

Analia Gutiérrez*
(CONICET, Argentina)

The variable prosodic parsings of Nivaçle glottal stop

ABSTRACT: This paper establishes the featural and prosodic representations of the Nivaçle (Mataguayan) glottal stop. On the one hand, it is proposed that the Nivaçle glottal stop is unspecified for place features, but specified for constricted glottis ([c.g]). On the other hand, it is advanced that /ʔ/ is an independent consonantal phoneme in the language that has multiple prosodic parsings. First, a glottal stop can occur (contrastively) in syllable onset position. Second, a postvocalic glottal stop can be variably parsed to the vocalic Nucleus of the syllable and hence form part of a Complex Nucleus or to the coda position. As a result, two different manifestations of phonetic glottalized vowels are realized: *creaky/rearticulated* and *vowel-glottal coda*, respectively. It is argued that these diverse glottal realizations are rooted in a set of prosodic constraints.

Keywords: Nivaçle; Phonology; Glottal; Features; Prosody.

RESUMEN: Este trabajo establece la configuración de rasgos distintivos y las representaciones prosódicas de la oclusiva glotal del nivaçle (mataguaya). Por un lado, se postula que la oclusiva glotal del nivaçle no está especificada para rasgos de lugar, pero sí para rasgos de glotis constreñida ([g.c.]). Por otro lado, se propone que la /ʔ/ es un fonema consonántico independiente que tiene varios análisis prosódicos. Primero, una glotal puede ocurrir (de manera contrastiva) en posición silábica de ataque. Segundo, una glotal postvocálica, puede ser variablemente analizada como Núcleo de la sílaba, y así formar parte de un Núcleo Complejo, o como coda. Por lo tanto, aparecen dos realizaciones fonéticas de vocales glotalizadas: vocales *rechinadas/rearticuladas* y *vocal-glotal* en posición de coda, respectivamente. Estas diversas realizaciones de la glotal están basadas en una serie de restricciones prosódicas.

Palabras clave: Nivaçle; Fonología; Glotal; Rasgos; Prosodia.

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1. Introduction

The featural representation and phonemic status of the glottal stop, its surface realizations, and glottalization on vowels, have raised challenges in the phonological analyses of languages of the Americas (Silverman 1997; Gerfen & Baker 2005; Stenzel 2007; Elías-Ulloa 2009; Chávez-Peón 2010; Bennett & Henderson 2013; Arellanes Arellanes 2015; Avelino, Coler & Wetzels 2015, among others).

Most of the problems posed by the glottal stop arise from its ambiguous patterning. On the one hand, the glottal stop can form a natural class with either obstruents or sonorants. On the other hand, what is commonly referred to in phonological inventories as “glottal stop” has been variously analyzed as: i) a full independent segment (e.g., Yalálag Zapotec, cf. Avelino 2004); ii) a constricted glottis ([c.g.]) feature on vowels (e.g. Mixtec, cf. Gerfen 1999); iii) a floating constricted glottis feature (e.g., Mixtec, cf. Macaulay & Salmons 1995), and as a floating tone (Tukano, cf. Ramírez 1997, as cited in Stenzel 2007). Furthermore, unlike other features, which are posited to have a unique structural dominance affiliation within a given feature hierarchy model, the [c.g.] feature has been variously analyzed as directly dominated by a mora in Wanano (Stenzel 2007), exclusively by a non-nuclear mora in Blackfoot (Peterson 2004), by a root node (Zoll 1996), or a laryngeal ([LAR]) node (Clements & Hume 1995).

The phenomenon of glottalization has been proposed as a potential areal feature of Chaco languages (González 2014).¹ The Mataguayan language family (Chorote, Maká, Nivaçle, and Wichí) belongs to this group.² While there is consensus about the presence of ejective obstruents and glottal stops in Mataguayan languages (Chorote, Maká, Nivaçle, and Wichí), the relationship between glottal stops and vowels in these languages has not been exhaustively or comparatively studied. Nevertheless, what is consistent in the previous literature is the analysis of the glottal stop as an independent phonemic segment: Gerzenstein (1983) and Carol (2014) for Chorote, Gerzenstein (1994) for Maká, Stell (1972, 1989) and Gutiérrez (2015, 2016) for Nivaçle, and Nercesian (2014) for Wichí.

This paper establishes the featural and prosodic representations of the Nivaçle glottal stop. On the one hand, it is proposed that the Nivaçle glottal stop is unspecified for place features, but specified for constricted glottis ([c.g.]). On the other hand, it is advanced that /ʔ/ is an independent consonantal phoneme in the language that has variable prosodic parings. First, a glottal stop can occur (contrastively) in syllable onset position. Second, a postvocalic glottal stop can be variably parsed to the vocalic Nucleus of the syllable and hence form part of a Complex Nucleus or to the coda position. As a result, two different manifestations of phonetic glottalized vowels are realized: *creaky/rearticulated* and *vowel-glottal coda*, respectively. It is argued that these diverse glottal realizations are rooted in a set of prosodic constraints.

¹ Demolin & Storto (2012: 268-269) point out that glottalized obstruents and sonorants are found “in a good number of South American languages, though less common in Amazonia.” According to the authors’ survey, glottalized consonants can be found in Atacameño, Aymaran, Chonan, Selk’nam, Tehuelche, Itonama, Kawesqar, Matacoan [Mataguayan], Nambiquaran, (many dialects of) Quechuan, Trumai, Uru-Chipayan, and Vilela.

² In the literature on this language family, other names have been alternatively used: Matacoan or Mataco (Greenberg 1987: 73; Campbell & Grondona 2007), Mataco-Mataguayan (Tovar 1961), Mataco-Maka (Kaufman 1990: 46), and Mataguayan (Najlis 1984; Fabre 2014).

This paper is organized as follows. Section 2 gives background on the Nivaçle language and on the ambiguous phonological patterning of glottal stops across languages. Section 3 analyzes the interplay between the Nivaçle glottal stop and syllable structure constraints. It is shown that this segment can be parsed not only to onset and coda positions, but also to the Nucleus of the syllable. Section 4 postulates the featural representation of the glottal stop and presents a number of arguments for its placeless specification. Finally, Section 5 concludes with the main findings of this paper.

2. Context

2.1. The language and its speakers

Nivaçle [niβa'kle] is a Mataguayan language spoken in the Argentinean and Paraguayan Chaco by approximately 16,350 speakers in Paraguay (DGEEC 2012) and 500 in Argentina (INDEC 2004-2005). The Nivaçle language has also been referred to in the literature as *Ashlushlay* (Henry 1936; Wicke & Chase-Sardi 1969; Stell 1972) *Chunupí* (Hunt 1915) and *Chulupí* (Junker et al. 1968; Stell 1989; Campbell & Grondona 2007). Nivaçle is the preferred name in Paraguay. Here I adopt the spelling Nivaçle, rather than Nivaclé, Nivakle, or Niwakle, following the new orthographic conventions established during the 2nd. Nivaçle Linguistic Congress (*Uj'e Lhavos*, Paraguay, December 3-5 2010).³

2.2. The Nivaçle phonological system and the data

Nivaçle has 21 phonemic consonants, presented in Table 1. Similarly to other Mataguayan languages, Nivaçle has a two-way laryngeal distinction in non-continuant obstruents (plain vs. ejectives) – except for the complex segment [k̠] – and no voicing contrast (voice vs. voiceless) within the obstruent class. Fricatives contrast in four places, and there is a lateral fricative. Segments in square brackets represent allophonic variants of the segments to their left, while variation is indicated by the tilde (~) symbol.

³ During that congress, the Linguistic Committee of the Nivaçle People (*Comisión Lingüística Pueblo Nivaçle*, CLPN) was created. One of the goals of the CLPN, formed by Nivaçle teachers and specialists on the Nivaçle language and culture, was to revise and consolidate the two Nivaçle orthographies constructed by distinct religious missions: one proposed by the Catholics and one proposed by the Mennonites. In the Paraguayan Chaco, Nivaçle writing and reading skills are taught until the sixth grade of primary school.

Table 1. Nivaçle consonants

		Labial	Dent-alv.	Palato-alv.	Palatal	Velar	Uvular	Glottal
Stop	Plain	p	t			k	~ [q]	
	Ejective	p'	t'			k'	~ [q']	?
	Lateral release					k̠	~ [q̠]	
Affricate	Plain		ts̠	tʃ̠				
	Ejective		ts̠'	tʃ̠'				
Fricative		f ~ [ɸ]	s	ʃ	ʈ	x	~ [χ] ~ [h]	
Nasal		m	n					
Approximants		w ~ [β]			j			

Regarding the Nivaçle vowels, while Stell (1989: 97) postulates a phonemic distinction between plain vowels /i e a o u/ and glottalized vowels /i̠ e̠ a̠ o̠ u̠/, Gutiérrez (2015) argues that there are only six vowels /i e a o u/, and that glottalized vowels are underlying vowel-glottal stop /Vʔ/ sequences with different prosodic parsings (cf. Section 3.3).

The Nivaçle data discussed here are from my own fieldwork with both female and male native speakers of Nivaçle. Fieldwork was carried out in the Nivaçle communities of *Uj'e Lhavos* and *Santa Teresita* (Paraguay) between 2009 and 2013.

2.3. On the ambiguous patterning of glottal stop

Cross-linguistically, glottal stops often pattern differently from supralaryngeal consonants. This asymmetry has been mostly characterized in terms of different featural configurations, namely, that glottals are placeless or do not have an oral articulator (Steriade 1987; Bessell & Czaykowska-Higgins 1991; Buckley 1994; Rose 1996). Some phonological patterns particular to the glottal stop are laryngeal transparency to the spreading of vocalic place features (1a) or nasalization (1b); debuccalization of final stops and fricatives (2); and epenthesis/hiatus-resolution processes (3) (see also Shaw (1991) and Borroff (2007)).

(1) Arbore (Cushitic)

a. /gereʔa/ [gereʔe] 'it is a belly' (Steriade 1987)

Sundanese (Austronesian)

b. /niʔis/ [niʔis̠] 'relax in a cool place' (Cohn 1993)

(2) Kelantan (Austronesian)

a. /ʔasap/ [ʔasaʔ] 'smoke' (Trigo 1991: 124)

b. /kilat/ [kilaʔ] 'lightening'

c. /balas/ [balah] 'finish'

(3) Malay (Austronesian)

a. /di-daki/ [didaki] ‘to climb [PASS]’ (Lombardi 2002: 228)

b. /di-ukir/ [diʔuke] ‘to carve [PASS]’

In some cases, glottal stops have been treated as a type of pharyngeal (McCarthy 1991). Following McCarthy (1994), Lombardi (2002: 221) adopts the hypothesis that glottal stops have pharyngeal place and extends the Place Markedness hierarchy (Prince & Smolensky 1993) by adding PHARYNGEAL as the least marked place: *DOR, *LAB » *COR » *PHAR. This representation would then, according to Lombardi, account for the unmarked status of the glottal stop and its role in the aforementioned phenomena of transparency, neutralization and epenthesis.

Another facet of the complex status of glottal stops is that they have been analyzed variously as (i) segmental or (ii) suprasegmental phenomena. When considered full segments, glottals have been treated as obstruents (Ladefoged 1971; Hyman 1975) or sonorants (Chomsky & Halle 1968) and so patterning with glides (Kenstowicz & Kisseberth 1979; Kavitskaya 2002). In addition, there has been debate as to whether glottal stops are [+ consonantal] (Hyman 1985) or not (Hume & Odden 1996).

Two other kinds of patterns have led to the analysis of glottals as suprasegmentals: specifically, glottal stops may be implemented as creaky phonation overlaid on the realization of other segments, and underlying creaky phonation may be realized as glottal stop (Avelino 2004: 181). For instance, whereas the glottal stop of Yatzachi Zapotec is sometimes realized as creakiness on the surface (as a prosodically conditioned variant realization), other related languages – Jalapa Mazatec, Comaltepec, Chinantec and Copala Trique – simply have phonemic creakiness (Boroff 2007: 39). In other words, there is not a necessary one-to-one correspondence between phonemic representations and phonetic reality.

3. Nivaçle glottal stop and syllable structure

In the literature on glottalized vowels in other languages, most of the arguments against treating the glottal stop as a phonemic segment rely on its defective distribution, e.g., the glottal stop may be the only coda in a language, (e.g. in Mixtec; Macaulay & Salmons 1995), and/or the glottal stop may not occur or be contrastive in initial position (e.g. in Quiavini Zapotec; Chávez-Peón 2010). As will be shown in the following sections, the Nivaçle glottal does not fit this picture; [ʔ] is contrastive in onset position (cf. Section 3.2) and I will argue that, importantly, it can be also parsed to coda position (cf. Section 3.3).

⁴ Abbreviations used in this paper include: 1: first person, 2: second person, 3: third person, BEN: benefactive, CISL: cislocative, CON: container, DET: determiner, DIR: directional, EXCL: exclusive, IMP: imperative, INST: instrumental, INT: intransitivizer, IPFV: imperfective, IT: itive, LOC: locative, NEG: negation, O: object, PL: plural, POSS: possessive, PUNCT: punctual, S: subject, S.I.: something, VEN: ventive. Note that transcriptions follow IPA conventions, but primary stress will be represented with an acute accent and secondary stress with a grave accent.

3.1. Nivaçle glottal stop as an epenthetic onset

An initial question related to the interplay of syllable structure constraints and the role of epenthetic glottal stop is whether onsetless syllables ever occur in Nivaçle. Stell (1989: 116-117) claims that V syllables are licit syllable structures in Nivaçle; she illustrates her point through the following examples:⁴

(4) o-sej-k̃la
‘prickly pear’

(5) ʎa-n-ku-a
3.S-DIR-desire-3.o
‘he desires (s.t.)’

Stell (1989: 116-117)

Based on the data gathered in the context of my own fieldwork, I will argue that onsetless syllables are neither allowed at the beginning, nor inside of the word; the constraint ONSET is undominated (8).

(6) [ʔ]osejk̃la
‘prickly pear’

(7) ʎan-kú=[ʔ]a
3.S-desire=3.o
‘he desires (s.t.)’

(8) ONSET » DEP-IO-ʔ

(9)

	/osejk̃la/	ONSET	DEP-IO-ʔ
a.	osejk̃la	*!	
b.	ʔosejk̃la		*

In (9) it can be seen that an epenthetic glottal stop is inserted to ensure satisfaction of ONSET, thus violating low-ranked DEP-IO-ʔ.

Let us now consider how the constraint ONSET works in the following examples. In her grammar, Stell (1989) presents three allomorphs for the first person possessive prefix:

Table 2. First person plural inclusive possessive prefixes

kas-	before CV-initial roots
kats̃-	before V-initial roots
katsi-	before CC-initial roots

Here I argue that because [kaʔs-] – not [kas-] – is prefixed to the root in cases like (10b), there is no underlying glottal stop in root initial position:

- (10) a. [ʔ]a.si.ná
 speech
 ‘word/speech’
- b. ka.ʔs-à.si.ná
 1.POSS-speech
 ‘our speech’
- c. *kas-ʔa.si.ná
 1.POSS-speech
 ‘our speech’

Also, Stell notes a series of allomorphic alternations involving glottal stops. There exist a number of suffixes that alternate between being vowel-initial and [ʔ]-initial, as seen in the (d)-(e) and (f)-(g) pairs in (11), as well as parallel alternations between the vowel-final and [ʔ]-final prefixes, as in the (a)-(b) pairs. Rather than treating such cases as *allomorphic* alternations, I treat them as *phonologically*-governed alternations. For example, if the root for ‘love’ is posited to be V-initial, /en/, rather than glottal-initial, then the surface occurrence of [ʔ], and the /x-/ form of the first person subject follow as *phonological* generalizations.

(11) Morpheme boundary epenthetic onset

- | | | | |
|--|--|-----|---------------------------------|
| a. ni-n-fós
NEG-3.S-bury
‘s/he does not not bury’ | b. ni-[ʔ]én
NEG-love
‘you do not love’ | cf. | c. x-én
1.S-love
‘I love’ |
| d. ni-j-én-el
NEG-1.S-love-EXCL.PL
‘we do not love’ | e. x-a.ʔsí-[ʔ]el
1.S-pour-EXCL.PL
‘we pour’ | | Stell (1989: 258) |
| f. xà-t-pekɫ-éj
1.S-CISL-return-DIR
‘I return to...’ | g. xa-pèʔ-ja-[ʔ]éj
1.S-hear-PUNCT-DIR
‘I hear (from the distance)’ | | |

What is seen here is that vowel sequences that arise through morpheme concatenation are systematically avoided by epenthesis of a glottal stop. From the perspective of syllabification of the segmental sequence, this [ʔ] functions to provide an onset for the otherwise onsetless vowel-initial syllable. To illustrate this, consider the syllabification of the form for ‘you do not love’ in (11b) with – as opposed to without – the epenthetic [ʔ]:

cf. (11d, f) repeated here for convenience:

(16) a. ni-j-én-el

NEG-1.S-love-EXCL.PL
'we do not love'

(Stell 1989: 258)

b. xà-t-pe.kl̃-éj

1.S-CISL-return-DIR
'I return to Filadelfia'

na=*Filadelfia*

DET=*Filadelfia*

As seen in Figure 1 below, the presence of the suffix-initial [ʔ] from the example in (14) shows clearly in the waveform as aperiodicity and low amplitude in the signal.

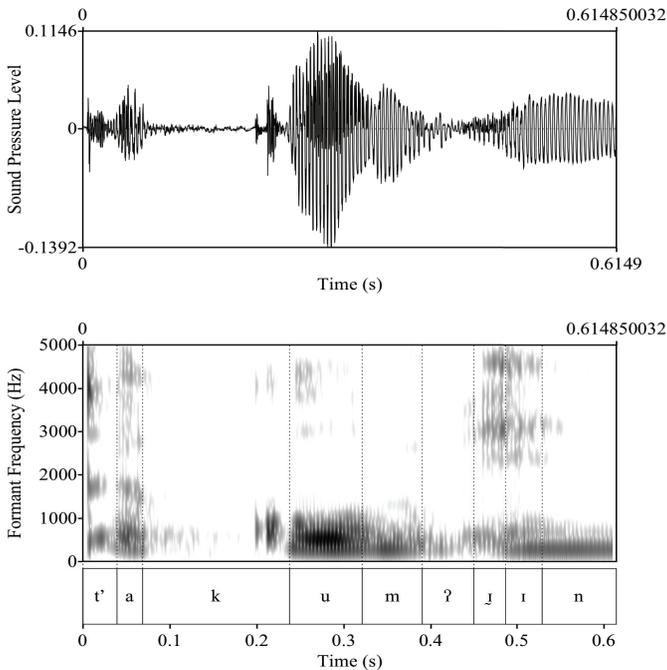


Figure 1. Waveform and spectrogram [t'akúmʔɪn] 's/he works' by female speaker TS.

During fast speech, the ʔ-initial suffix overlaps with the articulation of a preceding non-continuant obstruent, e.g., a root-final stop, such that an ejective stop results:

(17) ji-ʔé na=kot̃s.xát-ʔe ~ kot̃s.xá.t'e
be-LOC DET=land-LOC
'It is on the land'

Below, Figures 2 and 3 show the alternation between the forms in (17).

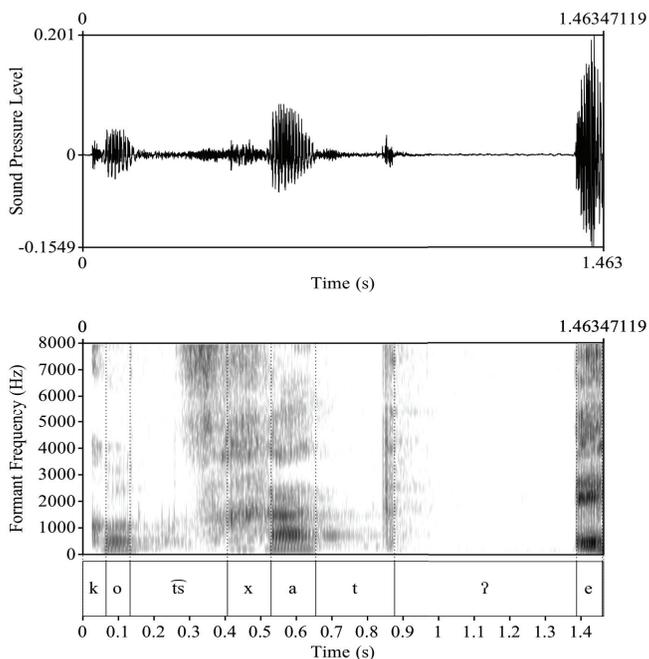


Figure 2. Waveform and spectrogram [kofsxátʔe] ‘on the land’ by male speaker FR.

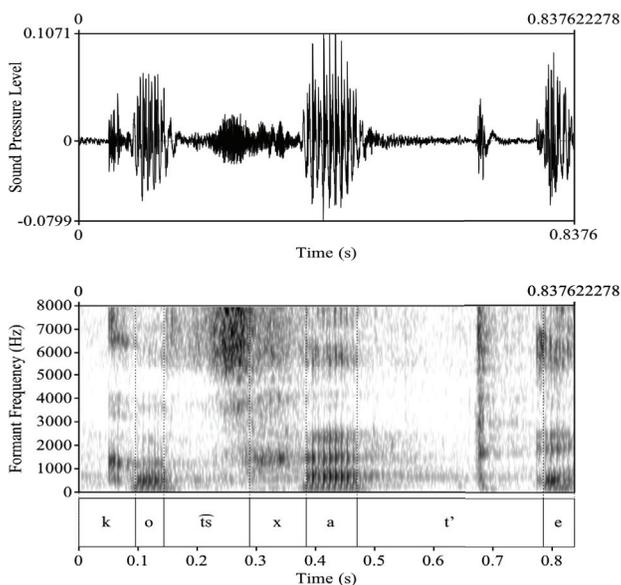


Figure 3. Waveform and spectrogram [kotsxát'e] ‘on the land’ by male speaker FR.

Note the long glottal stop closure in Figure 3; this is characteristically found in a very emphasized stop-glottal sequence in a citation context. In this first version, FR emphasized the presence of a glottal stop in a very careful pronunciation of ‘on the land’. The second version (Figure 3) is characteristic of casual speech. The important point here is that the glottalization that is realized as either [tʔ] or [tʰ] can only result from there being a phonemic /ʔ/ in the input; [kofs.xa.te] is not attested as a possible output. The alternative hypothesis that the root-final consonant is an ejective stop /kotsxaʔtʰ/ is not plausible as it would not account for the [...tʰ...] realization. Nor would it account for the fact that in other contexts when an epenthetic vowel is inserted, as shown in (18), there is no ejective in the output.

(18) a. kofsxat-[i]s
land-PL
‘lands’

b. *kofsxatʰ-[i]s

Besides serving as suffix-initial onsets, the following examples show that glottal stop can also serve as a lexically specified (i.e. non-epenthetic) root-internal onset.

(19) a. kan.ʔút
‘yesterday’

b. nu.ʔú
‘dog’

c. fñil.ʔá
‘small lizard’

d. mis.ʔá
‘scarlet-headed blackbird’

e. lùm.ʔa.ʃĩ
‘tomorrow’

f. kum.ʔá
‘crowned eagle’

cf. f'. kum.xá
‘aloja (alcoholic drink)’

g. am.ʔá
‘rat’

cf. g'. am.pá
‘nothing’

j. ka.jin.ʔá
‘hummingbird’

k. k̄li.sa.ʔá
‘blue-black grassquit’

(20) a. fak̄l.ʔú
‘brother-in-law’

- b. -fakl.ʔá
'nephew'
- c. fakl.ʔis
'bat'
- d. ukl.ʔá
'type of dove'

Albeit not exhaustive, this is a representative list of cases in which the glottal stop surfaces as a root-internal onset. A closer look reveals that these might not all be considered mono-morphemic roots; the [ʔ] might in fact be morpheme-initial, especially when considering the similarity between the kinship terms and that many forms are names of animals. Nevertheless, whether the above examples involve instances of glottal stop being parsed to root-internal onsets or not, these data clearly support the claim that glottal stops can behave as contrastive onsets in Nivaçle. Recall, in this regard, the minimal pairs listed in (19f-f') and (19g-g').

It is worth commenting on examples (20) where the complex segment [kɫ] is parsed as a coda before a glottal stop onset. It is normally the case that the complex segment [kɫ] consistently neutralizes to [k] in coda position. However, the only context in which [kɫ] does not undergo this neutralization to [k] is before a tauto-morphemic glottal stop. This exceptional syllabic behavior of [kɫ] will become relevant in the discussion of the feature specification of glottal stop (cf. Section 4).

3.3. Glottal stop as coda and Complex Nucleus

So far, I have presented an analysis of the Nivaçle internal syllable structure that accommodates the notions of Onset and Coda not as prime constituents, but rather as prosodic domain edges. Further, I assume an internal syllable structure that has a Nucleus as a constituent (Shaw 1992, 1994), specifically, as the Prosodic Head of the syllable. In Nivaçle, the Nucleus functions as the prosodic unit that hosts all and only the moraic units of the language.

Let us turn now to a consideration of contexts where glottal stop can be interpreted as serving as a word-medial (21) or word-final coda (22), and part of a Complex Nucleus (23).

With regards to Nivaçle syllable structure, CVC is an attested (and frequent) syllable type in the language. Moreover, it is claimed that the minimal foot in Nivaçle is CVC (Gutiérrez 2015). Let us investigate, then, the distribution of the glottal stop with respect to the final coda C in these CVC syllables. Examples in (21) show that a coda containing a glottal stop can precede both obstruents and sonorants. However, it cannot precede another glottal stop (*ʔʔ) or an ejective (ʔC'). This restriction can be interpreted as a type of Obligatory Contour Principle (OCP) effect (Odden 1986) whereby there cannot be two adjacent [c.g.] feature specifications.

(21) Word-internal coda

- a. ji-páʔ.kat 'my hand'
- b. xi.βéʔ.kɫa 'moon'
- c. βéʔ.la 'one'

- | | |
|---------------|----------|
| d. náʔ.ni | ‘girl’ |
| e. xa-péʔ.j-a | ‘I hear’ |

In addition, examples of word-final glottal stops are presented in (22). Importantly, they occur after all vowel qualities.

(22) **Word-final coda**

- | | |
|--------------|------------------|
| a. t’íʔ | ‘broth’ |
| b. méʔ | ‘otter’ |
| c. ji-k.t’éʔ | ‘my grandmother’ |
| d. ji.táʔ | ‘scrubland’ |
| e. kas-kíúʔ | ‘our toy’ |
| f. faj.xóʔ | ‘charcoal’ |
| g. k’ak.xúʔ | ‘I greet you’ |

The examples in (21) and (22) illustrate one variant of Nivaê phonetic glottalized vowels. Specifically, what I call *vowel-glottal coda*. In all these cases, the glottal is aligned to the right edge of the syllable domain and it is parsed directly to the syllable node, as a coda (21)-(22). However, if there is another consonant intervening between the glottal stop segment and the right edge of the syllable, the glottal stop is parsed into the Nucleus of the syllable (23). As a result, a Complex Nucleus emerges at the expense of not creating a complex coda – an illicit syllable structure in the language (23a’-23d’). This is exactly the context for the realization of another variant of Nivaê phonetic glottalized vowels, what I call *creaky/rearticulated* vowels (23a-d), represented variably as [ʎ] and [Vʎ], respectively.

(23) **Creaky/rearticulated vowels**

- | | | | |
|--------------|---|------------|--------------|
| /kíloʔp/ | | | |
| a. [kíʎp] | ~ | [kíóʔp] | a’. *kíloʔp |
| ‘winter’ | | | |
| /waʔs/ | | | |
| b. [wáʎs] | ~ | [wáʔs] | b’. *waʔs |
| ‘sky’ | | | |
| /jisaʔʃ/ | | | |
| c. [ji-sáʎ] | ~ | [ji.sáʔʃ] | d’. *jisaʔʃ |
| 1.POSS-hair | | | |
| ‘my hair’ | | | |
| /kuʔktin/ | | | |
| d. [kúʎ.tin] | ~ | [kúʔk.tin] | e’. *kuʔktin |
| ‘thunder’ | | | |

The alternation between creaky and rearticulated vowels is, according to my fieldwork research, mostly due to speech style factors: whereas the creaky variant tokens typically occur in fast or casual speech, the rearticulated variants are typically found in careful speech tokens.⁵ Note that both the creaky [V̥] and the rearticulated [Vʔ^{V̥}] variants have approximately identical duration: 200 ms.

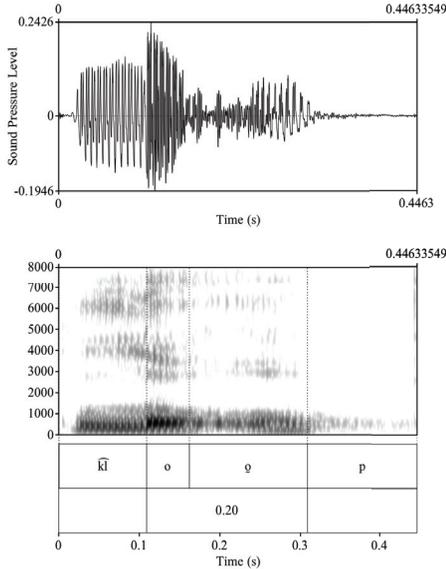


Figure 4. Waveform and spectrogram of [k̄l̄op] ‘winter’ by male speaker MV

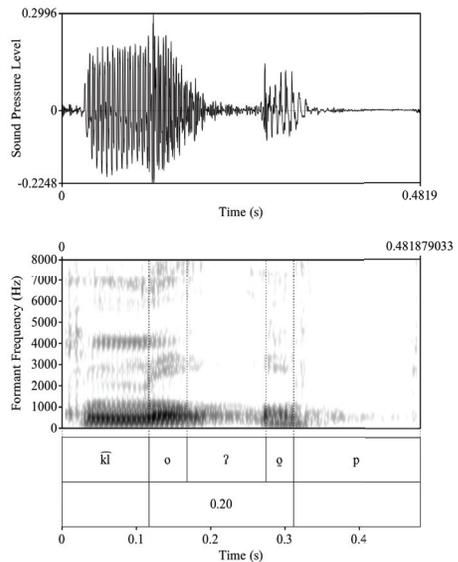


Figure 5. Waveform and spectrogram of [k̄l̄oʔ^op] ‘winter’ by male speaker MV.

On the one hand, Figure 4 shows an initial period of modal phonation followed by aperiodicity. On the other hand, Figure 5 shows three different phases: modal phonation followed by a glottal closure, followed by aperiodicity in the glottal pulses, which translates into a creaky and (and lower amplitude) vowel.

Let us turn to an acoustic consideration of what are referred to as the Nivaçle “vowel-glottal coda” cases. Recall that these are represented as [Vʔ], and occur when there is no (other) coda consonant in the syllable.

⁵ It has been noted in the literature that the implementation of glottalized vowels is subject to variation within and between speakers across languages (Avelino 2004; Gerfen & Baker 2005). For instance, gender has been noted as a factor in the realization of phonation types. Gordon and Ladefoged (2001: 10) report that creaky vowels produced by San Lucas Quiavini Zapotec men sound creakier than those produced by women. Speech rate has also been correlated to variation in the implementation of phonation types (Picanço 2005: 37), as is argued for Nivaçle here.

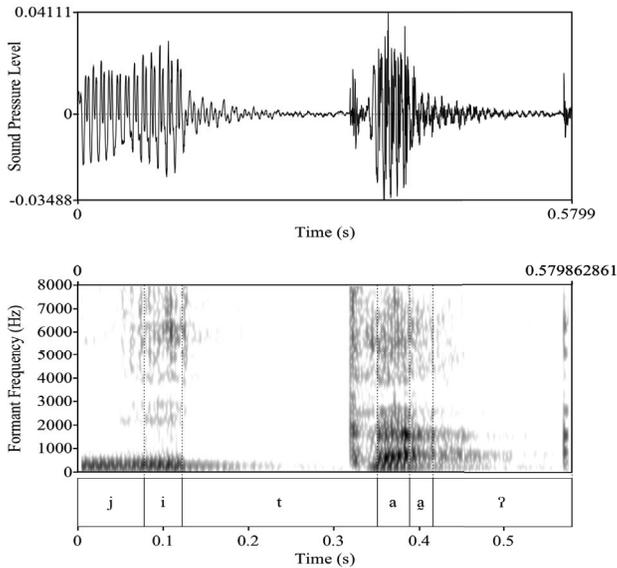


Figure 6. Waveform and spectrogram of [ji'taʔ] *scrubland* by male speaker FR

As seen in Figure 6, a vowel-glottal coda consists of a modal vowel portion followed by a full glottal closure. The last part of the vowel can be creaky due to the adjacency with the glottal stop.

To recapitulate, I analyze Nivaçle glottalized vowels (21)-(23) as underlying sequences of /Vʔ/. Further, given that there is a consistent correlation between glottalized vowels and the locus of stress, I propose that a postvocalic glottal stop is, like vowels, underlyingly moraic. Recall that the Weight-to-Stress Principle (Prince & Smolensky 1993) states that heavy (bimoraic) syllables are required to be stressed. In other words, a postvocalic glottal stop is itself defined as a moraic root node specified for [c.g.]. This root node can attach to (i) the syllable node as coda and thus get realized as a glottal stop (21)-(22), or (ii) to the Nucleus of the syllable and form part of a Complex Nucleus – phonetically realized as a creaky/rearticulated vowel (23).

Figure 7 summarizes the prosodic parsing of postvocalic glottal stop and the prosodic representation of Nivaçle phonetic glottalized vowels. Recall that I assume an internal syllable structure where the Nucleus is the head of the syllable and the host of the moraic units of the language (vowels and postvocalic glottal stop).

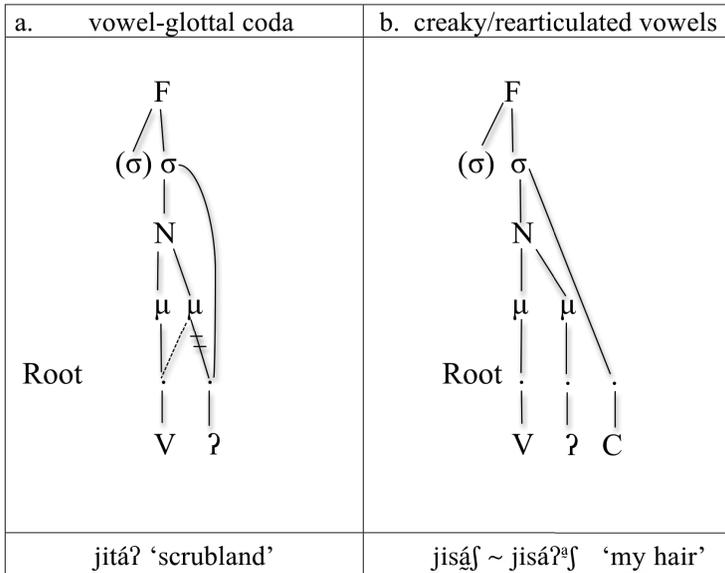


Figure 7. Prosodic representation of /Vʔ/

In Figure 7, it can be observed that: (i) moras are always parsed into the Nucleus; (ii) if the segmental content of the /ʔ/ is disassociated/delinked from its mora so that the /ʔ/ can be realized as a coda, then (in accordance with (i)) the mora remains in the Nucleus; (iii) if the full segmental content of the /ʔ/ is parsed into the Nucleus, then the surface realization is of a creaky/rearticulated vowel.

In sum, it has been shown that Nivaçle glottal stop can occur in both onset and coda position, and as part of a Complex Nucleus. Table 2 summarizes the possible syllable parsings of the glottal stop.

Table 2. Syllable types and glottal stop

Syllable types			
Open	Closed	Complex Onset	Complex Nucleus
CV	CVC	CCV(C)	CVʔC
ʔV	CVʔ	CCVʔ	
	ʔVC	*CʔV (C)	
	ʔVʔ	*ʔCV (C)	

This broad base of distribution, parallel to other major classes of consonants, motivates the representation of /ʔ/ as having an independent root node. This allows it to be parsed into not only onset, but also coda position. Importantly, a postvocalic glottal stop can be also parsed to the Nucleus of the syllable, as argued for the examples in (23).

4. Feature specification of Nivaôle glottal stop

In light of the evidence related to the distribution of the glottal stop, I will discuss the feature representation for this segment. The first hypothesis advanced here is that the glottal stop is unspecified for place features. Three supporting arguments will be discussed:

- (i) laryngeal transparency (vowel harmony across a glottal stop)
- (ii) parsing of the glottal stop in coda position (as opposed to ejectives, which are specified for place features)
- (iii) lack of delateralization of [k̠] before a glottal stop onset (cf. (20) above)

Laryngeal transparency has been advanced as an argument for the lack of internal place of articulation structure of laryngeals in comparison to other consonants (Section 2.3); that is, for glottal stops being placeless in non-guttural systems. In autosegmental phonology terms: due to laryngeal transparency, vocalic features can spread across a glottal stop because no crossing of an intervening consonantal place specification is involved (Goldsmith 1976).

In Nivaôle, spreading of vocalic features can be observed across non-epenthetic (24-26) and epenthetic glottal stops (28-29) at morpheme boundaries. Specifically, progressive vowel harmony has been attested with the imperfective /-ʔin/ and the locative /-ʔeʔ/ suffixes; as discussed in Section 3.2 these glottal initial morphemes are not epenthetic.

(24) /...e-ʔin/
[...e-ʔen]

- a. [nixaklèʔf̃ʔɛ́n]
- /ni=xá-kleʔf̃-ʔɛ́n/
- NEG=1.S-wash-LOC-IPFV
- ‘I do not (generally) do the cleaning’

- b. [xaj-kùm-ʔe-ʔɛ́n]
- /xaj-kuʔm-ʔe-ʔɛ́n/
- 1.S-work-LOC-IPFV
- ‘I am/was working’

(25) /...a-ʔin/
[...a-ʔan]

- [ɪpèʔjaʔán]
- /ɪ-peʔja-ʔin/
- 2.S-hear-IPFV
- ‘you are hearing’

- (26) /...a-ʔin/
[...a-ʔan]

[jifàʔjaʔán]
/ji-faʔja-ʔin/
3.s-fly-IPFV
's/he is/was flying'

In (24)-(26) the high front vowel /i/ is realized harmonically as a front or back non-high non-rounded vowel across an underlying glottal stop. I have not found examples of non-low back rounded vowels triggering harmony: *[oʔon], *[uʔun]:

- (27) [xaβkúʔin] *[xaβkúʔun]
/xa-wkuʔ-ʔin/
1.s-swing-IPFV
'I am swinging'

Vowel harmony is also attested across epenthetic glottal stops. When two vowels are adjacent in the input due to morpheme concatenation, a glottal stop is inserted and there is regressive vowel harmony: the vowel following the glottal stop spreads its place features to the preceding vowel. This vowel harmony process occurs when the trigger is a [-back, -low] vowel and the target is a [+low] vowel. Examples (28)-(29) illustrate this phenomenon:

- (28) a. [meʔéɫ]
/ma-el/
IMP.go-EXCL.PL
'go (you all)!'

b. [meʔéj]
/ma-ej/
IMP.go-DIR
'go (you singular) there!'

- (29) a. [xapéʔj-a]
/xapeʔj-a/ pa=laβím
1.s-hear-PUNCT DET=wind
'I heard the wind'

b. [xapèʔjeʔéj]
/xa-peʔj-a-ej/ pa=t'áǰ
1.s-hear-PUNCT-DIR DET=noise
'I heard noise (from the distance)'

Interestingly, the two attested types of vowel harmony processes can be shown with the predicative verb 'to be nearby'. On the one hand, we see progressive spreading of vowel features across an underlying glottal stop (30). On the other hand, we see regressive vowel harmony across an epenthetic glottal stop (31):

Nevertheless, there is one particular context in which $[\widehat{k\bar{l}}]$ is preserved in coda position, namely before glottal stops root internally. Compare, in this regard, (36a) with (36b), where the glottal stop onset is not part of the root.

(36) a. uk̄l.ʔá
‘turtle dove’

cf.

b. [xatpék'in]
xa-t-pek̄l-ʔin
1.S-CISL-return-IPFV
‘I return (more than once)’

Here I argue that the fact that $[\widehat{k\bar{l}}]$ can only occur as a coda before $[\text{ʔ}]$ highlights the place-less specification of glottal stop. The fact that $[\widehat{k\bar{l}}]$ does not occur before consonants (for instance, as the first member of a complex onset or in heterosyllabic consonant clusters) but before vowels – and before tautomorphemic glottal stop – suggests a relationship between glottal stop and vowel-like properties. This special behaviour of $[\widehat{k\bar{l}}]$ favours a *Licensing by Cue* approach (Steriade 1997) over a prosodic approach (Lombardi 1995). Specifically, it is not the case that $[\widehat{k\bar{l}}]$ is banned from occurring in *coda position*, but rather that the contrastive cues for the identification of this complex segment are obscured before consonantal segments that are specified for place features.⁷

The generalizations arrived at in this section, then, form the basis for the following feature specification of the glottal stop and ejectives.

Table 3. Feature specification of glottal stop and ejectives

	ʔ	T'
PLACE		LAB/COR/DOR
CONSTRICTED GLOTTIS	✓	✓

Briefly, the data and phenomena analyzed so far are predicted by the \emptyset place specification hypothesis for $/\text{ʔ}/$. The phonologically active distinctive feature below the root node that function to define a glottal stop in Nivaçle is $[\text{c.g.}]$.

⁷ An anonymous reviewer points out that licensing-by-cue is usually about optimizing before sonorant consonants. While I do not have conclusive evidence about the $[\text{sonorant}]$ specification of $/\text{ʔ}/$, it is worth mentioning that sonority does not rise across syllable boundaries (from an obstruent to a resonant). On the one hand, the *Syllable Contact Law* is a highly ranked constraint in this language, and it would then disfavor the specification of $/\text{ʔ}/$ as a sonorant segment. On the other hand, the fact that $/\widehat{k\bar{l}}/$ simplifies to $[\text{k}]$ and not $[\text{l}]$ highlights its $[-\text{sonorant}]$ specification. For a fuller description of this complex segment, see Gutiérrez (2015).

5. Conclusions

This paper has established the featural and prosodic representations of the glottal stop.

First, it has been proposed that the glottal stop is unspecified for place features, but specified for [c.g.]. There are three main arguments put forward in favor of this proposal: (i) laryngeal transparency (vowel harmony across a glottal stop), (ii) parsing of the glottal stop in coda position (as opposed to ejectives), and (iii) lack of delateralization of [k̠] before a glottal stop onset.

Second, it has been shown that the distribution of the Nivacle glottal stop is not defective. On the one hand, it can be parsed to onset position, as both an epenthetic and contrastive segment. On the other hand, it can be parsed to coda position or to the Nucleus of the syllable and hence form part of a Complex Nucleus. As a result, two different manifestations of phonetic glottalized vowels are realized: *vowel-glottal coda* and *creaky/rearticulated*, respectively. These diverse glottal realizations are rooted in a set of prosodic constraints, for example, the avoidance of onsetless syllables and complex codas.

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