Theoretical Issues in the Representation of the Glottal Stop in Blackfoot*

Tyler Peterson
University of British Columbia

1.0 Introduction

This working paper examines the phonemic and phonetic status and distribution of the glottal stop in Blackfoot.[1] Observe the phonemic distribution (1), four phonological operations (2), and three surface realizations (3) of the glottal stop:

(1) a. *otsi* ‘to swim’ c. *otsiʔ* ‘to splash with water’
b. *oʔtsi* ‘to take’

(2) a. Metathesis: VʔVC → VVʔC
nitáóʔmaiʔtakiwa
nit-áʔ-omaiʔtakiwa
1-INCHOAT-believe
‘now I believe’

b. Metathesis → Deletion: VʔVːC → VVːʔC → VVːC
kátaookaawaatsi
kátaʔ-ookaa-waatsi
INTERROG-sponsor.sundance-3s.NONAFFIRM
‘Did she sponsor a sundance?’ (Frantz, 1997: 154)

c. Metathesis → Degemination: VʔVʔC → VVʔʔC → VVʔC
áóʔtooyiniki
áʔ-oʔtoo-yiniki
INCHOAT-arrive(AI)-1s/2s
‘when I/you arrive’

d. Metathesis → Deletion → V-lengthening: VʔVC → VVʔC → VVːC
kátaoottakiwaatsi
kátaʔ-ottaki-waatsi
INTEROG-bartender-3s.NONAFFIRM
‘Is he a bartender?’ (Frantz, 1997)

(3) Surface realizations: [VʔC] ~ [VV̰C] ~ [VːC]
aikaiʔni ‘He dies’
a. [aɪkaɪʔni]
b. [aɪkaɪ̰ni]
c. [aɪkajni]

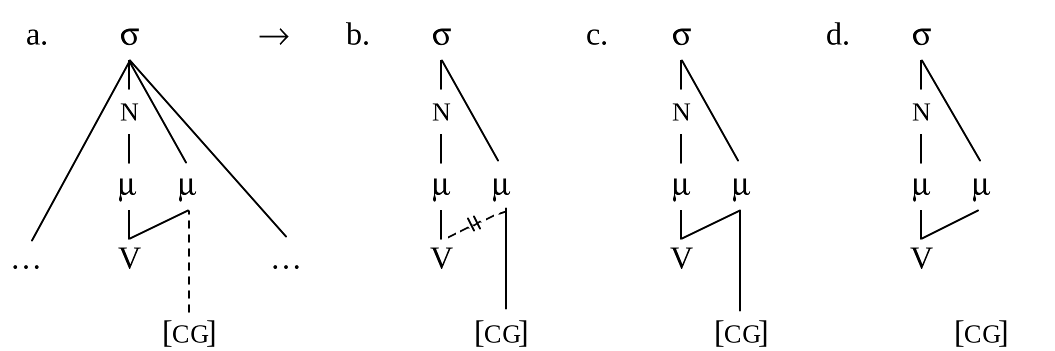
The glottal stop appears to have a unique status within the Blackfoot consonant inventory. The examples in (1) (and §2.1 below) suggest that it appears as a fully contrastive phoneme in the language. However, the glottal stop is put through variety of phonological processes (metathesis, syncope and degemination) that no other consonant in the language is subject to. Also, it has a variety of surfaces realizations in the form of glottalization on an adjacent vowel (cf. (3)), and/or compensatory lengthening of that vowel (cf. (2)c.) – effects that no other consonant have. These observations of the distributional and surface properties of the glottal stop in Blackfoot motivate the following investigation: what exactly are the properties of the glottal stop that set it apart from other consonants in the inventory? Once those properties are identified, how can they be represented in the phonology of Blackfoot? At this point, these questions make a priori assumptions about the glottal stop as a full consonantal segment, and this paper will challenge that assumption by suggesting that the glottal stop in Blackfoot is not in fact a full phonemic segment of the inventory, but actually the phonetic realization of a glottalization on an underlyingly long vowel, the surface realizations the result of parsing and licensing strategies at work in the syllable with adjacent vowels.

The goal of this paper is to develop an adequate phonological representation that can unify the various phonological (cf. (2)) and phonetic patterns (cf. (3)) of the glottal stop in Blackfoot under one account. The distribution of the glottal stop and its surface realizations has offered a frequent challenge to the phonological accounts of various languages. This is partly due to its interaction with (or manifestation as) different phonation types of vowels (i.e. creaky voice), tone (Picanço 2002; Yip 1995), compensatory lengthening alternations (Kavitskaya 2001), it's ability to surface as either a full segment or glottalization in the same language (Zoll 1998; Brown 2004), as well as it's versatility to class with either resonants or stops (Shaw, p.c.). In addition this the glottal stop in Blackfoot is subject to restrictions that other segments are immune to, for example gemination, or the ability to function as an onset – all phenomena that must be considered in any adequate phonology of the glottal stop.

1.1 Proposals

The specific proposal that will be sketched out is that what surfaces both phonemically and phonetically as the glottal stop in Blackfoot is the result of the realization of a morpheme-level, floating feature [CONSTRICTED GLOTTIS] ([CG]) feature, which is prosodically licensed by a 'non-nuclear' mora. This is schematized (4)a.:

(4)



Given certain assumptions about syllable structure and syllabification, and prosodic features such as the nucleus and mora (both will be explained in more detail below), the syllable template in (4)a. coupled with the proposal that the floating [CG] feature is prosodically licensed by this non-nuclear mora, makes at least three predictions regarding the interaction between vowel length (as represented by the mora) and the realization of this feature, all of which are borne out in Blackfoot. When [CG] is licensed by a non-nuclear mora (as opposed to nuclear one), a de-linking of the vowel features occurs and a full glottal stop surfaces (Vʔ) as in (4)b. If there is no de-linking of the vowel, as in (4)c., laryngealization (creaky voice) on that vowel surfaces ($V_1\underset{\sim}{V}_1$). (4)d. demonstrates that if floating [CG] is left floating (i.e. unlicensed), a bimoraic long vowel surfaces (Vː). This effectively derives all of the surface realizations of the glottal stop.

One crucial prediction that follows from this proposal is that all morphemes with previously assumed Vʔ sequences are actually underlyingly bimoraic long vowels (Vː) (cf. (4)a.), and the present analysis will take quite literally the phonological representation of a long vowel as two versus one mora. Both impressionistic and preliminary phonetic analysis suggests that when the glottal stop surfaces (as a result of parsing the [CG] feature to the non-nuclear mora, cf. (4)b.) it shortens the long vowel *or* creaky voice appears on the last half of the long vowel (cf. (4)c.) The non-nuclear or 'second' mora provides a natural phonological representation for the locus of processes like 'compensatory shortening' of a vowel (or a glottal stop surfacing) and creaky voice on the second half of a long vowel. This approach, coupled with the proposed non-nuclear mora licensing condition on [CG], will interact in a principled way in capturing the metathesis and deletion (degemination) patterns. Within a moraic-prosodic framework these processes will actually follow instead from universal conditions on syllable weight restrictions and a ban on moraic onsets (Shaw p.c.) and not directly from conditions on the glottal stop itself. For example, when [CG] is licensed by the non-nuclear mora and the vowel is de-linked, the resulting full glottal stop is then treated as a legitimate consonantal onset; however, its moraic status bans it from being an onset. The result is a diphthongization of the two vowels under one nuclear mora and the non-nuclear [CG] glottal stop mora is left in a suitable coda position (cf. (4)a.); thus capturing the underlying generalization that the glottal stop can never occur as an onset (cf. (4)-0). Under this analysis, deletion is viewed as an unparsed [CG] feature – the underlying bimoraic, long vowel is simply left intact (cf. (4)d.).

The paper is organized as follows: in §2 the established distributional properties and previous approaches to its distribution of the glottal stop in Blackfoot will be re-examined. This will take the form of reviewing various data as well as incorporating data that has been collected from a speaker. In section 3, the above proposals will be discussed in greater detail and implemented.

2.0 Background and Observations

Consonant length in Blackfoot is contrastive. There are no voiced non-sonorant consonants underlyingly in Blackfoot, nor are there any liquids. Phonemically, there are only three vowels /i/, /o/, and /a/, with various surface (lax) realizations. Vowel length is also contrastive, however only tense vowels can be long. Vowels may also be voiceless in certain environments (i.e. word-finally). Frantz (1997) observes three diphthong in Blackfoot: [ai], [ao] and [oi].

(5) Consonant Inventory:

p	t		k	ʔ (’)
	s	ts	x (h)	
ps	ts		ks	
m	n			
w			j (y)	

Vowel Inventory:

	i		u	
‘i’	ɪ		ʊ	‘o’
	e	ʌ	o	
‘a’	ɛ		ɔ	
	æ	a		

2.1 The phonemic status of the glottal stop

The glottal stop appears to have phonemic status as a full segment, as it contrasts in the following minimal pairs (All examples in this subsection are from Frantz (1995)):

(6)	a.	*ini*	‘to see’	a’	*iʔni*	‘to die’
	b.	*sik*	‘black or dark’	b’	*siʔk*	‘cover/blanket’
	c.	*itsi*	‘high quality’	c’	*iʔtsi*	‘to feel emotion’
	d.	*itsk*	‘past; by’	d’	*iʔtsk*	‘bare’
	e.	*oto*	‘spring’	e’	*oʔto*	‘to pick up/take’
	f.	*moksis*	‘awl’	f’	*moʔksis*	‘armpit’
	g.	*ipot*	‘to beat a drum’	g’	*ipoʔt*	‘his eyes are closed’
	h.	*opam*	‘across’	h’	*opaʔm*	‘lull to sleep or relaxation’
	i.	*á*	DURATIVE ASP.	i’	*áʔ*	INCHOATIVE PREFIX
	j.	*ika*	‘foot’	j’	*ikaʔ*	‘for now; presently’
	k.	*ini*	‘to see’	k’	*iʔni*	‘to die’

In some examples it can contrast in three different positions (7), or with another stop (8):

(7)	a.	*otsi*	‘to swim’	c.	*otsiʔ*	‘to splash with water’
	b.	*oʔtsi*	‘to take’			
(8)	a.	*moʔtsís*	‘arm/hand’	a’	*mottsís*	‘gut/intestine’
	b.	*otaʔs*	‘on/upon’	b’	*otats*	‘horse’

From this, a basic generalization emerges: in non-derived forms, the glottal stop never appears as a syllable onset.[2] This generalization will also hold in derived environments: where the vowel occurs at a the right edge of a morpheme, upon concatenation with a vowel initial morpheme, it will metathesize to the closest post-vocalic, pre-consonantal position; or, as will be demonstrated in §3.0, a post-nuclear, pre-coda position.

2.2 *Phonological processes*

As can be seen in the examples in (2), three phonological processes can be observed operating on the distribution of the glottal stop: metathesis, deletion (including degemination) and assimilation. Frantz (1997: 154) observed that the triggering of these three processes is motivated by a constraint banning the glottal stop from surfacing intervocalically. This distributional property can be seen in the roots in §2.1, but also applies as a condition in a derived environment. Metathesis is thus a reflex of this condition moving the glottal stop to the nearest post-vocalic, pre-consonantal position. Frantz's rule in (9) can be seen operating on (11) and (12):

(9) *Glottal Metathesis*
ʔV → Vʔ / V__C

(10) *Glottal Syncope/Degemination*

$$\text{ʔ} \rightarrow \varnothing \;/\; \left\{ \begin{array}{c} \underline{V_1V_2\!:\ \_\_\ C} \\ \_\_\ \text{ʔ} \end{array} \right\}$$

(11) *nitáóʔmaiʔtaki*
nit-áʔ-omaiʔtaki
1-INCHOAT.-convinced
'now I'm convinced'

(12) *kátaookaawaatsi*
kátaʔ-ookaa-waatsi
INTEROG-sponsor.sundance-3s.NONAFFIRM
'Did she sponsor a sundance?'

Metathesis feeds other phonological processes, such as deletion. A similar intervocalic environment surfaces in (12)-(13) and metathesis is triggered; however, once the glottal stop is moved to this position it is deleted. This is reflected in the formulation of (10): When two glottal stops are adjacent degemination occurs (presumabley after the application of metathesis: *áʔ-oʔtoo-jiniki* → *áóʔʔtoojiniki* → *áóʔtoojiniki*):

(13) *áóʔtoojiniki*
áʔ-oʔtoo-jiniki
INCHOAT-arrive-1s/2s
'when you arrive'

Finally, metathesis and deletion occur in (15) when the glottal stop precedes a long consonant, accompanied by compensatory lengthening of the preceding vowel.

(14) *Glottal Assimilation*
Vʔ → Vː / __Cː (where C [s])

(15) *kátaoottakiwaatsi*
kátaʔ-ottaki-waatsi
INTEROG-bartender-3s.NONAFFIRM
'Is he a bartender?'

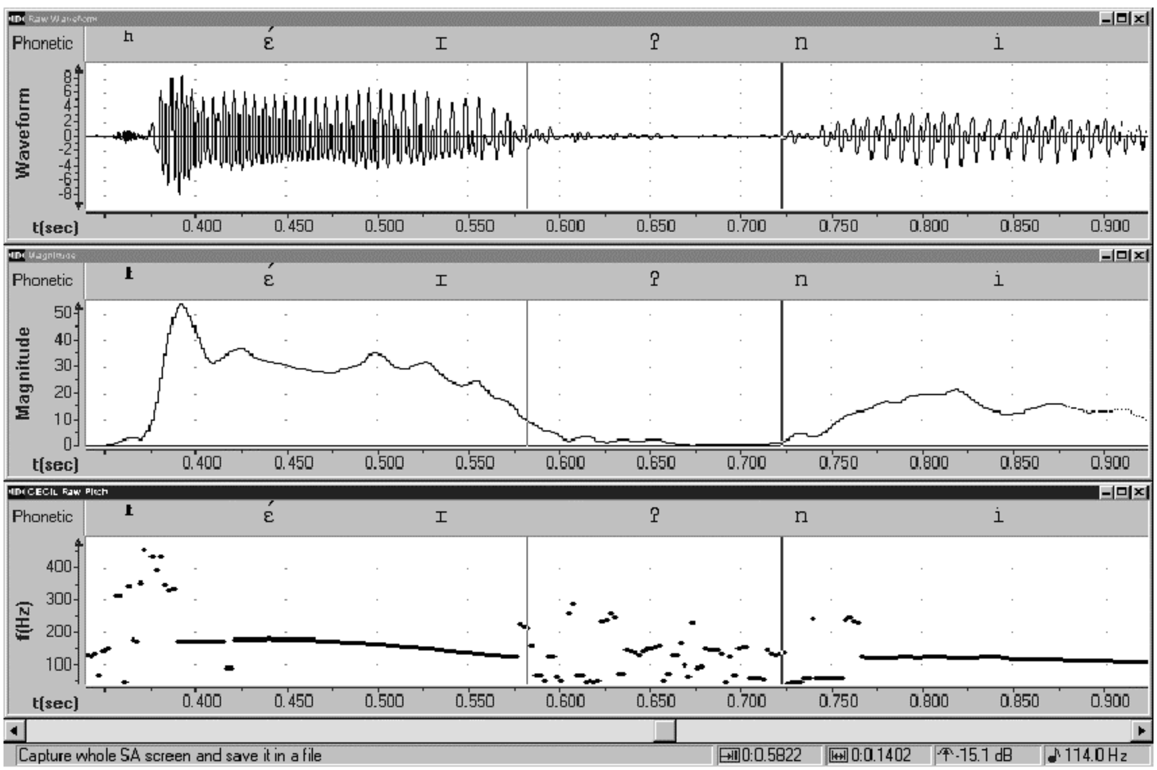
2.3 *Speaker Data and Surface Variations:* ʔ ~ V̰ ~ V

McLennan and Bortolin (1995) suggest a diachronic change between what speakers call 'Old Blackfoot' and 'New Blackfoot'. This characterized by several phonological changes, among which the glottal stop is gradually being replaced by creaky voice and or long segments; or in other words, the right edge of a vowel is gradually assimilating the glottal stop, sometimes surfacing as creaky voice or lengthening. There is evidence that this is also a synchronic phenomenon, where the surface variations in (16) are in free alternation:

(16) […VʔC...] ~ […VV̰C…] ~ […VːC…]

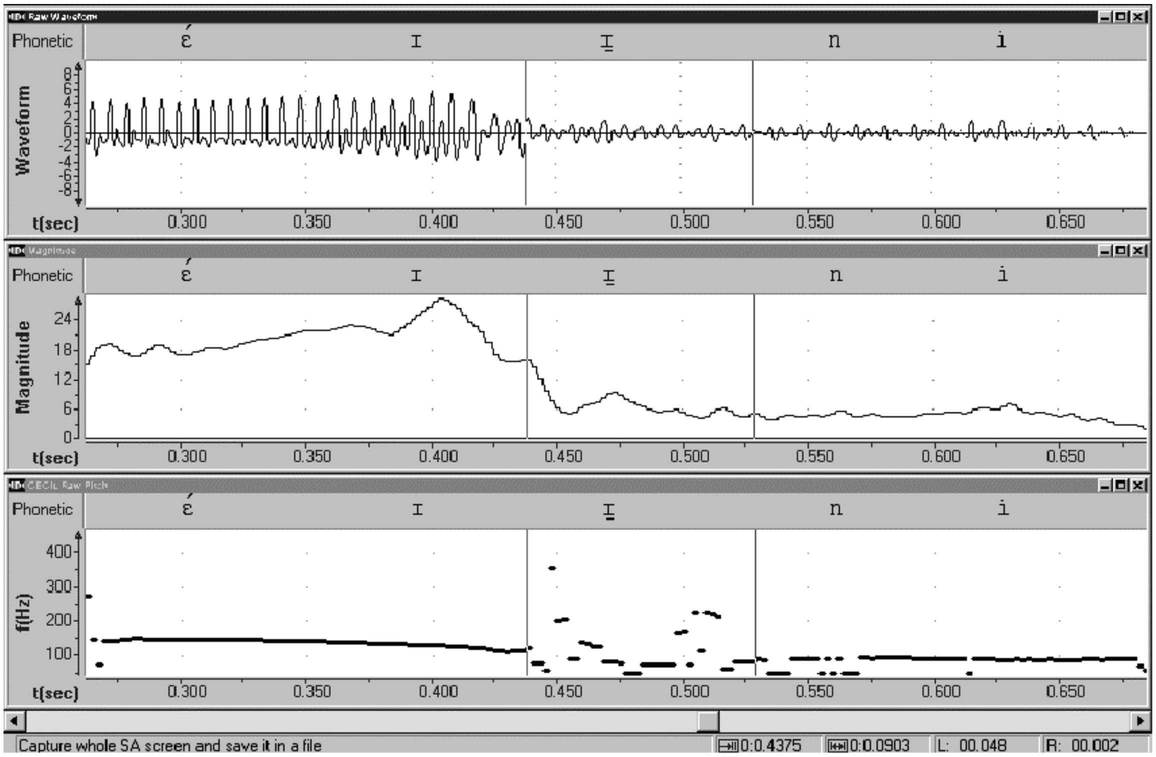
This has been observed in BPC's speech, a speaker of New Blackfoot: in *aikaiʔni* 'He dies', preliminary phonetic analysis reveals that the glottal stop can surface as a full stop (17), what appears to be creaky voice (18), or almost completely reduced or assimilated to the preceding vowel (19).[3]

(17) [aɪkaɪʔni] *full glottal stop*

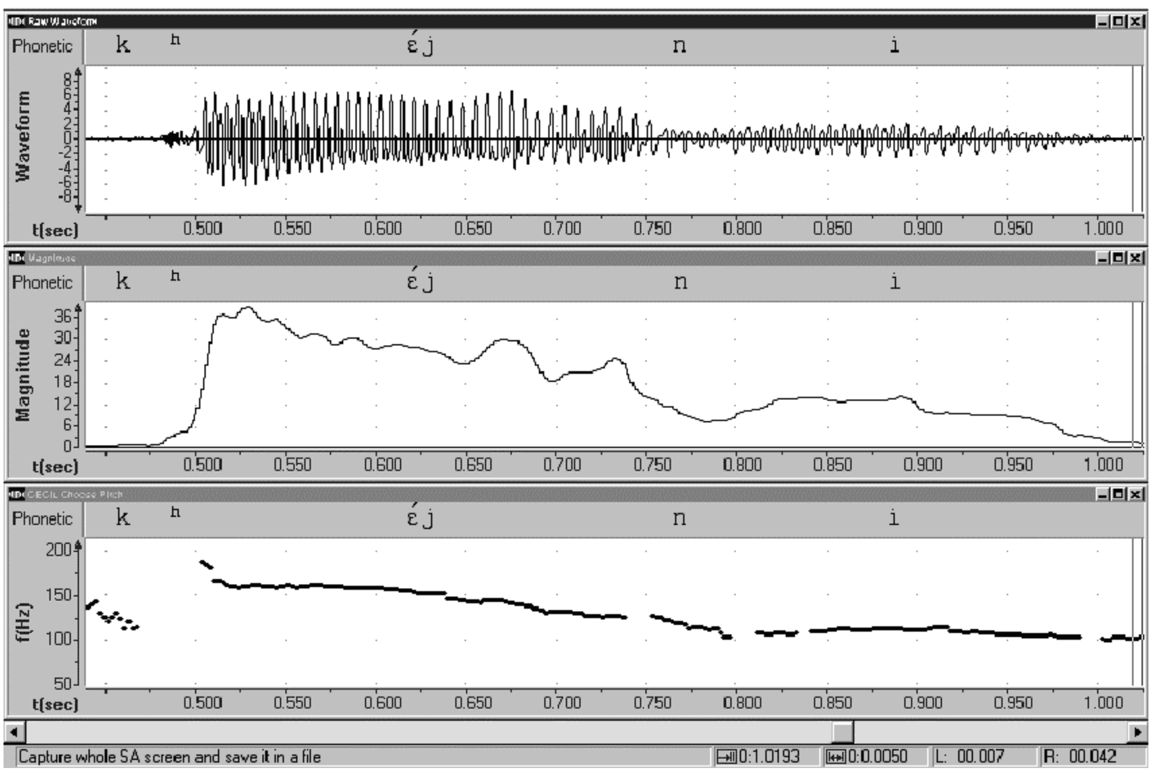


While there is clearly a post-vocalic complete stop (17) [aɪkaɪʔni], there is a continued low magnitude, periodic waveform after the vowel in [aɪkaɪ̰ni], suggesting possible creaky voice. In (19) there is very little reduction in magnitude and no negligible stop before the [n] segment:

(18) [aɪkaɪ̰ni]   *possible creaky voice*



(19) [aɪkʰɛjni]   *almost completely reduced*



However, in some cases the surface realization of the glottal stop was quite stable, as can be observed in the following minimal a/b pairs of (20)-(22):

(20)	a.	/ini/	‘to see’	→	a’	*nitáinip*	[nɪtɛ́ɪnip]	‘I see it’
	b.	/iʔni/	‘to die’	→	b’	*aikaiʔni*	[aɪkɛɪʔni]	‘He dies’
(21)	a.	/sik/	‘black or dark’	→	a’	*siksináttsi*	[sɪksɪnʌ́ttsi]	‘it’s black’
	b.	/siʔk/	‘cover/blanket’	→	b’	*síʔkaan(i)*	[siʔkáːn(i)]	‘blanket’
(22)	a.	/otsi/	‘to swim’	→	a’	*tóótsit*	[dúːtsɪt]	‘swim!’
	b.	/oʔtsi/	‘to take’	→	b’	*oʔtsit*	[uʔtsɪt]	‘take it!’

In longer phrases, the same variability can be found; and in at least one case (23), the glottal was deleted without lengthening:

(23) [kitayoʔkaawatsiksa]
kátaʔjájoʔkááwaiksaawa
kátaʔ-já-joʔkaa-waiksaawa
INTERROG-DUR-sleep-3p:NONAFFIRM
‘are they sleeping?’

(24) [kitaiʔnóókawatsiksa]
kikátaiʔnóókwaiksaawa
k-Ikátaʔ-ino-ok-waiksaawa
2-INTER-see(TA)-INV-3p:NONAFF
‘did they see you?’

(25) [kitaooyokskaʔsiwaatsiksa]
kátaoʔkskaʔsíwaatsiki
kátaʔ-okskaʔsi-waatsiki
INTERROG-run-3s:NONAFFIRM
‘did he run?’

(26) [kitoʌʔtaki]
kitaoʔtaki
kitaʔ-otaki
‘did he take any’

(27) [kitaoʔkaawaatsi]
kátaookaawaatsi
kátaʔ-ookaa-waatsi
INTERROG-sponsor.sundance-3s.NONAFFIRM
‘did she sponsor a sundance?’

(28) [nitóʌ́ʔmaiʔtaki̥]
nitáóʔmaiʔtaki
nit-áʔ-omaiʔtaki
1-INCHOAT-convinced
‘now I’m convinced’

(29) [eoʔtúːniki]
áóʔtooyiniki
áʔ-oʔtoo-yiniki
INCHOAT-arrive(AI)-1s/2s
‘when I/you arrive’

(30) [áóʔmaiʔtaki]
áóʔmaiʔtaki(wa)
áʔ-omaiʔtaki(wa)
INCHOAT-convinced
‘now he believes’

All of the observed ʔ ~ V̰ ~ V (~ ∅) variations in BPC’s speech can be accounted for by considering the glottal stop not to be a actual segment in the language, but rather the realization of a laryngeal feature of vowels. The (in)stability of this feature is a reflection of parsing strategies within the prosodic domain – a hypothesis that will be explored in further detail below.

3.0 Phonological Representations and the Glottal Stop

Although the above re-write style rules can adequately account for the distribution of the glottal stop in derived environments (as well as reflecting its post-vocalic, pre-consonantal distribution in roots), the phenomena characterized by these rules seem to suggest something more is at work here. The central question is exactly why are these restrictions placed on the glottal stop's distribution? This ‘conspiracy’ effect can be perhaps characterized as an attempt to converge on a well-formed output, and notions like ‘coda-like’ position point to an account that includes the syllable as the natural and relevant domain for these alternations. Taking this as a direction, in producing an account for the Blackfoot syllable it is possible to first begin with a set of assumptions that can be inferred from Frantz's rules. This will provide the observational groundwork and insight necessary for capturing the essence of glottal stop distribution within a prosodic framework. Informally, these rules can be interpreted in the following way:

(31) Glottal Metathesis: The glottal stop cannot occur as an onset.

Once metathesis occurs, it feeds further processes. The derivation of [kátaʔ-oːkaːwaːtsi] could yield: [káta.ʔoː.kaː.waː.tsi]. Metathesis applies as the constraint on a glottal stop onset surfacing: *[ká.taoːʔ.kaː.waː.tsi]. Although the glottal stop has been moved to an adequate post-vocalic position, it is still deleted: *kátaookaawaatsi*. The glottal stop is always deleted after a surface sequence of three vowels, and this suggests a restriction on syllable weight: the second syllable in [ká.<u>taoːʔ.</u>kaa.waa.tsi] would be ‘too heavy’ and the glottal stop is marked for deletion in order to respect syllable weight. When gemination occurs (as fed by metathesis) in [áoʔʔ.toː.yi.ni.ki] → *áóʔtooyiniki,* the glottal stop is deleted. Assuming this geminate occurs within the same syllable, this deletion rule would reflect the universal constraint on tautosyllabic geminates:

(32) Glottal Syncope/De-Gemination: Syllable weight must be respected; No tautosyllabic geminates.

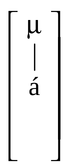
So far, what this line of inquiry actually suggests is that there is an alternation between a full vowel and the glottal stop somewhere in the nucleus of a syllable. However, treating the glottal stop as just another consonant in the inventory implies that it is available for syllabification not only as a moraic coda (hence compensatory lengthening alternations), but that it can also function as an onset. A somewhat simplistic but effective suggestion would be to class the glottal stop with other segments that cannot function as onsets: vowels. Taking this at face value, the glottal stop in this language can be viewed a form of glottalized vowel, or in other words, the glottal stop itself is actually a vowel with some added laryngeal feature. This compromises the glottal stop's position in the segment inventory of Blackfoot: instead of being a true member of the inventory, the glottal stop is actually the result of a floating [CG] feature realized at the edge of a nucleus. How this feature is aligned with the nucleus edge will be addressed in §3.2.

3.1 Morpheme-level Subsegmental Features: [CONSTRICTED GLOTTIS][4]

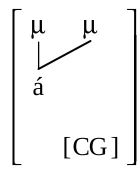
Zoll (1998) proposes a single underlying distinction between full segments and subsegmental elements, or *floating* features (7). A floating laryngeal feature such as [CG] can move around to find a place to dock and attach to existing vowel's root node. An alternative is that the [CG] feature can be directly licensed by a prosodic node, without an intermediary root node. Brown (2004) and Gittlen and Marlett (1989; cited in Macaulay and Salmons 1995) have proposed that glottalization, is a feature of syllables in Mixtec, and this can extend in principle to glottalization in Blackfoot.

Blackfoot has contrastive length, therefore length is encoded underlyingly. The hypothesis that will be forwarded is that [CG] is licensed by the second mora of an underlyingly bimoraic vowel – the properties of which are discussed in the following section.

(33) a. /á/ DURATIVE (cf. *áyoʔkaawa* 'he is sleeping')
 b. /áʔ/ INCHOATIVE (cf. *áʔyoʔkaawa* 'now he is sleeping')

(34) a. 

DURATIVE ASPECT

b. 

INCHOATIVE PREFIX

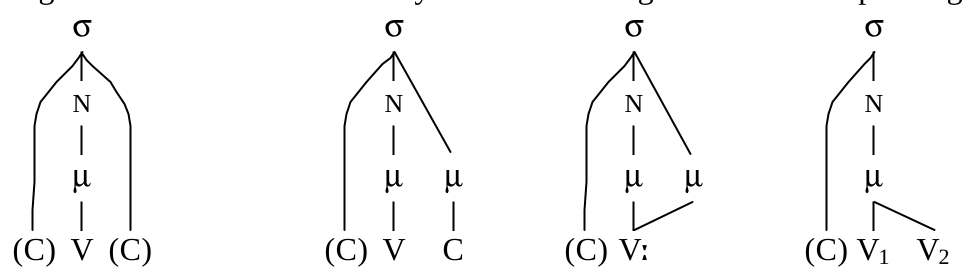
The morpheme level specification of the floating [CG] feature can be highlighted in the minimal pairs DURATIVE/INCHOATIVE minimal pairs, now represented in the lexicon as [á]/[áá]$_{[CG]}$. There are advantages and disadvantages to root node vs. prosodic licensing, and it is beyond the scope of this paper to fully compare in detail this distinction (see Zoll 1998 for detailed discussion), but by linking the [CG] feature directly to the prosody we gain the power of predictability in the surface distribution of the creaky voice and the glottal stop. If [CG] could only licensed by a (vocalic) root node, we would need to appeal to alignment or other measures in order to derive the surface position of glottalization.

Given the assumption that prosody licenses glottalization, so far there is no way to distinguish between the two moras in a long vowel, as it would seem the first mora could also license the [CG] feature. From here, we are now ready take this preliminary theory of the floating feature [CG] as a lexically-specified, morpheme-level feature, prosodically licensed by a mora, and observe how it interacts with the next level: the syllable. In the next section, I will elaborate on this inherent properties and asymmetries of the first and second mora in a long vowel syllable and how they determine the distribution of glottalization.

3.2 A Syllable Template: the Nuclear Moraic Model

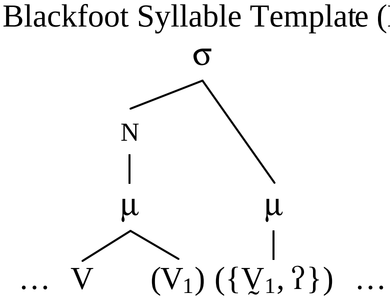
Syllable weight is standardly defined in terms of the mora (Hyman 1985, Hayes 1989, Zec 1988, etc.). This provides a fundamental dichotomy of syllable types into light monomoraic vs. heavy bimoraic syllables. Although this claim has empirical support from the behaviour of certain stress systems, compensatory lengthening processes, contrastive length etc., it is proposed that there is also a distinction between the two moraic constituents of a bimoraic syllable: the second mora of a bimoraic syllable is characterized as actually 'weak' in relation to the first mora. This asymmetry is captured by assigning a 'Nucleus' status to the first mora – an intervening head between the mora and the syllable node – vs. a non-nuclear mora which is headed by the syllable node directly (Shaw, 1992):

(35) a. Light   b. Heavy   c. Long V   d. Diphthong

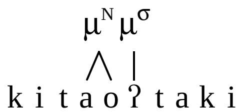


(35)a. represents a light, monomoraic syllable, while (35)b. and d. represent a closed, bimoraic syllable and one with a long vowel respectively. (35)d. is again a light syllable diphthong. Evidence for these representations (an adaptation of Shaw, 1992) follow from a closer examination of the function of the second mora and how it is actually distinct from the first. When viewed in a certain way, a bimoraic syllable can be seen as a temporal metric that measures across the most sonorous part of a syllable. A nuclear mora will always head a vocalic (or at least sonorant) segment, while the second mora typically a less sonorant segment such as a consonant, representing a decreasing sonority sequencing temporally across the two moras. The second mora can encode vowel length (underlyingly), but it is dependent on the root node features of the vowel that makes up the actual nucleus ('N'), the only obligatory feature of a syllable. What is relevant for the present analysis is the fact that the second mora can effectively represent the locus of the 'weakening' of the right edge through creaky voice or shortening of the underlyingly long vowel. In addition to this, the first two vowels of a three-vowel nucleus in Blackfoot are consistently a diphthong, and that a maximal sequence of three vowels is always [$V_1V{:}_2$] (*$V_1V_2V_3$; *$V{:}_1V_2$), and glottalization is always post-vocalic, or in this approach, post-nuclear. This yields the following nucleus template for Blackfoot (Peterson, to appear; Shaw 1992, 1993; and see Yip ???? for a similar treatment in Choayang):

(36) Blackfoot Syllable Template (Nuclear Moraic Model)



Again, this is drawn from evidence that, in syllables where a glottal stop follows a nucleus, that nuclear sequence is always a diphthong:

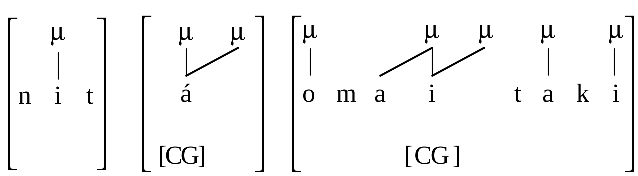
(37)


Through eliciting other diphthong-long vowel examples of this type, a longer sequence was expected: *kitaookaawaatsi*, but BPC produced several tokens of *kitaoʔkaawaatsi*. (27) also displays a similar free variation between a glottal stop and lengthened vowel: *kitaookaawaatsi* ~ *kitaoʔkaawaatsi*. This alternation is also apparent in words with plain long vowels, as in *tápisamikooko* 'late night'. BPC would produce both Vː and Vʔ upon repeated elicitation: […kooko] ~ […koʔko]. It is difficult to tell from just looking at the dictionary if diphthongs inherently a part of this, but BPC's speech so far has always confirmed it. The glottal stop seems to never appear in any position other than directly following a nucleus, and almost all of the forms produced by BPC contain a diphthong or short vowel followed by a glottal stop. In these cases, once [CG] is licensed, by the 'weak' mora, the delinking of the vowel to the weak mora can be said to be optional in BPC's speech.

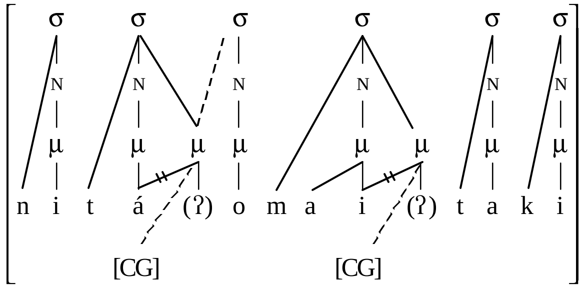
The non-nuclear is the locus of glottalization and therefore licenses the [CG] feature. Equipped with this template, and our assumptions regarding the licensing of [CG], we can now observe how these behave in a derived environment, including the various parsing strategies highlighted in (4). Consider the metathesis case:

(38) Metathesis: VʔVC → VVʔC
nitáóʔmaiʔtakiwa
[nit]-[áː]$_{[CG]}$-[omaiːtakiwa] (compare UR with (2)a.)
1-INCHOAT-believe
'now I believe'

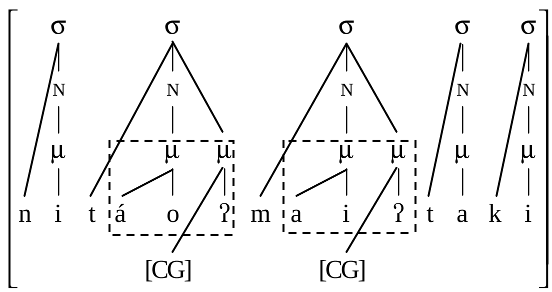
With the revised URs discussed in the previous subsection, all Vʔ sequences are underlyingly Vː with lexically specified floating [CG] feature:

(39)


The floating [CG] is parsed to the non-nuclear mora triggering the delinking of the vocalic nucleus [a]. The outcome in (40) is the syllabified form */ni.tá.ʔo.maiʔ.ta.ki/, but this is ungrammatical because the moraic glottal stop, surfacing as a consonant, is syllabified as an onset:

(40) 

It is the assumption that the glottal stop becomes a consonant and then is forced as an onset that invokes the metathesis rule:

(41) 

The glottal stop is now in a position where it can't be re-syllabified as an onset, but at the expense of deleting a mora. Observing another (universal) constraint on the bi-moraic limit of syllables, this metathesis forces the re-syllabification to correct a potential trimoraic syllable by diphthongization of […á$_{\mu}$o$_{\mu}$…] into […áó$_{\mu}$…], where the two segments share a mora. This is confirmed by the template and accent spread (Peterson, to appear). This derivation deals with the metathesis and weight-related deletion. The glottal stop, surfacing as a full, mora-bearing segment cannot be re-syllabified as an onset (Shaw p.c.). It escapes this by moving rightwards to a suitable coda position in the next syllable. Given space considerations, I will defer a detailed analysis of examples of metathesis feeding deletion/degemination (i.e. (2)b. - d.): [kátaʔ-ookaawaatsi] → [kátaooʔkaawaatsi] → *kátaookaawaatsi;* [áʔ-oʔtoo-yiniki] → [áoʔʔtooyiniki] → *áóʔtooyiniki;* instead suggesting that the above analysis in principle can be extended to these cases as well. A potentially problematic case is the compensatory lengthening case of (2)d.: [kátaʔ-ottakiwaatsi] → [kátaoʔttakiwaatsi] → *kátaoottakiwaatsi*. Underlyingly, [kátaʔ] is now viewed as [kátaa], yielding a possible output **kátaaottakiwaatsi*. This actually follows from the syllable template in (36): the glottal stop would surface as the second [a] and then go through the diphthongization process and ending up as a glottal stop on the non-nuclear [o] mora. This is predicted but does not actually surface **kátaoʔttakiwaatsi.* One could suggest that [CG] is simply left unparsed, leaving the template to rearrange the […aao…] sequence into the grammatical […aoo…], but the reason for this is unclear.

4.0 Summary

Synchronically, glottal approximants which result in compensatory lengthening are predicted to be moraic, while glottal stops whose deletion does not trigger compensatory lengthening are predicted to be weightless (Hayes 1989). Kavitskaya (2001) argues that the synchronic variation of this type mirrors the diachronic fate of glottal stops. They fluctuate between glottal approximants and vowels: when they surface as vowels, compensatory lengthening results in monophthongization. The present analysis offered an alternative approach, where the surface realization of either creaky voice or a full glottal stop was the result of the prosodic licensing of a [CG] feature by the non-nuclear mora of a bimoraic vowel. This offered a principled approach to not only predicting the position and distribution of glottalization (i.e. the right edge of a long vowel, or the non-nuclear mora), but also the surface phonetic realization of glottalization (i.e. the parsing strategies outlined in (4)). However, there are several outstanding issues: the two most pressing are the impact of reinterpreting all Vʔ sequences as Vː on the lexicon. For example, are there any other contrasts: [á]/[á]$_{[CG]}$ or [áá]/[áá]$_{[CG]}$? Secondly, there is typically only one [CG] per root, but potentially more than one bimoraic syllable to license it. How does floating [CG] discern which to parse to? There were also many other facts that were ignored, such as why you get an unparsed [CG] before a geminate consonant (cf. (2)d.). These are questions I will defer to further research. The outcome of this analysis is a way to better capture the distribution and surface realization of glottalization in Blackfoot, through deriving its properties in the prosody and not through sets of (possibly extrinsically) ordered sets of rules that obscure the true function of glottalization.

Notes

*Thanks to Pat Shaw, Gessiane Picanço and J.C. Brown for their helpful input. I would also like to thank my Blackfoot consultants Broderick Prairie Chicken, and Beatrice and Melinda Bullshields (examples not cited were elicited by the author). This research was made possible with the financial support of a research grant (SSHRC 410-200-123) awarded to R-M. Déchaine, P.I. and D. Pulleyblank, Co-Inv. All errors are my own.

[1] Blackfoot is an Algonquian language spoken by about 5000 people of the Blood, Peigan, an Siksika tribes in southern Alberta and Northwestern Montana. Its closest sister within the Algonquian family is Cree. In Blackfoot orthography the glottal stop is represented by an apostrophe ('), but for expository purposes in this paper I will use 'ʔ'.

[2] However, the glottal stop can be found intervocalically between two identical vowels. This suggests a purely phonetic realization, where it occurs as the onset to the second member of an 'echo' vowel:

i.	*saʔai*	'duck'	iv.	*stáʔao*	'ghost/spirit'
ii.	*háʔayaa*	'oh oh!'	v.	*akáístaʔao*	Blood clan name
iii.	*saoʔohkaʔpii*	'boring'	vi.	*iiʔittaki*	'to skin'

Given this, the general observation above still holds: in non-derived environments, the glottal stop cannot appear as an onset to a syllable unless it surfaces phonetically as part of an echo vowel complex: (V_1ʔV_1).

[3] It should be noted that this is only a preliminary phonetic analysis for expository purposes, and should be followed up by a more detailed and rigorous examination.

[4] After a survey of dictionary entries, it appears that Blackfoot allows only one glottal stop per morpheme.

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