant,[3] or as preaspiration.

vanta	/vant^{h}a/	[vḁn.ta]	'to lack'
vakta	/vak^{h}t^{h}a/	[vax.ta]	'to watch'
hoppa	/hop^{h}p^{h}a/	[hɔh.pa]	'to hop'
batna	/pat^{h}na/	[pah.tna]	'get better'

[2]The syllabification of [laak] here assumes that final consonants are extrasyllabic in Icelandic, see e.g., Morén (2001) for discussion.

[3]It is assumed here that the main difference between phonemically voiced and voiceless fricatives (and sonorants) in Icelandic is the feature [spread glottis], not voicing (Kingston 1990).

(12) Aspiration shifts from a stop to a preceding sonorant.

Input: /vant^{h}a/	*ASP[ONS]	MAXASP	*ASP
a. ☞ van̥.ta		*	*
b. van.t^{h}a	*!	*	*
c. van.ta		**!	

(13) An aspirated stop spirantizes before a heterorganic aspirated stop. The second stop loses its aspiration.

Input: /vak^{h}t^{h}a/	OCP[ASP]	RELEASE	MAXASP	MAXCONT
a. vak^{h}.ta		*!	*	
b. vak^{h}.t^{h}a	*!	*!		
c. ☞ vax.ta			*	*

(14) An aspirated geminate stop surfaces as a preaspirated stop.

Input: /hɔp^{h}p^{h}a/	OCP[ASP]	RELEASE	*ASP[ONS]	MAXASP	*ASP	MAXPLACE
a. hɔp^{h}.p^{h}a	*!	*!	*		**	
b. ☞ hɔh.pa				*	*	*
c. hɔp.pa				**!		
d. hɔp.p^{h}a			*!	*	*	
e. hɔp^{h}.pa		*!		*	*	

To refer to the stop in (14) as 'preaspirated' is perhaps somewhat of a misnomer. In some languages (e.g., Faroese), preaspirated stops are the mirror image of postaspirated stops, i.e., they are stops preceded by a brief period of aspiration. Phonetic studies show, however, that in Icelandic this period of aspiration has the duration of a full segment and is equivalent to [h] (see e.g., Thráinsson 1978:4). This is substantiated by phonological evidence since forms like [hɔh.pa] are only possible outputs if the aspiration preceding the stop is moraic (parsing this word as [hɔ^{h}p.a] would be a fatal violation of ONSET). The crucial difference, then, between postaspirated and preaspirated stops in Icelandic is that preaspirated stops are really a sequence of two segments, [h] and stop, and can't therefore be derived from postaspirated stops simply by changing the timing relationship between glottal opening and oral closure. Instead we must assume that these preaspirated stops are derived from a cluster of an aspirated consonant followed by a stop. Despite not being a single segment, clusters of aspiration and stop in Icelandic are traditionally referred to as preaspirated stops and I will follow that convention here.

4 Syllable Contact

4.1 Open Syllable Lengthening

An exception to the general rule of consonant heterosyllabicity in Icelandic are clusters of the type /p^{h}, t^{h}, k^{h}, s/ + /j, v, r/, which syllabify as complex onsets.

(15) *flysja* /flɪsja/ [flɪɪ.sja] 'peel'
lepja /lɛp^{h}ja/ [lɛɛ.pja] 'drink'

Following Vennemann (1972), Gouskova (2004) and others, I attribute this to laws of syllable contact, the idea being that each language selects a threshold for an acceptable sonority slope between coda and a following onset. If two consonants differ too much in sonority, a syllable boundary cannot be placed between them.

The analysis presented in this and following sections will build on Gouskova's (2004) constraints on syllable contact. The DISTANCE constraints are in a stringency relationship and predict that combinations of coda and onset with a certain sonority distance should be either well-formed or ill-formed in a given language. The syllable contact scale for Icelandic, shown in Table 2, is based on Gouskova's work with some modifications. The complete sonority hierarchy of Icelandic is shown in Table 3.

0	*+1*	*+2*	*+3*	*+4*	*+5*	*+6*
v/v	r/v	n/v	ð/v	θ/v	t/v	s/v
r/r	n/r	ð/r	θ/r	t/r	s/r	
n/n	ð/n	θ/n	t/n	s/n		
ð/ð	θ/ð	t/ð	s/ð			
θ/θ	t/θ	s/θ				
t/t	s/t					
s/s						

Table 2: Syllable contact scale for Icelandic. Each group in the sonority hierarchy (see Table 3) is represented here by one of the segments belonging to that group. For example, s/n represents a syllable boundary between [s] or an aspirated stop and a nasal or a lateral.

0	*+1*	*+2*	*+3*	*+4*	*+5*	*+6*
p^h t^h k^h s	p t k	f θ x	ɣ ð	m n l	r	v j

Table 3: Sonority hierarchy in Icelandic.

Given the hierarchy presented in Tables 2 and 3, clusters of the type /p^h, t^h, k^h, s/ + /j, v, r/ differ in sonority by 5 and 6 points in Icelandic. We, therefore, posit the following constraint:

(16) *DISTANCE+5 — Sonority should not rise by 5 points or more across a syllable boundary (Gouskova 2004:211).

Ranking *DISTANCE+5 above NOLONGVOWEL ensures that clusters with a high sonority rise are tautosyllabic on the surface, preceded by a long vowel in the previous syllable.

(17) Clusters with a great sonority rise are tautosyllabic.

Input: /flɪsja/	*DIST+5	STOW	NLV
a. flɪs.ja	*!		
b. flɪ.sja		*!	
c. ☞ flɪɪ.sja			*

4.2 Preaspiration

It seems to be generally accepted in the literature on Icelandic (see e.g., Gouskova 2004, Morén 2001, Keer 1999, Vennemann 1972), that the only consonant clusters in the language that don't cross a syllable boundary on the surface due to sonority reasons are clusters of the type discussed in Section 4.1 above, i.e., clusters that rise in sonority by at least 5 points. I will argue, however, that an acceptable sonority slope across a syllable boundary in Icelandic is actually lower than that, namely 4 points.

When an aspirated stop is followed by /l, n, m/ in underlying structure, it surfaces as preaspirated.[4]

[4]Evidence that preaspiration is derived in this environment comes from weak feminine nouns that form the

(18)	*epli*	/ep^{h}li/	[ɛh.plɪ]	'apple'
	batna	/pat^{h}na/	[pah.tna]	'get better'
	vakna	/vak^{h}na/	[vah.kna]	'wake up'

Various phonological explanations have been suggested to account for the emergence of preaspirated stops in this environment (see e.g., Thráinsson 1978, Ringen 1999, Keer 1999, Morén 2001) but what is interesting about these examples is that, much like in the examples in 15 above, the forms surface with a *tautosyllabic* consonant cluster. This might suggest that the occurrence of preaspirated stops in these surface forms is actually caused by the inability of the underlying clusters, which differ in sonority by 4 points, to cross a syllable boundary.

Evidence for a constraint against a sonority rise of 4 points across a syllable boundary in Icelandic is not limited to clusters containing aspirated stops. In fact, *no* heterosyllabic consonant clusters can be found in the language that rise in sonority by more than 3 points according to the scale in Table 3. Furthermore, we have evidence of certain phonological processes and alternations that we can assume are strategies to avoid a bad syllable boundary.

Plain stops and voiced fricatives are in complementary distribution word-internally in Icelandic. Plain stops never appear before /r, j, v/, but they do appear before the less sonorous [l] and [n].

(19)	*laga*	[laa.ɣa]	'fix'
	sigra	[sɪɣ.ra]	'win'
	sigla	[sɪk.la]	'sail'
	hefna	[hɛp.na]	'avenge'
	leðja	[lɛð.ja]	'mud'

Clusters of plain stops followed by /r, j, v/ rise in sonority by 4 and 5 points, respectively. Therefore, the distribution of plain stops and fricatives shown 19 conforms to our predictions that a sonority rise of 4 points is not acceptable across a syllable boundary in Icelandic.

Another phonological process, that seems to be motivated by laws of syllable contact, concerns consonant epenthesis in certain environments. Clusters of /s/ and a following /l, n, m/ are always broken up in surface structure by an epenthetic /t/.

(20)	*sýsla*	/sisla/	[sis.tla]	'county'
	visna	/vɪsna/	[vɪs.tna]	'wither'
	hismi	/hɪsmɪ/	[hɪs.tmɪ]	'husk'

Again, this evidence conforms perfectly to our theory of bad syllable contact since the consonant sequences in 20 have a sonority rise of 4 points and should therefore not be able to surface heterosyllabically unless something comes between them.

Given the data presented in this section, we now posit a new constraint for Icelandic:

(21)	*DISTANCE+4	Sonority should not rise by 4 points or more across a syllable boundary

4.3 Complex Codas

Before continuing our analysis of preaspirated stops, it is necessary to address a certain disagreement in the literature on Icelandic regarding the syllabification of clusters consisting of a preaspirated stop followed by a sonorant. Several authors, including Gouskova (2004:222) and Morén (2001:199), have argued that preaspirated stops should be syllabified as complex codas (i.e., [ɛhp.lɪ]). One of

genitive plural case by suffixing /na/ to the noun stem (morpheme boundaries are marked with a dash).

(1)	*gat-a*	/kat^{h}+a/	[kaa.ta]	'street NOM.SG.'
	gat-na	/kat^{h}+na/	[kah.tna]	'street GEN.PL.'

The alternation of a plain (deaspirated) stop and a preaspirated stop within a single noun paradigm suggests that the preaspiration is derived rather than underlying.

the arguments for this kind of syllabification is that not all sequences of aspirated stops followed by [l], [n] or [m] are attested onsets in Icelandic (i.e., appear word-initially). Forms like [pahtna], the argument goes, can't have a complex onset, [pah.tna], because [tn] is not a permissible onset cluster. If it is indeed the case that preaspirated stops form complex codas, then the fact that they arise in surface structure in the first place presumably has nothing to do with syllable contact since the stop and a following sonorant still have a syllable boundary between them in the output, which is exactly what preaspirating the stop is supposed to prevent. It is therefore essential to determine the actual parsing of preaspirated stops in Icelandic before any claims about the reason behind the preaspiration can be made.

I argue that an output such as [ɛhp.lɪ] is not possible in Icelandic because complex codas are not allowed in the language. The evidence for this comes from data on cluster simplification processes. Vennemann (1972:8) observes that in Icelandic, [t] is lost between [s] and a consonant, except if this consonant is [r]:

(22)	*systkin*	/sɪstʰkʰɪn/	[sɪs.cɪn]	'siblings'
	vestra	/vɛstʰra/	[vɛs.tra]	'in the west'

This happens, Vennemann argues, because [tr] is a permissible onset in Icelandic while [tk] is not. By correlation, this process of cluster simplification must also suggest that complex codas are not allowed in Icelandic because deleting a consonant is preferred over creating a complex coda in situations where resyllabification is blocked by restrictions on possible onsets.

(23)

Input: /sɪstʰkʰɪn/	*ComplexCoda	*Ons[tk]	Max
a. sɪst.cɪn	*!		
b. sɪs.tcɪn		*!	
c. ☞ sɪs.cɪn			*

The process of cluster simplification is not only useful to determine the structure of Icelandic syllables, it is also indicative of the kinds of onset clusters allowed in the language (other than those attested in word-initial position).

Vennemann (1972) correctly pointed out that /stʰkʰ/ clusters are simplified to [sk] on the surface while /stʰr/ clusters stay intact and attributed this to the fact that [tk] is not a possible onset in Icelandic. He did, however, overgeneralize when he stated that [t] is lost between [s] and *all* consonants other than [r], as the following example shows.

(24)	*fastna*	/fastʰna/	[fas.tna]	'get engaged'

In addition, clusters of /s/ and /l/ are always broken up on the surface by an epenthetic [t] which must suggest that [tl] is a permissible onset as well:

(25)	*sýsla*	/sisla/	[sis.tla]	'county'

The examples above show that both [tn] and [tl] are possible onsets in Icelandic despite not being attested in word-initial position. As far as other phonotactically possible combinations of stops and sonorants are concerned, the only one not attested word-initially in Icelandic is [pn]. As the following example shows, [pn] too is a permissible onset:

(26)	*vespna*	/vespʰna/	[vɛs.pna]	'vespas GEN.PL.'

Given the data above, there is no reason why words like *batna* and *betla* should not be syllabified with complex onsets: [pah.tna], [pɛh.tla]. In fact, this kind of syllabification is *optimal*.

5 The Puzzle

We showed in Section 4.1 that certain consonant clusters in Icelandic always syllabify as complex onsets and we attributed this to a constraint against a sonority rise of 5 points or higher, *Distance+5. An example of this is repeated in (27):

(27) *lepja* /lɛpʰja/ [lɛɛ.pja] ‘drink’

In Section 4.2 we suggested that forms with preaspirated stops might also be the result of a constraint on sonority rise across syllable boundaries, in this case a constraint we referred to as *DISTANCE+4. An example is repeated in (28):

(28) *batna* /patʰna/ [pah.tna] ‘get better’

The derivations shown in (27) and (28) both have the same result: a bad syllable boundary is avoided in the surface structure. But why are there two different strategies at play here? Why don’t both forms either end up with a lengthened vowel or preaspiration? The most straightforward explanation is that even though both types of syllable boundaries are undesirable, they are not *equally* undesirable. They still violate different constraints, namely *DISTANCE+5 and *DISTANCE+4, respectively. We can account for the difference between (27) and (28) by simply ranking a constraint against long vowels between our two *DISTANCE constraints, ensuring that only forms with a particularly high sonority rise in their word-internal consonant clusters surface with a long vowel.

(29) *DIST+5 » NOLONGVOWEL » *DIST+4

Since forms like /patʰna/ cannot surface with a complex onset due to our constraint ranking, they surface with preaspiration instead:

(30)

Input: /patʰna/	*DIST+5	NLV	*DIST+4	DEP
a. ☞ pah.tna				*
b. paa.tna		*!		
c. patʰ.na			*!	

However, we run into trouble if we apply the same constraint ranking to forms like /lɛpʰja/. Even though a long vowel in the output is more acceptable than a +5 syllable boundary, it is still better to preaspirate to avoid the undesired syllable boundary:

(31)

Input: /lɛpʰja/	*DIST+5	NLV	*DIST+4	DEP
a. ☞ lɛh.pja				*
b. ☹ lɛɛ.pja		*!		
c. lɛpʰ.ja	*!		*	

The reason we end up with the wrong output in (31) is that just because open syllable lengthening is *possible* before certain consonant clusters, it doesn’t necessarily mean that it is *optimal*. The preaspirated candidate is favored because it doesn’t violate NOLONGVOWEL. More importantly though, the preaspirated candidate doesn’t violate *DISTANCE+5 *either* because the moraic aspiration ensures that the sequence of stop and sonorant does not cross a syllable boundary.

Intuitively, syllable contact is responsible for both preaspirated forms and forms with complex onsets preceded by a long vowel. But posing different constraints on syllable contact is not enough to produce the different outputs. I argue that the real problem is that the preaspirated candidate shouldn’t be considered a possible output at all because it must result from an opaque constraint interaction.

This idea is not new. Thráinsson (1978:29-33) suggested that all preaspirated stops in Icelandic are derived from aspirated geminates, either underlying ones, as in /pakʰkʰa/ > [pah.ka], or derived ones, as in /ɛpʰlɪ/ > /ɛpʰpʰlɪ/ > [ɛh.plɪ]. Thráinsson did not offer a plausible reason for why stops should geminate before sonorants but I argue that the gemination is a strategy to avoid a bad syllable boundary. The subsequent loss of the stop’s place features results from constraints on the appearance of postaspiration in pre-obstruent position.

This analysis is in keeping with the properties of Icelandic preaspirated stops discussed earlier, namely that due to the segmental status of the aspiration, they must be derived from a sequence

of an aspirated segment and a stop. However, arguing that the preaspiration in (18) is the result of gemination requires an intermediate stage in the derivation and can't therefore be accounted for within the framework of classic OT.

6 Conclusion

In this paper, I have argued that Icelandic has a lower threshold for an acceptable sonority slope between two heterosyllabic consonants than previously observed in the phonological literature on the language. Restrictions on the rise in sonority between a coda and a following onset are the main motivation for the emergence of so-called preaspirated stops before sonorants (along with constraints on glottal activity). I have also argued that due to opaque interactions of phonological constraints, a strictly non-derivational framework such as Optimality Theory is not suited to capture the facts of Icelandic preaspiration.

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