LARYNGEALS AND PROSODY IN PANOAN

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1. Introduction[1]

Panoan comprises 34 languages currently or formerly spoken in Peru, Bolivia and Brazil (Amarante Ribeiro 2006; cf. Loos 1999, Lewis 2009). Panoan languages have been of interest in recent literature because they are ergative (Loos 1973, Valenzuela 2003, Lanes 2005) and because of several segmental and syllabic alternations that appear to be foot-sensitive in the absence of or in conflict with stress (see for example González 2003 and Elías-Ulloa 2006). Many of these alternations involve laryngeal consonants. For example, [h] is epenthesized rhythmically in Huariapano (Parker 1994, 1998), and /ʔ/ undergoes foot-sensitive deletion or coalescence in Capanahua (Loos 1969, Safir 1979, González 2002, Elías-Ulloa 2006).

The fact that glottal consonants are deployed in foot-sensitive alternations in Capanahua and Huariapano begs the question of whether other Panoan languages have similar phenomena. This paper attempts to answer this question by surveying the prosodic functions of glottal consonants [h, ʔ] in 27 Panoan languages. It builds on Gonzalez (under review), a study of the phonemic and phonetic status of glottals in 20 of these languages. These detailed surveys are made possible through a recent increase in documentary work in Panoan, mostly by Brazilian researchers, as well as a surge in acoustic, comparative and historical studies of this language family.

The main findings of the present study are that while rhythmic, exclusively foot-sensitive phenomena involving laryngeals is only reported for Huariapano and Capanahua, stress-conditioned insertion of [ʔ] is attested in four other languages: Katukina, Kaxinawá, Sharanawa and Saynáwa. Additionally, it is shown that in a large number of Panoan languages surveyed, laryngeals —specially [ʔ]— act as boundary markers for various prosodic categories, including morphemes, words,

[1] This work was partially supported by a Small Grant from the Council on Research and Creativity (CRC) at Florida State University, which allowed the author to conduct library research in Brazil in Summer 2011. The author thanks José Elías Ulloa for kindly sharing his work on Shipibo and Capanahua and Rogério Vicente Ferreira for answering questions about Matis. Special thanks to Angel Corbera Mori, Eclenir da Silva, Filomena Sndalo and Maria Bernardete Abaurre at UNICAMP; Bruna Franchetto, Marília Facó Soares, and the librarian Cristina Araujo Coimbra at UFRJ; and Mara Santos at the Museu do Indio in Rio de Janeiro for their generous hospitality and their invaluable help in accessing, obtaining and discussing Panoan sources.

Rebeka Campos-Astorkiza & Jon Franco (eds.), *Papers in linguistics by the BIDE generation, Anuario del Seminario de Filología Vasca «Julio de Urquijo»* XLVI-1 (2012), 151-168.

phrases, sentences and utterances. Because the glottal stop is rarely phonemic in Panoan, this paper argues that the range of prosodic functions that it can take is connected to its phonological status.

The structure of this paper is as follows. Section 2 provides a brief phonological sketch on the Panoan languages surveyed in this study. Section 3 discusses in detail the prosodic functions of glottals attested in the languages in the survey, and section 4 summarizes the generalizations that emerge. Section 5 provides a preliminary analysis for some of the patterns discussed under Optimality Theory. Finally, section 6 is the conclusion.

2. Panoan languages: A brief introduction

Panoan languages have been dubbed one of the least studied language families in South America (Erikson 1994). However, the last decades have seen an increase in their documentation efforts, especially for Panoan languages spoken in Brazil. These include acoustic investigation (Lanes 2000, 2005, Elías-Ulloa 2010), comparative approaches (Lanes 2000, 2005, Cruvinel 2009, Silva 2010), and phonological analyses in Optimality Theory (Costa 2000, Dorigo 2001).

Panoan languages tend to have between 11 and 16 consonant phonemes. These typically include voiceless stops /p, t, k/, affricates /ts, tʃ/, fricatives /s, h/ and /ʃ/ or /ʂ/, nasals /m, n/, approximants /w, j/, and rhotic /ɾ/ (Lanes 2005: 196-198). The four-vowel system /a, i, ɨ, u/ appears to be the most common vowel inventory (Lanes 2005: 94-95). The preferred syllable template is CV, although V, VC and CVC syllable structures are well-attested. Codas are usually restricted to sibilants, glottals and nasals; the latter are frequently realized as nasalization on the previous vowel. Some Panoan languages appear to have a minimal two-syllable restriction for words. Stress is typically assigned in a two-syllable window initially or finally depending on the language. Foot structure varies between iambic and trochaic, sometimes within the same language, as in Matses (Dorigo 2001), Marubo (Costa 2000) and Shipibo (Elías-Ulloa 2006).

Table 1 lists the 27 Panoan languages included in the present survey. This table provides information on whether glottal consonants occur phonemically / / or phonetically [ ] and a brief summary of their distribution. The Panoan branch and location for each language is given according to the information in Lewis (2009) and the main references consulted for this investigation.

Table 1

Distribution of glottals in the Panoan languages surveyed[2]

Language	Glottals	Distribution	Branch and location	References
Matís	[ʔ] (/k/)	Word-final	Northern Brazil	Ferreira 2001, 2008, pc
Matsés (Mayoruna)	[ʔ] (/k/) [ʔ]	Syllable-final Morpheme-final	Northern, Peru Northern, Brazil	Fleck 2003 Dorigo 2001
Shipibo- Conibo	/h/ /ʔ/	Syllable-initial (mostly) Phrase-initial, final; #_#	North-Central Peru	Elías-Ulloa 2006, 2010; Valenzuela et al. 2001
Capanahua	/h/ [h] /s/ /ʔ/ [ʔ] [ʔ] /tʃ/	Word-initial Word-medial coda Syllable initial, final + _ +; other contexts Word-medial coda	North-Central Peru	Loos 1969, 1986, Loos and Loos 1998, Elías-Ulloa 2006, 2009
Marubo	[ʔ]	Boundary marker	North-Central, Brazil	Costa 1992, 2000
Sharanawa (Marinahua)	/h/ [ʔ]	Syllable-initial (rare) #_#; syllable-final	South-Central Peru, Brazil	Pike and Scott 1962, Shell 2008
Yaminahua	[ʔ] (/k/)[3] [ʔ] /h/	Syllable-initial Word-initial, word-final Word-initial (one word)	South-Central Peru, Bolivia, Brazil	Eakin 1991, Faust and Loos 2002, Loos 2006, Lanes 2000, 2005
Yawanawa	/h/ [h] /x/ [ʔ]	Syllable-initial Word-medial coda Syllable-initial Syllable/word final	South-Central Brazil	Paula 2004[4]
Amahuaca	/h/ /ʔ/ [ʔ]	Morpheme/root initial Syllable-initial, final Word-final	South-Central Peru, Brazil	Osborn 1948, Russell 2008 Sparing-Chávez 1998
Poyanáwa	/h/ [ʔ]	Syllable initial and final Not reported	South-Central, Brazil	Paula 1992
Nukini	/h/	Syllable-initial, final	South-Central, Brazil	Aguiar 2004
Mastanawa	/ʔ/ /h/	Syllable-initial Word-final (rare) Syllable-initial (rare)	South-Central, Brazil	Silva 2010
Tuxinawa	/ʔ/	Syllable-initial	South-Central, Brazil (extinct)	Silva 2010

[2] The symbol # indicates word boundaries. + stands for morpheme boundaries.
[3] Cruvinel (2009: 14) considers that /ʔ/ is a phoneme in Yaminahua.
[4] But see Lanes (2005: 196), who lists /x/ instead of /h/ for Yawanawa.

Language	Glottals	Distribution	Branch and location	References
Xitonawa	/h/ /ʔ/	Syllable/word-initial Syllable-initial, final	South-Central;Brazil	Silva 2010
Yoranawa (Parquenahua, Nahua, Yora)	/h/	Word-initial	South-Central, Brazil	Cruvinel 2009
Chácobo	/h/ /ʔ/	Word-initial Syllable-initial; word-final	Southern, Bolivia	Prost 1965, 1967, Shell 2008
Katukína	/h/ [ʔ]	Mostly word-initial Word-final	South-Eastern, Brazil	Aguiar 1994[5]
Camannawa	/ʔ/	Not reported	South-Eastern, Brazil	Loos 1999
Kaxinawá	/h/ [ʔ]	Word-initial (mostly) Syllable-final	South-Eastern Peru, Brazil	Camargo 1992, Shell 2008
Kaxararí	/h/ [ʔ]	Syllable-initial Word final; V_V	Eastern, Brazil	Sousa 2004[6]
Cashibo-Cacataibo	/ʔ/	Word-initial	Western, Peru	Shell 1950, 1987, Wistrand Robison 1978
Shanenawa	/h/ [ʔ]	Syllable-initial Word-final; #_#	Unclassified Brazil	Cândido 1998, 2004
Huariapano	/h/ [h] [ʔ]	Word-initial Word medial coda Word-final	Unclassified, Peru; extinct	Parker 1994, 1998
Arara	/h/ [h] ~ [v]	Syllable initial Coda (one morpheme) Syllable-initially (rare)	Unclassified, Brazil	Cunha 1993
Saynáwa	/h/ [h] /s/ [ʔ]	Word-initial Syllable final [o_t] Word/utterance final	Unclassified, Brazil	Cavalcanti Couto 2010
Pacanawa	/h/ /ʔ/	Not reported Not reported	Unclassified, extinct	Loos 1999
Yoranawa (Parquenahua, Nahua, Yora)	/h/	Word-initial	South-Central, Brazil	Cruvinel 2009

The information available for Panoan, and in particular, for glottal consonants in each of its languages varies widely. However, the following generalizations apply

[5] Barros (1987: 41-43) reports that [ʔ] can occur word-initially in isolated words and as onset and coda.

[6] But see Lanes (2005: 196), who lists /x/ instead of /h/ for Kaxarari.

from the sources consulted. Most Panoan languages (21 out of 27 surveyed) have a phonemic /h/ in their inventory, but significantly fewer (10 out of 27 surveyed) have a phonemic glottal stop. In general, when glottals are phonemic in Panoan they rarely occur in coda position. Below are examples from Yawanawa (1), where /h/ can occur as an onset (1a) and as a coda word-medially (1b) (Paula 2004: 61), and Cashibo-Cacataibo (2), where /ʔ/ occurs contrastively word-initially (Shell 1950; Wistrand Robinson 1978).

(1) /h/ in Yawanawá (Paula 2004: 73, 79, 84)[7]
a. /*h*u/ 'hair' /mɨ.*h*i/ 'hand'
b. /tsɨ*h*.ʃɨ.pa/ 'black' /ka.ka*h*.ma/ 'doesn't want to go'

(2) /ʔ/ in Cashibo-Cacataibo (Shell 1950: 198-201)
a. [*ʔ*i.no] 'wildcat' vs. [i.tsi.bi] 'kind of tree'
b. [*ʔ*o.to.tum.bo] 'kind of fruit' vs. [o.mõ] 'kind of frog'

Several Panoan languages have laryngeals as allophones of other consonants. For example, glottal stops are allophones of /k/ in Peruvian Matses (Fleck 2003), Yaminahua (Eakin 1991, Faust and Loos 2002) and possibly Matis (Ferreira p.c.). [ʔ] is also an allophone of /tʃ/ in Capanahua (Loos 1969). Reports for Amahuaca suggest that the glottal stop alternates with [k] and [n] in specific morpho-phonological contexts (Russell 2008, Sparing-Chávez 1998). Glottal fricatives are allophones of sibilants in Capanahua (Loos 1969, Elías-Ulloa 2009) and Saynáwa (Cavalcanti Couto 2010) and of velar /x/ in Yawanawá (Lanes 2000, 2005). Although contrastive, /h/ is reported to alternate with /v/ in Arara (Cunha 1993). For a more extensive survey of allophonic variation involving glottals in Panoan, see González (under review).

Laryngeals are also involved in an extensive range of prosodic functions in Panoan. They enter in rhythmic (foot-based) alternations in Huariapano and Capanahua (section 3.1) and quantity-sensitivity to stress in Katukina, Shanenawa, Saynáwa and Kaxinawá (section 3.2). Additionally, they often demarcate morphological and syntactic boundaries from morphemes to sentences (section 3.3) and may also indicate emphasis (section 3.4). A detailed consideration of each of these functions follows.

3. Prosodic distribution of glottals in Panoan

3.1. Rhythmic alternations in Panoan

Huariapano (unclassified; extinct) and Capanahua (North-Central Panoan) have well-studied rhythmic, foot-sensitive phenomena involving glottals in coda position. Huariapano has a phonemic /h/, as evidenced by the minimal pair [hi.wi] 'branch, stick' and [i.wi] 'stingray' (Parker 1994: 96). [h] also epenthesizes word internally in coda preceding voiceless consonants (cf. 3a with 3b, c). Stress does not condition [h]

[7] The data in this paper is presented following the conventions of the IPA unless otherwise noted. Syllable boundaries, and often, stress marks are included for convenience, following syllabification and stress for each language.

epenthesis except in the first syllable of the word, where [h] epenthesis cannot co-occur with main stress (cf. 3b, c with 3d) (Parker 1994, 1998).

(3) Coda [h] epenthesis in Huariapano (Parker 1994: 102, 108; 1998: 26, 28)

a.	[ka. moʂ]	'species of venomous snake'	*[ka*h*. moʂ]
b.	[ˌpi*h*.ka. ti*h*.kaj̃]	'they ate'	
c.	[na*h*. kaʔ]	'manioc beer'	
d.	[na.kaʔ]	'flea'	*[na*h*.kaʔ]
e.	[ˌiʃ.to. ki. raŋ.ki]	'(it) came running'ˋ	*[ˌiʃ.to*h*.ki. raŋ.ki]

Descriptively, [h] is inserted in odd-numbered syllables (cf. 3b-d with 3e; Parker 1994). [h] epenthesis occurs left-to-right in the word in a trochaic pattern similar to the main pattern of secondary stress in Huariapano; this is why it does not occur in stressed word-initial syllables (Gonzalez 2003; cf. Parker 1994, 1998). From a metrical point of view, [h] epenthesis occurs in foot heads and serves a rhythmic purpose. This phenomenon appears to be a unique phenomenon in Panoan, especially since [h] is rarely involved in prosodic alternations in this language family. Intriguingly, [h] epenthesis in Huariapano shows many similarities to coda [h] insertion in Urarina (González 2011), an Amazonian isolate located close to the area where Huariapano was spoken (Olawsky 2006). For further examples and theoretical analysis, see Parker (1994, 1998), and González (2003, 2011).

Related rhythmic phenomena involving the glottal stop are attested in Capanahua, which has both /h, ʔ/ as phonemes and lacks secondary stress (Loos 1969). In this language, [ʔ] is deleted in coda of even-numbered syllables (cf. 4a, b with 4c; Loos 1969: 183-4). Elías-Ulloa (2009: 1-11) reports that /ʔ/ occurs exclusively in 'stressed' syllables, i.e., in head syllables in the metrical structure. In coda of unstressed initial syllables, /ʔ/ occurs variably as a glottal stop or creakiness on the preceding vowel (4d). In 'unstressed' syllables, i.e. in non-head syllables in the metrical structure, /ʔ/ is always realized as creakiness of the preceding vowel (4e).

(4) [ʔ] deletion in Capanahua (from Elías Ulloa 2009: 11, 14)

a.	/taʔ/	[taʔ]	*declarative modal*
b.	/ʔonan-iʔ-ki/	['ʔo.na.niʔ.ki]	'He knows'
c.	/βitʃ-iʔ/	['βi.tʃi]	'I grab'
d.	[baʔ.'kiʃ] ~	[bạ.'kiʃ]	'tomorrow, yesterday'
e.	[('tuʔ.ku.) (-ˌma. –tạ.) -ki]		'it's not a frog'

A related phenomenon in Capanahua is onset-to coda metathesis of [ʔ] (Loos 1986: 299). An onset glottal stop in a third syllable of a word metathesizes to the coda of the same syllable, glottalizing the vowel over which it passes (5a). If there is already a coda glottal stop in this syllable, the onset deletes (5b) (Loos and Loos 1998: 21, 22).

(5) [ʔ] metathesis in Capanahua (Loos 1986: 299)

a)	/kɯtsin-ʔino/	(colored-tiger)	[ke.tsĩ.ĩʔ.no)]	'tigrillo'
b)	/bana-ʔaʔ-ki/	(plant-past validational)	[ba.na.aʔ.ki]	'I planted'

The phenomena exemplified in (4, 5) is also conditioned by foot-structure. In particular, the non-heads of trochaic feet are made lighter or weaker by [ʔ] deletion, while [ʔ] metathesis makes the head of a trochaic foot stronger (González 2003). La-

ryngeal rhythmic phenomena in Capanahua signal foot structure in the absence of stress, and in conflict with it in Huariapano. This is rare typologically, since stress and foot tend to work together in languages (González 2003 and references therein).

Although the remaining Panoan languages surveyed do not have exclusively foot-conditioned rhythmic phenomena involving glottals, a connection between laryngeals and stress is found in a few languages. This will be discussed in the next section.

3.2. Stress alternations in Panoan

The glottal stop is epenthesized for stress purposes in Katukina, Kaxinawá, Shanenawa and Saynáwa. The first two languages belong to the Southeastern branch of Panoan. The third, according to Cândido (2004), is very close to Katukina, and Saynáwa is unclassified. All these languages have final stress.

Katukina has phonemic /h/ in onset position (Aguiar 1994: 45, Barros 1987: 10, 18) and a predictable occurrence of [ʔ] in coda of stressed, final syllables ending in oral vowels (6a). Other codas include /ɾ, s, ʂ, ʃ, j, n, w/ (6b), which unlike [ʔ] can be onsets as well (Aguiar 1994: 73).

(6) Glottal consonants in Katukina (Aguiar 1994: 58-67, 78)

a.	/ßaɾi/	[ßa.' ɾiʔ]	'sun, day'	/tsatsa/	[tsa.'tsaʔ]	'fish'
b.	/kaman/	[ka.'mɜ̃]	'puppy'	[ja.'wiʂ]	'armadillo'	

Similarly, Shanenawa has phonemic /h/ as onset word initially and medially (Cândido 2004: 38, 39). [ʔ] is epenthesized in word-final syllables that lack a coda, ensuring that the main-stressed final syllable is heavy (7b, c) (Cândido 2004: 41-7). Other codas in Shanenawa are /s, ʂ, n, j, w/ (7a) (Cândido 2004: 41). In compounds formed of two words, each ending in an open syllable, the glottal stop surfaces only in the final syllable of the second word (7d). Thus, [ʔ] seems to be a reflex of main stress rather than of stress generally (Cândido 2004: 43).

(7) Glottal consonants in Shanenawa (Cândido 2004: 38, 39, 42, 43, 45)

a.	[ka.'mã]	'dog'	['ʂaw]	'bone'	[ju.'maj]	'ounce'
b.	/fu/	['fuʔ]	'hair'	/nai/	[na.'iʔ]	'sky'
c.	/istuku/	[is.tu.'quʔ]	'monkey'	/paʂinipa/	[pa.ʃi.ni.'paʔ]	'yellow'
d.	[i.'viʔ]	'wood' +	[pa.'niʔ]	'net (bed)'	[i.ˌvi.pa.'niʔ]	'bed'

Kaxinawá also has main stress always on the last syllable of the word, with the exception of very specific morphological contexts (Camargo 1992: 174-176). /h/ is phonemic and generally occurs as onset word-initially (Camargo 1992: 96, 113). The glottal stop occurs as word-final coda if the word ends in an oral vowel (8a, b). It can also occur as word-medial coda in an otherwise open syllable, although this context is not well understood (Camargo 1992: 143, 144). Other codas in Kaxinawá include /n, s, ʂ/ (8c, d) (Camargo 1992: 148).

(8) Glottal consonants in Kaxinawá (Camargo 1992: 142, 143, 145, 175)

a.	/ɨ/	[ɨʔ]	'scratch'	/na/	[naʔ]	'nest; this one'
b.	/punu/	[pu.noʔ]	'vein'	/ʂapu/	[ʂa.poʔ]	'cotton'
c.	/pupus/	[pu.pus]	'mud'	/unpaʂ/	[õm.paʂ]	'water'
d.	/hunun/	[hu.nõ]	'tree with poisonous fruit'			

Last but not least, Saynáwa also has /h/ and stress on the final syllable (Cavalcanti Couto 2010). A process of [ʔ] epenthesis occurs word-finally if the stressed syllable lacks a coda consonant (cf. 9a, b). It is interesting that [ʔ] epenthesis occurs after nasal vowels (9b) and that it alternates with vowel lengthening in monosyllables (9c) (Cavalcanti Couto 2010: 118, 139).

(9) Glottal consonants in Saynáwa (Cavalcanti Couto 2010: 77, 84, 117, 139)

a.	/βitaʃ/	[βi.ˈtaʃ]	‘leg’	/ɾais/	[ɾa.ˈis]	‘son-in-law’
b.	/hənə/	[hə.ˈnəʔ]	‘river’	/ismin/	[ˌiʃ.ˈmɛ́ʔ]	‘vulture-king’
c.	/na/	[ˈnaʔ] ~ [ˈnaː]		‘this’ (demonstrative pronoun)		

These four languages lack phonemic /ʔ/ and have final stress and obligatory glottal stop epenthesis in coda in the main stressed syllable. As shown in the following section, other languages with word-final epenthesis of [ʔ] in Panoan have different properties: they may have phonemic /ʔ/, they do not necessarily have final stress, and glottal stop epenthesis is optional and variable. These differences strongly suggest that the main motivation for final glottal stop epenthesis in Katukina, Shanenawa, Kaxinawá and Saynáwa is stress-related. An analysis of this pattern in the framework of Optimality Theory will be proposed in section 5.

3.3. Domain demarcation in Panoan

The glottal stop is reported to have a demarcative function in several Panoan languages at the beginning or end of various domains, including morphemes, words, phrases, sentences and utterances. The most inclusive example of boundary demarcation for [ʔ] appears to be Marubo, where the glottal stop can indicate initial or final boundaries for all of these morphological and syntactic constituents (Costa 1992: 221-227). In other Panoan languages the demarcative nature of this consonant is reportedly more limited, being inserted as onset in word or utterance initial position before onsetless vowels, at morpheme or word boundaries between adjacent or identical vowels, and in coda position at the end of morphemes, words, phrases and sentences. Crosslinguistically, it is common for glottal stops to demarcate prosodic boundaries; one well-known example is German (Ladefoged and Maddieson 1996: 74, Alber 2002).

3.3.1. Morpheme boundaries

In some Panoan languages, including Capanahua, Marubo, Shipibo and Brazilian Matses, the glottal stop is epenthesized at morpheme-boundaries. Capanahua also deletes glottals across morpheme boundaries. Glottal restrictions to specific morphemic positions are attested in Capanahua, Shipibo and Amahuaca.

In Marubo, which lacks phonemic glottals, [ʔ] can indicate morpheme initial or final boundaries; very slow speech can also demarcate morphemes (Costa 1992: 221-227). Similarly, in Brazilian Matses, which also lacks phonemic laryngeals, [ʔ] optionally occurs as a morpheme-final marker between suffixes or between roots and suffixes (Dorigo 2001: 72, 139, 141). [ʔ] is reported to be a coda in these cases. It tends to occur after the ‘non-past’ {-ɛ́}, ‘past’ {-ɔ}, ‘remote past’ {-da}, and ‘com-

pleted action' {-a} suffixes. It also appears regularly between a root and the nominalizer {-kit} and sporadically before the intensifier {-kjɔ} (Dorigo 2001: 139-140, 201). The glottal stop is not the only boundary marker in Brazilian Matses; other possible markers are /ɾ/, realized as [ɾ] between vowels (Dorigo 2001: 143-147) and [n], which occurs between the root and the adjectivizer {-bo} or the diminutive {-pi} (Dorigo 2001: 150-152).

In Capanahua, where /ʔ/ is phonemic, [ʔ] is epenthesized intervocalically across certain morpheme boundaries (10) (Loos 1969; Elías Ulloa 2009: 23-4). On the other hand, both /h/ and /ʔ/ can be deleted across morpheme-boundaries in some cases. For example, /ʔ/ can be deleted before the recent past morpheme (11b), but not before the remote past (11a). Deletion of /h/ may accompany deletion of an adjacent consonant (11c, d).

(10) Capanahua glottal stop epenthesis between morpheme boundaries (Loos 1969: 176)

a.	/bana-i/	['ba.na.ʔi]	'planting'
b.	/bana-ipi-ki/	['ba.na.ʔi.pi.ki]	'planted it (yesterday)'

(11) Capanahua /ʔ/ and /h/ deletion between morpheme boundaries (Loos 1969: 176-177)

a.	/mapɯt–ʔoʂki/	[ma.pɯ.ʔoʂ.ki]	'he ascended (remote past)'
b.	/mapɯt–ʔa-ʂ-ki/	[ma.pɯ.taʂ.ki]	'he ascended (recent past)'
c.	/siɾip-ha-kin/	[si.ɾi.a.kin]	'did it well'
d.	/hamak-ha-kin/	[ha.ma.a.kin]	'stepped down'

Valenzuela et al. (2001: 282) state that [ʔ] occurs predictably in Shipibo when a stressed open monosyllable is followed by a vowel-initial item at morpheme boundaries, as in /to/ 'pop' + /ati/ (nominalizer) = [toʔati]. A connection between stress and boundary marking in Shipibo is also mentioned for utterance-final positions (section 3.3.4).

Glottal consonants are reportedly restricted to certain morphemes or morpheme positions in various Panoan languages. Thus, in Capanahua both [h, ʔ] are restricted to the first syllable of a morpheme, and in Shipibo, [ʔ] never occurs morpheme-internally or within a compound (Elías-Ulloa 2010). Similarly, in Amahuaca, /h/ reportedly occurs as onset morpheme-initially only (Osborn 1948: 189)–but cf. Russell (2008: 63), who states that /h/ can only be found initially (i.e., as onset) within a root.

3.3.2. Word boundaries

The glottal stop can occur as an optional word-initial boundary in Yaminahua (Lanes 2000, 2005, Loos 2006) and in Marubo. In the latter, [ʔ] is reportedly inserted word-initially both in isolated words or in words in context (Costa 1992: 221-227). The glottal stop is also common between adjacent vowels across word boundaries in Shanenawa (Cândido 1998), Shipibo (Elías-Ulloa 2010), and (optionally) in Sharanawa (Pike and Scott 1962).

As a word-final boundary, the glottal stop is attested in Marubo (Costa 1992), Yaminahua (Lanes 2000, 2005), Kaxarari (Lanes 2005), Huariapano (Parker 1994),

Chacobo (Shell 2008), Sharanawa (Pike and Scott 1962), Shanenawa (Cândido 1998, 2004), Amahuaca (Osborn 1948; Russell 2008) and Saynáwa (Cavalcanti Couto 2010). Examples from most of these languages are discussed in more detail below.

In Sharanawa, [ʔ] optionally appears at the end of words in isolation (Pike and Scott 1962: 3, 4). In Huariapano, where /ʔ/ is not a phoneme, [ʔ] occurs optionally as word-final coda after a vowel. Unlike other word-final codas /s, ʃ, ʂ, n/, the glottal stop fails to attract stress and therefore does not contribute to syllable weight (cf. 12a, b) (Parker 1994).

(12) Huariapano [ʔ] as a word-final boundary marker (Parker 1994: 97, 98)

a.	/pino/	['pi.no] ~	['pi.noʔ]	'hummingbird'
b.	[ja.'wiʃ]	'opossum'	[ʂa.'ßin]	'bee'

Similarly, in Chacobo, where /h, ʔ/ are attested in onset position, [ʔ] is reported to occur at the end of a word in isolation (Shell 2008: 40, Prost 1965, 1967). In Amahuaca, [ʔ] is also reportedly inserted word-finally after a codaless vowel (Osborn 1948: 189, Russell 2008: 66). /ʔ/ is attested in this language word-medially as coda, and as onset word-initially and medially (Shell 2008: 57-59, Russell 2008: 66; cf. Osborn 1948: 189).

In Shanenawa, the glottal stop optionally occurs word-finally in stressed syllables (section 3.2), and also, optionally, between words (13) (Cândido 1998, 2004).

(13) Glottal stop between compounds in Shanenawa (Cândido 1998: 97)

a.	[na.'waʔ]	'non-Indian'	[pi.'jaʔ]	'arrow'	[na.ˌwaʔ.pi.'jaʔ]	'rifle'
b.	[ta.'ɾiʔ]	'cape'	[ʂɨ.'ʧɨʔ]	'chest'	[ta.ˌɾiʔ.ʂɨ.'ʧɨʔ]	'blouse'

The occurrence of the glottal stop as a word-final boundary marker varies in the languages considered above. But unlike the cases examined in section 3.2, it can be optional, [ʔ] may or may not be a phoneme in the language, and main stress does not necessarily fall on the final syllable. For these reasons, these patterns are considered to be qualitatively different to the stress-conditioned epenthesis of [ʔ] discussed in section 3.2.

3.3.3. Phrase boundaries

Demarcation of phrase boundaries is not generally reported for Panoan languages. Two exceptions are Marubo and Shipibo. In Marubo, the glottal stop can indicate the end or beginning of a phrase, or can occur before or after pause (Costa 1992: 224, 227). In this language, lengthening of low-pitched, short and unstressed syllables can also indicate the end of beginning of a phrase (Costa 1992: 227, 228). Similarly, in Shipibo [ʔ] is reported to be usually epenthesized phrase-initially before onsetless vowels and phrase-finally after codaless vowels (14) (Elías-Ulloa 2010). The same applies at the beginning or end of words in isolation, which are equivalent to phrases according to Elías-Ulloa (2010).

(14) Shipibo [ʔ] insertion at phrase boundaries (Elías-Ulloa 2010: 54)

a.	/akʊ̄npana/	[ʔa.kʊ̄m.pa.naʔ]	'rattlesnake'

3.3.4. Sentence and utterance boundaries

The glottal stop occurs as a boundary marker at the beginning and/or end of sentences or utterances in several Panoan languages. In Sharanawa, [ʔ] optionally appears at the end of sentences (Pike and Scott 1962: 3, 4). In Marubo, the [ʔ] can indicate the end or beginning of a sentence (Costa 1992: 224). Valenzuela et al. (2001: 282) reports a similar distribution for Shipibo, with the exception that utterance-finally, the glottal stop is inserted after stressed vowels only (but see Elías-Ulloa 2010, who proposes the phrase as the relevant domain). In Saynáwa, [ʔ] can occur at the end of an utterance; according to Cavalcanti Couto (2010: 157), the glottal stop is a prosodic marker that delimits the phonological utterance.

Two unusual patterns are Capanahua, where [ʔ] is reported to epenthesize before word-initial /β, ɾ/ in sentence juncture (15) (Loos 1969), and Amahuaca, where [ʔ] deletes utterance-initially (Shell 2008: 57-59, Russell 2008: 66; cf. Osborn 1948: 189). These patterns are not reported in any other of the Panoan languages surveyed.

(15) Capanahua [ʔ] epenthesis in sentence juncture (Loos 1969: 176)

a.	/ßana-wɯ/	[ʔßa.na.wɯ]	‘plant’
b.	/ɾaʔmaβi +ɾɯɾa-wɯ/	[ʔraʔ.ma.βi.ɾɯ.ɾa.wɯ]	‘chop now’

3.4. Emphasis

Fleck (2003: 75, ft. 2, 443) notes that in Peruvian Matses, the glottal stop can optionally occur syllable-finally in morphemes such as {-ma ~ -maʔ} ‘but’, {-ada ~ -adaʔ} ‘uncertainty’, {-ta ~ -taʔ} ‘imperative’. He observes that when [ʔ] occurs, the allomorph is more emphatic or dramatic, tends to co-occur with emphatic intonation and loudness, and normally follows a pause. For Shipibo, Shell (2008: 41) reports that /h/ is inserted in coda to denote emphasis, as in /hatíßi/ ‘everything’ vs. /hatíhßi/ ‘everything-emphatic’. Recent work in Shipibo does not seem to confirm this fact (see for example Elías-Ulloa 2010).

Lanes (2005: 203) mentions that in Kaxarari the glottal stop can occur word-medially between vowels, probably as a hiatus resolution and for emphasis. Unfortunately, no examples or further information are provided for this distribution.

4. Discussion

The survey of the prosodic distribution of laryngeals in Panoan languages shows that the glottal stop is overwhelmingly employed as a boundary marker demarcating the beginning or end of morphological and syntactic categories. Also attested but rarer is the connection of the glottal stop (in one case only, the glottal fricative) to foot-structure, main stress, and emphasis. This is coherent with the cross-linguistic tendency for laryngeals (especially the glottal stop) to be involved in prosodic phenomena (Ladefoged and Maddieson 1996: 74; González 2003 and references therein). The wide range of prosodic functions of the glottal stop in Panoan is also probably connected to its relatively low occurrence as a phoneme in most of the languages surveyed.

If the specific phonological contexts for boundary marking are considered, it appears that in most cases the glottal stop is epenthesized before initial vowels or after

final ones. In the first case, the glottal stop may fulfill the role of a default onset due to its lack of supra-laryngeal features. Alternatively, the glottal stop may be inserted because many Panoan languages have a restriction or preference against vowel-initial morphemes, words, phrases and sentences.

In a few languages the glottal stop occurs to break out a sequence of two vowels in separate morphemes or words. A restriction against complex vowels may be a necessary but not exclusive motivation for this epenthesis, since adjacent vowels within morphemes or words do not trigger epenthesis. On the other hand, the glottal stop is also epenthesized as coda at the end of morphological and syntactic boundaries. Here the motivation is not syllable-based since codas are dispreferred typologically. A possible aerodynamic scenario for the occurrence of [ʔ] in this position is the lowering of pitch that may occur during the final part of words in isolation, phrases, sentences or utterances. Pitch lowering and the slower vibration of the glottal folds might contribute to the occurrence of glottal stops in this position. This seems supported for Marubo, where [ʔ] epenthesis is more common in syllables that are low-pitched and unstressed than in syllables that are high-pitched, stressed and long (Costa 1992: 224-225).

The occurrence of the glottal stop as a boundary or emphatic marker in the Panoan languages surveyed is frequently reported as a tendency or as optional. However, in four languages (Katukina, Kaxinawá, Shanenawa, Saynáwa) the glottal stop is epenthesized in a final, stressed syllable in a categorical manner. The fact that [ʔ] epenthesis is obligatory, unlike the occurrence of the glottal stop constituent-finally, suggests that it is connected primarily to stress. In these four languages, the glottal stop is the default segment which can be used to make a stressed syllable heavy (cf. Cândido 2004 and Cavalcanti Couto 2010). Since these languages have iambic footing, and the preferred iamb configuration cross-linguistically is the uneven light-heavy (Hayes 1995), these languages exemplify a connection between stress and foot structure that is mismatched in the glottal phenomena attested for Capanahua and Huariapano (section 3.1). An Optimality-Theoretic analysis of this pattern is provided in the next section.

5. Analysis

While the foot-conditioned laryngeal phenomena attested in Huariapano and Capanahua have been well-studied and analyzed in the literature (see section 3.1 for details and references), this is not the case for other prosodic phenomena involving laryngeals in Panoan. This section proposes and Optimality-Theoretic account for glottal stress-conditioned epenthesis in Katukina, Shanenawa, Saynáwa and Kaxinawá. A theoretical analysis of boundary and emphasis marking is not offered at this time since these are frequently reported to be optional or limited to specific morphemes and in general the information available for them is more sketchy.

The analysis proposed here makes use of undominated constraint FtBin (Prince 1980, Kager 1989, Prince & Smolensky 1993), which outranks Parse (McCarthy and Prince 1993: 14). The effect of this ranking is to ensure that all syllables in a word are parsed by binary feet. The constraint Rightmost (Prince & Smolensky

1993, Kager 1999: 131) conspires for main final stress, while RhType = Iamb advocates for final prominence within a foot (Kager 1999: 136). The effect of these two constraints is to capture iambic footing and main final stress in these languages.

(16) Metrical constraints for Katukina, Shanenawa, Kaxinawá and Saynáwa (I)

FtBin	Feet are binary under a moraic or syllabic analysis
Parse	Syllables are parsed into feet
Rightmost	Align (Hd-Ft, Right, PrWd, Right) 'The head foot is rightmost in the prosodic word'
RhType = Iamb	Feet have final prominence

Stressed syllables are heavy in these four languages. If the main stressed syllable lacks a coda or a nasal vowel (which counts as two moras), a glottal stop is inserted. The constraint Stress to Weight, which advocates for quantity-sensitivity (Riad 1992, Kager 1999) outranks Dep-μ, which prohibits epenthesis of a moraic element (Kager 1999) (17).

(17) Metrical constraints for Katukina, Shanenawa, Kaxinawá and Saynáwa (II)

Stress to Weight	Stressed syllables are heavy
Dep-μ	Output moras have input correspondents

The relevant ranking for Shanenawa, Kaxinawá, Katukina and Saynáwa is FtBin, RhType = Iamb, Rightmost, Stress to Weight >> Dep-μ >> Parse. This is exemplified for Shanenawa in Tableau 1. Candidates (a, b, e, f) lose from violations of undominated constraints. Candidates (c, d) tie on a violation of Dep-μ, since glottal epenthesis has applied in word-final coda. However, candidate (c) is optimal since it complies with Parse, unlike candidate (d).

Tableau 1

Glottal stop epenthesis in stressed syllable: Shanenawa

/ivi/ 'wood'	FtBin	RhT=Iamb	Rightmost	STW	Dep-μ	Parse
a. ('i.vi)		*(!)		*(!)		
b. (i.'vi)				*!		
☞c. (i. 'viʔ)					*	
d. i ('viʔ)					*	*!
e. i. ('vi)	*(!)			*(!)		*
f. ('iʔ.) vi			*!		*	*

Compare this situation with languages like Matis, with final stress but no glottal stop epenthesis. The relevant ranking for this language is similar to that exemplified in Tableau 1, with the difference that Dep-μ outranks Stress to Weight. This is shown in Tableau 2, where candidate (b) is selected as optimal since it does not violate any of the undominated constraints in the ranking.

Tableau 2

No glottal stop epenthesis in Matis

/waka/ 'water'	FtBin	RhT=Iamb	Rightmost	Dep-μ	STW	Parse
a. ('wa.ka)		*!			*	
☞b. (wa.'ka)					*	
c. (wa.'kaʔ)				*!		
d. wa ('kaʔ)				*!		*
e. wa ('ka)	*!				*	*
f. ('waʔ) ka			*(!)	*!	*	*

A question that arises is what ensures that epenthesis is realized as a glottal stop rather than any other consonant or vowel in these languages. One option is that there is a universal hierarchy of Dep-μ constraints such as that supralaryngeal consonants, which have more featural content, are more costly to epenthesize than laryngeal consonants. This could be formalized as Dep-μ [supralaryngeal] >> Dep-μ [laryngeal].

6. Conclusion

This paper presented a survey on the distribution of glottal consonants in 27 Panoan languages, focusing on their range of prosodic functions. Important findings that emerge are, first of all, that the glottal stop is the most common consonant used for prosodic purposes. Secondly, the most frequent prosodic function for laryngeals is the demarcation of the beginning or end of morphological and syntactic categories. Another important finding is that strictly foot-sensitive phenomena featuring laryngeals seems to be circumscribed to Huariapano and Capanahua, although stress-related phenomena is attested in Katukina, Shanenawa, Kaxinawá and Saynáwa.

It was suggested in this study that the fact that the glottal stop is overwhelmingly recruited for prosodic functions is connected to the fact that this consonant is often non-phonemic in Panoan, unlike its counterpart /h/, which usually is not subject to prosodic alternations. This is compatible with the fact that laryngeals have special features compared to supralaryngeals that make them more likely to undergo prosodic phenomena crosslinguistically.

A preliminary analysis in Optimality Theory was proposed for stress-conditioned laryngeal phenomena in Katukina, Shanenawa, Kaxinawá and Saynáwa. The theoretical account for the prosodic functions of emphasis and boundary-marking is left for further investigation, partly because of its optional nature and also for the need of a closer look at the contexts where they occur.

Issues for further investigation include more in-depth documentation for Panoan languages, especially those where not much information exists on laryngeals. The

study of phonetic correlates of laryngeal consonants should also be pursued further to show the exact manner in which these consonants are pronounced and their influence on surrounding segments. Large steps in this direction are Lanes (2005) and Elías Ulloa (2010).

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