Diachronic and synchronic pharyngealization in West Greenlandic

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1 Introduction[1]

This paper proposes a unified analysis of diachronic and synchronic coalescence in West Greenlandic (WG) based on perceptual information. There are no consonant clusters in WG. Derived or historical clusters are resolved by coalescence to a geminate: $C_1C_2 \rightarrow C:_{1,2}$. In both diachronic (1a) and synchronic (1b) clusters containing a uvular stop /q/, pharyngealization (indicated by an underdot) is preserved in the output.

(1) a: upinraaq → upi̯n̯:aaq 'spring'
b: /imq+it/ → [i̯m̯:it] 'water' pl.

Pharyngealization may be preserved as a primary articulation (on a uvular), or as a secondary articulation on a labial or coronal geminate. 'N' is a uvular nasal.

(2) a: upinraaq → [upi̯N:aaq] or [upi̯n̯:aaq] 'spring'
b: /imq+it/ → [i̯N:it] or [i̯m̯:it] 'water' pl.

This talk argues that preservation of place features (secondary pharyngealization as well as primary place) is best explained by reference to perceptual information computed in a relevant citation form. The consistent preservation of

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pharyngealization and the asymmetry in primary place preservation across manners of articulation is explained by considering the hypothetical articulation of the uncoalesced cluster. The properties of the articulated cluster are deduced from surface properties of the language.

The paper is organized as follows. Section 2 gives background on WG and Section 3 presents the data to be accounted for. Section 4 discusses pharyngealization in WG and how perceptual information is relevant to coalescence. Section 5 analyzes pharyngeal preservation in coalescence and Section 6 analyzes preservation of primary place. Section 7 concludes.

2 Background on West Greenlandic

WG employs a four way place contrast. All the continuants, except 's' and 'ʂ', have voiced and voiceless allophones. The inventory and alternations presented here are as described by Rischel (1974). 'N' is the uvular nasal.

(3) WG consonants[2]

	labial	coronal	velar	uvular
stop	p	t, ɬ	k	q
nasal	m	n	ŋ	N
continuant	v	s, ʂ, l, j	ɣ	r

There are no clusters in WG. Consonants may be short or long, but geminates are restricted to intervocalic position. All geminates are voiceless obstruents or nasals. The continuants in (3), with the exception of 's' and 'ʂ' are voiced approximates when short and voiceless fricatives when long (Thalbitzer 1976). "ɬ" is a voiceless lateral affricate.

(4)

labial	coronal	velar	uvular
v ~ f:	l ~ ɬ:	ɣ ~ x:	r ~ χ:

Besides contrasting with singletons for length, labial and coronal geminates also contrast for secondary pharyngealization, represented as an underdot below the segment ("m̩"). The alternations are given in (5).

[2] /ʂ/ and /s/ are present in the chart for completeness. They will not figure in the data or analysis presented in this paper.

(5)	labial			coronal				velar			uvular		
singleton:	p	m	v	t	n	s	l	k	ŋ	ɣ	q	N	r
plain:	p:	m:	f:	t:	n:	s:	ɬ:	k:	ŋ:[3]	x:	q:	N:	χ:
pharyngeal:	p:	ṃ:	f̣:	ṭ:	ṇ:	ṣ:	ḷ:						

The uvular and velar series have the same voicing and constriction contrast between singleton and geminate as the coronal and labial series, but do not have a contrast between plain and pharyngealized geminates. Uvulars are specified as both [DORSAL] and [PHARYNGEAL] while velars are only [DORSAL]. Simply put, this contrast is absent because a pharyngealized velar is a uvular and a uvular is already pharyngealized.

WG has the three vowels in (6), which are lowered and retracted preceding uvulars or pharyngealized geminates (consonants specified as [PHARYNGEAL]).

(6) WG vowels

i	→	ị	
u	→	u̱	/__ [PHARYNGEAL]
a	→	a̱	

3 Coalescence

3.1 Diachronic coalescence

Dorais (1986) gives a detailed description and account of assimilation patterns in Inuktitut dialects. The Inuit/Inuktitut dialect continuum stretches from Alaska to Greenland with the most conservative (similar to Proto-Eskimo) dialects in the West. Consonant clusters are found in western dialects and the degree of assimilation increases towards the East. West Greenlandic shows complete assimilation, where all proto-clusters have been resolved to geminates. Of particular interest to the discussion in this paper are a set of clusters which Dorais labels 'special clusters'. In these clusters, the segments appear to undergo metathesis from West to East, before complete assimilation takes place. A chart of two representative cases is given below (taken from Bobaljik 1995). Dialect numbers increase from West to East.

[3] Rischel lists pharyngealized ʳŋŋ as distinct from plain ŋŋ, contrary to his (sensible) statement that velars do not contrast for pharyngealization. I do not include ʳŋŋ in this chart to avoid confusion. I follow Rischel's description in assuming throughout the rest of this paper that pharyngealized velars are uvulars.

Table 1: Cross-dialectical cluster assimilation

		nr → rŋ 'spring'	mr → rŋ 'crawl'
0.	Proto-Eskimo	*upən(ə)RaR-	*pa(C)aməR-
1.	Bering Strait Seward Peninsula	upinraaq	paamruqtuq
2.	North Slope Mackenzie	upinraaq	paamruqtuq
3.	Netsilik	upinraaq/ upinŋaaq	paamruqtuq
4.	Copper Caribou	**upinraaq/** upinŋaaq	paamruqtuq/ paamŋuqtuq
5.	Aivilik Polar	**upirŋaaq**	**paamruqtuq**
6.	Baffin	upirŋaaq	**paarŋuqtuq**
7.	Quebec	upirŋaaq	paarŋuqtuq
8.	Kalaallisut (Greenland) East Greenlandic	upirŋnaaq	paarŋuqtuq
9.	Labrador	upiŋŋaak	paaŋŋuqtuk

The important thing to notice in Table 1 is the difference between forms directly above and directly below the black line. Nasal-uvular (NQ) clusters change to uvular-nasal (QN) clusters (NQ → QN): *upinraaq* → *upirɳaaq* and *paamruqtuq* → *paarɳuqtuq*. The actual realization of these orthographic uvular-velar clusters is a uvular nasal geminate (this insight is discussed extensively in Bobaljik's (1995) reanalysis). Simply, the changes identified by Dorais to be accounted for are *nr* → *N:* and *mr* → *N:*.

(7) a: upi**nr**a:q → upi**N:**ạ:q (=upi**r**ŋaaq) 'spring'
b: paa**mr**uqtuq → pạ:**N:**ụqtụq (=paa**r**ŋuqtuq) 'crawl'

The pattern is more compelling, and poses a more interesting problem, than just the sound change represented in (7). Nasal-uvular clusters are not always fully assimilated to a uvular geminate in WG. There is an alternative realization where the output geminate retains the primary place of the original nasal and pharyngealization is realized as a secondary articulation.

(9) a: upinra:q → [upiN:ạ:q] or [upiṇ:ạ:q] 'spring'
b: pa:mruqtuq → [pạ:N:ụqtụq] or [pạ:ṃ:ụqtụq] 'crawl'

The examples in (9) show that pharyngealization is always preserved in coalescence, but that primary place of articulation is alterable.

3.2 Synchronic coalescence

Patterns of coalescence found in synchronic forms are similar to those seen diachronically in the previous sub-section. The picture in synchronic forms is more complete, however, than in diachronic forms. Coalescence of a uvular with a continuant or nasal results in a uvular or secondarily pharyngealized geminate. The examples in (10) show coalescence between two consonants adjacent in the underlying root. In the singular form, epenthesis allows two distinct segments to surface. 'T' indicates examples taken from Thalbitzer (1976), 'R' from Rischel (1974).

(10)	singular	plural					
	imiq	/imq+it/	→	iṃ:it	or iN:it	'band'	T
	uniq	/unq+it/	→	uṇ:it	or uN:it	'armpit'	T
	a:viq	/afq+it/	→	a:f:it	or a:χ:it	'walrus'	R

When /q/ coalesces with a stop, there is only one possible output: geminate [q:]. Pharyngealization as a secondary articulation is not possible on a stop (although secondarily pharyngealized stop geminates are found elsewhere in the language).

(11)	singular	plural					
	atiq	/atq+it/	→	aq:it	*aṭ:it	'name'	T
	qa:tiq	/qatq+it/	→	qaq:it	*qaṭ:it	'ring'	T
	ipiq	/ipq+it/	→	iq:it	*iṗ:it	'dirt	T
	tupiq	/tupq+it/	→	tuq:it	*tuṗ:it	'tent'	R

The examples in (10) show that coalescence in both synchronic and diachronic forms has variable realization as a uvular or a secondarily pharyngealized geminate. With stops, however, secondary pharyngealization is not an option; preservation of primary dorsal place results in a uvular with primary pharyngealization.

4 Pharyngeal spreading

The patterns of coalescence found in both synchronic and diachronic forms can be explained through an understanding of pharyngealization and gestural alignment in the language. The phonetic realization of pharyngealization explains its

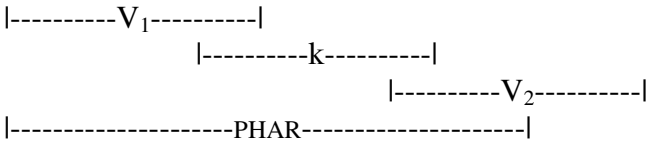
consistent preservation, as well as the asymmetries between primary place preservation across different manners of articulation.

4.1 Pharyngeal alignment

Pharyngealization is traditionally assumed to be contrastive on consonants in WG. The contrast between velars and uvulars, both [DORSAL] consonants, is one of pharyngealization. Labial and coronal geminates also contrast for the feature [PHARYNGEAL]. Uvulars and pharyngealized geminates differ as to whether [PHARYNGEAL] is a primary or secondary articulation. Pharyngealization on the surface always alters the articulation of surrounding segments, but does so differently as a primary than as a secondary articulation.

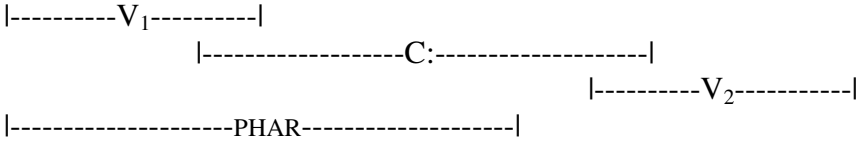
As a primary articulation, pharygnealization lowers and backs vowels preceding and following the consonant. Rischel reports that preceding vowels are affected much more drastically than following vowels. This description suggests that, from a gestural perspective, pharyngealization is aligned to overlap both the underlyingly specified consonant as well as both the preceding and following vowels. The representation in (12) demonstrates this alignment.

(12) /V_1qV_2/



In (12), the pharyngeal constriction is aligned to fully overlap the preceding vowel and partially overlap the following vowel. When pharyngealization is a secondary articulation on a geminate, only the preceding vowel is altered. This suggests that [PHARYNGEAL] on a geminate is aligned to overlap a preceding vowel, but ends before the offset of the geminate's primary closure. This alignment is shown in (13).

(13) /V_1Ç:V_2/



This alignment also suggests, as is proposed by Bobaljik (1995), that pharyngealized geminates are not actually specified as [PHARYNGEAL]. Instead, the preceding vowel is phonologically specified as [PHARYNGEAL], and any overlap of pharyngealization into the following consonant is a phonetic effect.

4.2 A phonetic representation

On the surface, pharyngealization on a consonant is always accompanied by pharyngealization of the preceding vowel. Uvulars and pharyngealized geminates are always preceded by pharyngealized vowels, and never by plain vowels.

(14)	ịq	*iq	ịQ:	*iQ:
	ụq	*uq	ụQ:	*uQ:
	ạq	*aq	ạQ:	*aQ:

When a long vowel precedes a pharyngealized segment, Rischel reports that the vowel is only pharyngealized during its second half (a diphthong). This observation shows that pharyngealization is a gradient and not a categorical effect and suggests that it is best analyzed as a phonetic process and not a phonological one (Cohn 1993, Zsiga 1997). Vowel pharyngealization can be thought of as the result of timing a pharyngeal articulation to overlap the articulation of a vowel. This particular alignment is motivated by perceptual considerations. Pharyngealization lowers the F2 of a vowel, providing strong cues to its presence.

If we take the pattern in (14) seriously, and assume that pharyngeal spreading is a robust feature of WG grammar, we can assume that pharyngealization is not licensed by association to a consonant alone, but must also be present on a preceding vowel. This observation about the surface structure of pharyngealization in WG can shed light on the behavior of pharyngealization in both synchronic and diachronic clusters. If pharyngealization on a consonant must be present on a preceding vowel, then a cluster with the shape VCQ is realized phonetically in WG as VQQ, with pharyngealization spreading from the uvular stop through an intervening consonant to the preceding vowel. In an autosegmental framework (Goldsmith 1975), a VCQ cluster with spreading is represented as in (15).

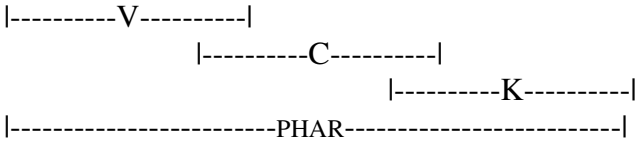
(15) /VCQ/

[PHAR]

The representation in (15) links an instance of [PHARYNGEAL] associated with a consonant to each preceding segment until it hits a vowel. I take this type of

linking to correlate with articulatory lengthening of a pharyngeal constriction. The idea is that features have natural articulatory correlates, and are entities with endpoints (cf. Gafos 2002).

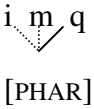
An underlying feature matrix does not specify the temporal relations between the endpoints of features. Autosegmental spreading as seen in (15), however, is meant to convey that the left endpoint of the underlying feature [PHARYNGEAL] is extending to the left endpoint of the features that constitute the vowel. The representation in (15) could also be modeled as the vastly simplified gestural score in (16), following Browman & Goldstein (1986, 1989).

(16)


In the remainder of this paper I assume that a representation like (15), based on the articulatory representation in (16), is available as the input to the phonological grammar. Correspondence constraints may refer to it. This form is generated by passing the UR through a language specific phonetic grammar which specifies the more detailed phasing or temporal relationships between the gestural units implied by features.

5 Pharyngeal preservation

This section presents an account of pharyngeal preservation based on the articulatory representation introduced in the previous section. Given an underlying form like /imq/, pharyngeal spreading constructs the representation in (17).

(17)


I analyze pharyngeal preservation in coalescence as the activity of a faithfulness constraint between corresponding vowels in the output and the citation form where pharyngealization has spread. This analysis of pharyngealization is phonetically natural; pharyngealization is preserved on vowels because it is perceptible on vowels. Pharyngealization in the output is not an arbitrary result of the [PHARYNGEAL] specification on /q/ winning out over the absence of [PHARYNGEAL] on the coalescing consonant. Instead, pharyngealization is the result of faithfulness to a perceptually salient property of the vowel. The partial

overlap of pharyngealization with the geminate constriction is the result of principles of gestural phasing in the language.

The general correspondence constraint (McCarthy & Prince 1995) in (18) can be relativized to a correspondence relation between the output and the relevant form.

(18) IDENTPHAR-V — Given a vowel in the input V_i and a corresponding output vowel V_o, if V_i is [PHARYNGEAL] then V_o is [PHARYNGEAL].

The input form referred to by the constraint in (18) is a phonetic representation of the uncoalesced cluster. Presumably, this is an abstract representation in synchronic coalescence, and a surface form in diachronic coalescence. If the faithfulness constraint in (18) outranks a general markedness constraint against pharyngealization, *PHARYNGEAL, pharyngealization will be preserved in coalescence.

(19)

/i̱$_1$m̱$_2$q$_3$+it/	IDENTPHAR-V	*PHARYNGEAL
→ i̱$_1$m̱:$_{2,3}$it		**
i$_1$m:$_{2,3}$it	* !	

In (19), pharyngealization is preserved from /i̱/ in the input to [i̱] in the output. The same situation holds for diachronic clusters.

(20)

/upi̱$_1$ṉ$_2$r$_3$a:q/	IDENTPHAR-V	*PHARYNGEAL
→ upi̱$_1$ṉ$_{2,3}$:a:q		* *
upi$_1$n:$_{2,3}$a:q	* !	

The use of a representation where pharyngealization has spread from a uvular allows diachronic and synchronic coalescence to be accounted for under the same analysis.

6 Primary place preservation

In both diachronic and synchronic clusters, the output of coalescence may have two attested surface realizations.

(21) synchronic forms

ịṃq+it	→	[ịṃ:it] or [ịN:it]	'water'
ạ:ɣq+up	→	[ạ:f:up] or [ạ:f:up]	'walrus'
ụṇq+it	→	[ụṇ:it] or [ụN:it]	'armpit'

(22) diachronic forms

upịṇrạ:q	→	[upịN:ạ:q] or [upịṇ:ạ:q]	'spring'
pạ:ṃqụqtụq	→	[pạ:N:ụqtụq] or [pạ:ṃ:ụqtụq]	'crawl'

When a uvular coalesces with a stop consonant, however, a uvular geminate is the only possible output.

(23)

/tụpq+it/	→	[tụq:it] *[tụp:it]	'tent'
/ạṭq+it/	→	[ạq:it] *[ạṭ:it]	'name'

The generalization that needs to be accounted for is that primary labial or coronal place is optionally preserved when originating on a nasal or continuant segment, but is never preserved when originating on a stop.

The notion of an articulatory representation allows a natural and explanatory account of the asymmetric behavior of place in stops and nasals and continuants. An articulatory representation specifies the relative temporal alignment of the gestures that make up segments. Features simply linked to root nodes are ordered one after another, making it impossible to represent the degree of overlap between articulations. It is often noted that the preservation of place features is sensitive to the availability of perceptual cues in a particular context (Jun 2002, Steriade 2000, Wilson 2001). For example, languages that allow heterorganic C_1C_2 clusters often release C_1, making cues to the place of C_1 available (Jun 2002). Trying to account for place preservation or deletion based on perceptual considerations necessitates some mechanism for computing the perceptibility of a particular contrast. The articulatory representation proposed in Section 4 is one such mechanism.

Cues to stop place are strongest at the stop burst. If a stop is overlapped significantly by another stop, and has no audible release, the cues to the place of C_1 are lost. A consonant in this environment has only the weak cues available at the VC transition. WG allows no consonant clusters, so it can be assumed that pre-consonantal stops are not released. The gestural alignment of an underlying sequence like /upq/ shows that /p/ is unreleased, and that the VC transition is overlapped by pharyngealization.

(24)
```
|----------V----------|
          |---------p----------|
                     |----------k----------|
|------------------------PHAR------------------------|
```

In an underlying sequence like /inq/ or /afq/, pharyngealization overlaps the articulation of the nasal or continuant. Unlike stops, nasals and continuants have some internal cues and lack a stop burst.

(25)
```
|-----------V----------|
          |----------n----------|
                     |----------k----------|
 |-------------------------PHAR-------------------------|
```

The cues to primary place in underlying clusters are summarized in (26).

(26)

	available cues	weakened by pharyngeal overlap?	labial and coronal preserved?
root-internal			
stop	VC	yes	never
nasal	VC, internal, CV	yes	optional
continuant	VC, internal, CV	yes	optional

Whether primary labial or coronal place is preserved in the output of coalescence is thus directly correlated with the availability of cues to these places. This observation is expressed by the constraints in (27a) and their fixed rankings with respect to general faithfulness constraints in (27b).

(27) a:

IDENTPLACE(stop)$_{REL}$	A released stop in the input and its output correspondent have the same primary place.
IDENTPLACE(nas)$_{PHAR}$	A pharyngealized nasal in the input and its output correspondent have the same primary place.
IDENTPLACE(cont)$_{PHAR}$	A pharyngealized continuant in the input and its output correspondent have the same primary place.

b: IDENTPLACE(stop)$_{REL}$ >> IDENTPLACE(stop)
IDENTPLACE(nasal) >> IDENTPLACE(nasal)$_{PHAR}$
IDENTPLACE(continuant) >> IDENTPLACE(continuant)$_{PHAR}$

These constraints refer to the presence of a release or pharyngealization on the consonants in the input, properties that are represented in the articulatory input. These faithfulness constraints interact with a markedness constraint that prefers uvulars to secondarily pharyngealized geminates, *SECONDARY[4]. If *SECONDARY is ranked between IDENTPLACE(stop)$_{REL}$ and IDENTPLACE(stop), labial and coronal place in stops will be lost in coalescence.

(28)

/tụpq + it/	IDENTPLACE(stop)$_{REL}$	*SECONDARY	IDENTPLACE(stop)
→ tụq:it			*
tụp:it		* !	

Coalescence involving a nasal or continuant segment is variably resolved to a uvular or secondarily pharyngealized geminate. Variable realization can be modeled with a variable ranking of constraints, in this case the rankings of *SECONDARY with IDENTPLACE(nas)$_{PHAR}$ and IDENTPLACE(cont)$_{PHAR}$.

(28) a: coronal and labial place is preserved

/ịmq + it/	IDENTPLACE(nas$_{PHAR}$)	*SECONDARY
→ ịm:it		*
ịN:it	* !	

b: coronal and labial place is lost

/ịmq + it/	*SECONDARY	IDENTPLACE(nas$_{PHAR}$)
ịm:it	* !	
→ ịN:it		*

This section has aimed to show that primary place preservation in synchronic and diachronic clusters can be understood by making reference to a gestural representation. Cues to primary place of articulation are computed based on the articulatory properties of the unassimilated clusters. Faithfulness constraints refer

[4] I abstract away from the fact that IDENTPLACE prefers uvulars equally to coronals and labials (since output geminates are correspondents of both /q/ and /C/). To account for this, IDENTPLACE must be relativized to different places of articulation and the ranking IDENT[LABIAL], IDENT[CORONAL] >> IDENT[DORSAL] must hold.

to these cues, accounting for asymmetrics patterns of place preservation in different manners of articulation.

7 Conclusion

This paper has proposed an account of the preservation of primary and secondary place features in diachronic and synchronic coalescence in WG. The consistent preservation of pharyngealization and the variable preservation of primary place based on manner of articulation is shown to be derivable from perceptual factors. Allowing the phonological grammar to make reference to an articulatory representation allows perceptual information to influence phonological patterning. Faithfulness constraints referring to an articulatory form allow a unified and phonetically natural account of place preservation in WG coalescence in both synchronic and diachronic forms.

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