

## **The Realization of Laryngeal Features in Ja'a Kumiai**

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# The Realization of Laryngeal Features in Ja'a Kumiai

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## 1. Introduction

This paper presents a phonological analysis of the distribution of laryngeal features in Ja'a Kumiai, a Yuman language spoken in Baja California, Mexico. Previous studies on other closely related Yuman languages have described a high degree of variation and optionality in the realization of laryngeal segments (glottal stops) in their phonological systems (Kroeber & Harrington 1914; Walker 1970; Langdon 1970, 1976, 1991; Miller 1991, 2001; Miller & Langdon 2008), but few studies provide acoustic data. One exception is found in the phonological analysis of a closely related variety, San José de la Zorra Kumiai (SJZK) by Gil Burgoin (2016). Gil Burgoin's instrumental data confirms there is a high degree of variability in the realization of laryngeal segments, and accounts for the distribution and realization of laryngeal articulations by the presence of two distinct laryngeal features in the phonological inventory. This paper contributes to the phonological documentation of Yuman languages based on the acoustic analysis of original data collected through field research. I show that, while laryngeal articulations in Ja'a Kumiai have a similar distribution to the one documented in SJZK, they are best accounted for with a single laryngeal sound in the phonological inventory. I claim that the distribution and realization of this segment results from the intrinsic acoustic variability of laryngeal segments and general phonological restrictions on the distribution of glottal stops that occupy different positions within a morphological template.

The structure of the paper is as follows. In §1.1, I provide background information on the Kumiai language. In §2, I describe the distribution of laryngeal sounds in two neighboring varieties of Kumiai, Jamul Tipay and San Jose de la Zorra Kumiai. In §3, I present an analysis of the distribution of laryngeal sounds in Ja'a Kumiai. I conclude in §4.

### 1.1. Background

Kumiai is a Yuman Language (Delta-California branch) spoken in the U.S.-Mexico border region (See Map 1) by approximately 150 people (Golla 2011). There are two major dialect areas: Ipai (ʼIipaay), spoken north of the San Diego River, and Tipai (Tipaay, Tiipay), spoken south of the river. These languages are phonologically complex (Kroeber

& Harrington 1914; Walker 1970; Langdon 1970, 1976, 1991; Miller 1991, 2001; Miller & Langdon 2008, Gil Burgoin 2016, Mai et al. 2018), though detailed instrumental analyses of their sound patterns are still largely missing. The variety of Kumiai studied here, Ja'a Kumiai, a Tipai variety of Kumiai, is spoken in Juntas de Neji in Baja California, Mexico. Ja'a Kumiai is critically endangered, with only four remaining speakers (Miller 2016b) and intergenerational transmission of the language has been interrupted. There are currently language revitalization and preservation efforts led by community members on both sides of the border.

The data presented here comes from an ongoing collaboration with Yolanda Meza, a native speaker of Ja'a Kumiai. All examples provided here are provided with a citation form that makes reference to a digital audio corpus of the language with broad phonetic annotations (Meza et al. in progress). Ja'a Kumiai has preliminarily been documented by Miller (2016a, 2016b) and Mai et al. (2018). The first language documentation corpora of Kumiai varieties spoken in Baja California (and closely related Koalh) have been archived at AILLA and ELAR (Field 2011, Field & Miller 2017).



Map 1. Location of Kumiai Communities North and South of the U.S.A.-Mexico Border (Mai, Aguilar & Caballero 2018)

The phonological inventory of Ja'a Kumiai has twenty-one consonants and five vowel qualities: /p, (b), t̪, t, (tʰ), k, ʔ, (tʃ̥), m, n, ɲ, r, s, ʃ, x, t̪, (tʃ̥), w, j, l, (l̥), a, a:, e, e:, i, i:, o, o:, u, u:/. The sounds in parentheses are marginal sounds resulting from recent neutralizations or innovations. Length is contrastive in vowels.

Stress is coextensive with a morphological root (Langdon 1970, Miller 2001, Mai et al. 2018). Ja'a Kumiai has monosyllabic templatic roots in the form of (C)V(:)(C), and the vowel of the root is always stressed. Complex onsets may contain "lexical prefixes", formatives that are either consonants or vowels (C- or V-). While lexical prefixes in some varieties seem to have a consistent semantic meaning (e.g., Mesa Grande (Langdon 1970)), they are semantically opaque and unproductive in most varieties, including Ja'a Kumiai. This morphological structure is crucial to this analysis because the templatic root is the locus of affixation. A single CVC string can be monomorphemic, e.g., [pap] 'bake', [nak]

‘to sit’, and [nar] ‘steal’, or polymorphemic, e.g., [m-ap] ‘want’, and, [n-ap] 'braid' (Miller 2001:60-61), as evidenced by patterns of affixation.

Some morphological constructions are dependent on this distinction between templatic morphological roots and lexical prefixes. The nominalizing /a(?)-/ prefix, for instance, attaches to the templatic root. Whether the surface pattern looks like prefixation or infixation depends on the status of the sequence of sounds in the onset as part of the templatic root or a lexical prefix. The data in (1) show such a distinction:<sup>1</sup>

- |  |   |
|--|---|
| (1)a. a- <b>tʃau</b><br>NOM-build<br>‘brick’         | b <b>tʃau</b><br>CCV root structure<br>‘to build’               |
| c. t-a- <b>foq</b><br>LP-NOM-clean<br>‘cleaning rag’ | d. <b>tfoq</b><br>C-CVC root and prefix structure<br>‘to clean’ |

These examples show the difference in status of onset sounds. In (1) the [tʃ] is a single sound (an affricate) that is part of the templatic root. In (1), [t] and [ʃ] are not a unit and only the alveo-palatal fricative [ʃ] is part of the root. I revisit this particular morphological construction in the discussion of laryngeal sounds in Kumiai varieties in §**Error! Reference source not found.**

## 2. Laryngeal segments in other Kumiai varieties

### 2.1. Jamul Tipai

Miller (2001) describes a single laryngeal segment in Jamul Tipai (Kumeyaay). In this variety, Miller describes the distribution of glottal stops as occurring intervocalically, prevocalically, and preconsonantly. Glottal stops are not reported to occur word-initially in consonant clusters. Intrusive vowels are described as commonly occurring between the glottal stop and other consonants in clusters.<sup>2</sup> The data in (2) provide examples of the distribution of glottal stops in Jamul Tipai.

- |                 |             |   |                        |
|-----------------|-------------|---|------------------------|
| (2)Word-initial | a. ʔiinyaay | ‘to be morning’, ‘ <i>ser de mañana</i> ’ |                        |
| Intervocalic    | b. waʔa:    | ‘door’, ‘ <i>puerta</i> ’                 |                        |
| Preconsonantal  | c. nyaʔru   | ‘money’, ‘ <i>dinero</i> ’                |                        |
| Postconsonantal | d. sʔaay    | ‘dry’, ‘ <i>seco</i> ’                    | Miller (2001: 13, 160) |

<sup>1</sup>The abbreviations used in this work are the following: NOM=nominalizing affix, LP=lexical prefix, SUB=subject marker, OBJ=object marker, IMP=imperative, DEM=demonstrative.

<sup>2</sup> I propose, following Mai et al. (2018), that there is a phenomenon of intrusive or excrescent vowels in the realization of consonant clusters in Kumiai varieties. In the Yumanist literature, these are described as “inorganic” vowels, which contrast with “organic” vowels. These intrusive vowels form vocalic transitions between consonants: they are short, typically centralized, though can approximate the formant structure of the following vowel, and they do not participate in phonological processes.

## 2.2. Laryngeal features in San Jose de la Zorra Kumiai (SJZK)

In Gil Burgoin's (2016) detailed analysis of San Jose de la Zorra Kumiai, two distinct laryngeal features are proposed in order to account for two patterns of glottal stop realization in SJZK. The two representations of laryngeal segments in SJZK are /ʔ/ and /ʔ̰/, corresponding to a stop and a floating feature of [+constricted glottis], respectively.

The glottal stop /ʔ/ in SJZK is a contrastive segment in the inventory whose distribution is shown in (3). Glottal stops are absent in preconsonantal position [ʔC], a distribution that parallels the one documented in Jamul Tipay.

(3) Word-initial	a. ʔup	'to bathe', 'bañar'	
Intervocalic	b. miʔeʔ	'maize', 'maíz'	
	c. ʔaʔaw	'fire', 'lumbre'	
Postconsonantal	d. sʔaw	'son', 'hijo'	
	e. pʔaw	'dry', 'sentarse'	Gil Burgoin (2016: 53-54)

Gil Burgoin's proposal is that there is a second laryngeal feature in SJZK, a floating feature, that is part of the underlying representation of a number of morphological constructions. This includes the nominalizing /-aʔ-/ prefix (described as /a(ʔ)-/ in Ja'a Kumiai in (1) above. In this analysis, the floating feature /ʔ̰/, [+constricted glottis], is phonologically conditioned: it is only realized on a sonorant consonant as laryngealization. There are two crucial arguments underlying this proposal: first, the floating feature /ʔ̰/ does not occur as laryngealization on the preceding vowel or as a canonical glottal stop; second, if the locus of affixation is an obstruent, then the laryngeal feature is not realized, obeying the same phonotactic restriction observed for /ʔ/ above in (3). The data in (1) show examples where the locus of affixation is before a sonorant consonant.

(4) Verbal base	Nominalized form
a. nak	b. [a'ŋaq]
'to sit', 'sentarse'	/aʔ-naq/
	NOM-sit
	'seat', 'asiento'
c. jak	d. [a'jaq]
'to lie', 'yacer'	/aʔ-jaq/
	NOM-lie
	'bed', 'cama'
e. [ʃwaw]	f. [ʃa'waw]
'to plant', 'sembrar'	/ʃ-aʔ-waw/
	LP-NOM-plant
	'planted field', 'milpa'

The laryngeal feature docks onto the sonorant consonant and is realized as creaky.<sup>3</sup>

The data in (5) show this same nominalizing construction, but with obstruent-initial roots. Here affixation results in only in the realization of the vowel of the /-a<sup>?</sup>-/ prefix. No laryngealization is reported.

(5) Verbal base	Nominalized form
a. saw 'to eat', 'comer'	b. a'saw /a <sup>?</sup> -saw/ nom-eat 'table', 'mesa'
c. ʃi:ʈ 'to roast', 'asar'	d. a'ʃiʈ /a <sup>?</sup> -ʃiʈ/ NOM-roast 'skillet', 'comal'
e. ʈim 'to shoot', 'disparar'	f. a'ʈim /a <sup>?</sup> -ʈim/ NOM-shoot 'rifle', 'rifle'

Gil Burgoin (2016: 228, 231)

Gil Burgoin proposes the following phonological rules, summarized in (6), to account for the distribution of the floating [+constricted glottis] /ʔ/ feature shown above.

(6) Distribution of [+constricted glottis] /ʔ/ in SJZK:

1. /ʔ/ → Ø / \_\_\_\_ [obstruent]
2. C<sub>[sonorant]</sub> → [+laryngealized] / ʔ \_\_\_\_

Gil Burgoin (2016: 230)

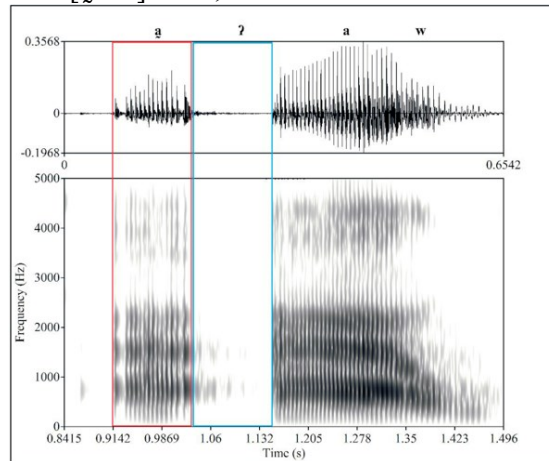
Gil Burgoin's analysis offers acoustic data to support the phonological analysis. The two spectrograms in (7) are used as evidence that there are two different laryngeal features in SJZK as evidenced by the difference in surface realization of /ʔ/ and /ʔ/ in SJZK.

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<sup>3</sup> Morphological glossing was added here and is not taken from Gil Burgoin (2016).

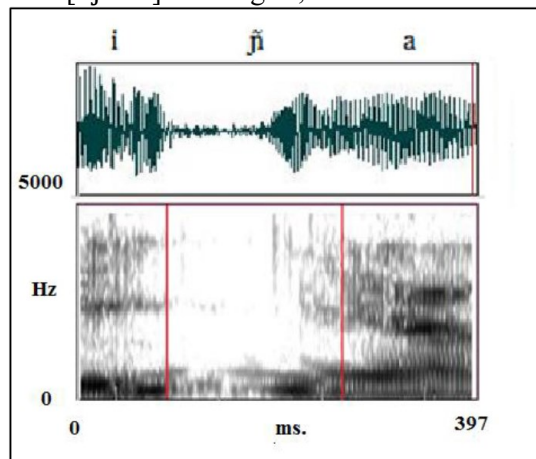
(7) Spectrograms of surface realization of /ʔ/ and /ʎ/ in San Jose de la Zorra Kumiai:

a. /ʔ/ [aʔaw] ‘fire’, ‘lumbre’



Gil Burgoin (2016: 53)

b. /ʎ/ [tiʎa:m] ‘last night’, ‘anoche’



Gil Burgoin (2016: 59)

In (7a), the segment /ʔ/ is realized as a canonical glottal stop, with complete closure. As the wave form and spectrogram show, there is almost no energy for the duration of the glottal stop. In contrast, (7b) shows /ʎ/ realized as laryngealization that is coextensive with the nasal. There is general attenuation of energy for the duration of the nasal suggesting glottal stricture, as well as evidence of irregular pulsing of  $f_0$  in the later half of the nasal, which is also a sign of laryngealization.

Having provided a summary of previous description of laryngeal articulations in two closely related Kumiai varieties, I now turn to the data and analysis of laryngeal sounds in Ja'a Kumiai.

### 3. Glottal Stop in Ja'a Kumiai

As in closely related varieties, the glottal stop is contrastive in Ja'a Kumiai. The data in (8) are near-minimal pairs that show that the presence or absence of [ʔ] is contrastive in this language.

- |        |        |                                   |                 |
|--------|--------|-----------------------------------|-----------------|
| (8) a. | sʔou   | 'daughter/son', ' <i>hija/o</i> ' | DIH0106:32:57.0 |
|        | b. sou | 'food', ' <i>comida</i> '         | DIH0106:02:36.3 |
|        | c. xʔa | 'tree', ' <i>árbol</i> '          | DIH0106:18:13.3 |
|        | d. xa  | 'water', ' <i>agua</i> '          | DIH0106:18:08.7 |

I propose laryngeal sounds in Ja'a are best analyzed as a single phoneme whose surface realization depends on the underlying phonotactic context, varying on a phonetic continuum from canonical closure to laryngealization on a vowel or sonorant, or can be reduced so that there are only traces of voiced laryngealization, such as dips in f0 without stop closure. This is a common feature of glottal stops cross-linguistically (Pierrehumbert & Talkin 1992, Dilley, Shattuck-Hufnagel & Ostendorf, 1996; Garellek 2013). The data in (9) show the distribution of glottal stops in Ja'a Kumiai.

- |                  |                |                                  |                 |
|------------------|----------------|----------------------------------|-----------------|
| (9) Word-initial | a. ʔip         | 'I give', ' <i>yo doy</i> '      | DIH0110:28:04.4 |
| Intervocalic     | b. niu ʔjaʔitʰ | 'table', ' <i>mesa</i> '         | DIH0106:07:03.3 |
| Preconsonantal   | c. skaʔlap     | 'butterfly', ' <i>mariposa</i> ' | DIH0025:05:42.5 |
| Postconsonantal  | d. nʔor        | 'fruit', ' <i>fruta</i> '        | DIH0126:04:55.3 |
|                  | e. txpʔetʰ     | 'decorated', ' <i>adornada</i> ' | DIH0062:11:01.5 |

The distribution of glottal stop in Ja'a is similar to Jamul Tipai in (2). Unlike SJZK, but similar to Jamul Tiipay, preconsonantal glottal stops are attested in word-medial position (see (9)c). The glottal stop in Ja'a Kumiai has the same restriction reported in Jamul Tipai and SJZK: it does not occur preconsonantly in word-initial position. The data in (10) show that the phonotactic environment constrains the surface realization of the underlying glottal stop in the same morphological construction.

- |         |                   |  |    |                   |
|---------|-------------------|--|----|-------------------|
| (10) a. | ʔip               |  | c. | amp               |
|         | /ʔ-ip/            |  |    | /ʔ-amp/           |
|         | 1SUBJ-listen      |  |    | 1SUJ-walk         |
|         | 'I listen'        |  |    | 'I walk'          |
|         | <DIH0073:03:09.0> |  |    | <DIH0106:12:16.7> |
|         | b. ʔamp           |  |    | d. jok (*ʔjok)    |
|         | /ʔ-amp/           |  |    | /ʔ-jok/           |
|         | 1SUJ-walk         |  |    | 1SUJ-vomit        |
|         | 'I walk'          |  |    | 'I vomit'         |
|         | <DIH0110:13:23.0> |  |    | <DIH0056:05:08.9> |



e. tʃijow (\*ʔtʃijow)  
 /ʔ-tʃijow/  
 1SUJ-sing  
 ‘I sing’  
 <DIH0035:17:56.7>

f. nup (\*ʔnup)  
 /ʔ-nup/  
 1SUJ-dive  
 ‘I dive’  
 <DIH0111:07:30.2>

The first-person subject marker is a prefix /ʔ-/ that only surfaces on vowel-initial stems (10)a-c). Consonant-initial stems surface unmarked for 1<sup>st</sup> person person as glottal stop is restricted in this context (10)d-f). While glottal stop can surface as laryngealization of an adjacent sonorant, as shown later in this section, this does not occur in this phonotactic context (i.e. (10)d-f)).

Another morphological construction where the glottal stop is involved is the nominalizing /a(ʔ)-/ prefix that attaches to verbs and derives a patient-like noun (a ‘patientive’ nominalization). This prefix, the cognate form in SJZK, is described above in (1), is affixed to the templatic root. Recall that in the example, the prefix attaches to a different location in a [tʃV] string depending on the structure of the root and lexical prefixes. When attaching to the verb *tʃau* ‘to build’, which has a CCVC root, the nominalized form is *a-tʃau*. In contrast, when attaching to the verb *tʃoq* ‘to clean’, which has a C-CVC morphological structure, the affix breaks up the initial consonant cluster surfacing as *t-a-foq* ‘cleaning rag’. The following examples in (11) show the realization of glottal stop as a canonical glottal stop.

- |  |  |
|--|--|
| <p>(11) Verbal base</p> <p>a. tʃjou<br/>       /tʃ-jou/<br/>       LP-sing<br/>       ‘so sing’ DIH0035:18:01.1</p> <p>c. ʃwou<br/>       /tʃ-wau/<br/>       LP-plant<br/>       ‘to eat’ DIH0106:08:04.8</p> <p>e. tʃxwal<br/>       /tʃ-x-wal/<br/>       LP-LP-serve<br/>       ‘to serve’ DIH0100:29:05.9</p> | <p>Nominalized form</p> <p>b. tʃaʔjou<br/>       /tʃ-aʔ-jou/<br/>       LP-NOM-sing<br/>       ‘song’ DIH0106:05:53.8</p> <p>d. tʃaʔwau<br/>       /tʃ-aʔ-wau/<br/>       LP-NOM-plant<br/>       ‘planted field’<br/>       DIH0106:08:04.8</p> <p>f. tʃxaʔwal<br/>       /tʃ-x-aʔ-wal/<br/>       LP-LP-NOM-serve<br/>       ‘spoon’ DIH0106:02:36.3</p> |
|--|--|

If the base for prefixation is a nasal consonant, however, the laryngeal may surface as glottalization of the nasal, as shown in (12).

(12) Verbal base	Nominalized form
a. <i>lta knap</i>	b. <i>lta<sup>a</sup>n<sup>a</sup>ap</i>
/lta k-nap/	/lta a <sup>?</sup> -nap/
hair IMP-braid	NOM-braid
‘braid my hair!’	‘braid’
DIH0097:01:33.4	DIH0110:41:06.4

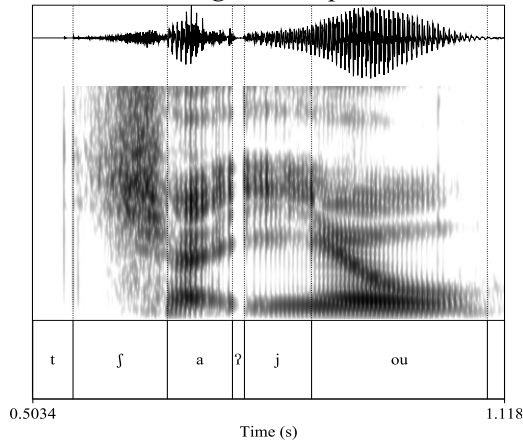
Finally, we see that when the base for prefixation is consonant initial, including nasal-initial bases, the laryngeal may also surface as glottalization on the nominalizing prefix vowel. This is shown in (13) below.

(13) Verbal base	Nominalized form
a. <i>xnak</i>	b. <i>x<sup>a</sup>nak</i>
/x-nak/	/x-a <sup>?</sup> -nak/
LP-necklace	LP-NOM-necklace
‘to necklace’ DIH0091:18:43.9	‘necklace’ DIH0106:03:41.7
c. <i>xwak</i>	d. <i>x<sup>a</sup>wak</i>
/x-waq/	/x-a <sup>?</sup> -wak/
LP-two	LP-NOM-two
‘to be two’ DIH0091:23:28.3	‘twins’ DIH0091:23:28.3
e. <i>akat</i>	f. <i>tʃ<sup>a</sup>kat</i>
/a-kat/	/tʃ-a <sup>?</sup> -kat/
LP-cut	LP-NOM-cut
‘to cut’ DIH0110:37:03.8	‘scissors’ DIH0110:37:03.8
g. <i>tim</i>	h. <i>a<sup>?</sup>tim</i>
/tim/	/a <sup>?</sup> -tim/
shoot	NOM-cut
‘to shoot’ DIH0110:35:48.1	‘rifle’ DIH0110:35:48.1
i. <i>tʃok</i>	j. <i>ta<sup>a</sup>fok</i>
/tʃok/	/t-a <sup>?</sup> -fok/
LP-clean	LP-NOM-clean
‘to clean’ DIH0104:30:05.5	‘cleaning rag’ DIH0106:07:03.3

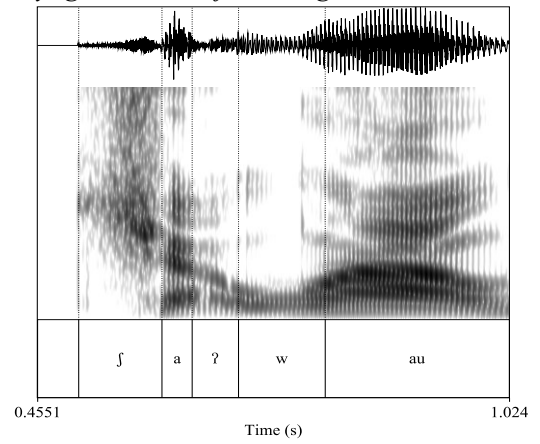
The data in (11)-(13) demonstrate the variable realization of glottal stop in Ja’a Kumiai ranging from canonical glottal stops, to laryngealization of a sonorant and a vowel. Crucially, in these data glottal stop occurs in the context of obstruent-initial roots. The phonotactic restriction reported in San José de la Zorra Kumiai is not present in Ja’a. Instead, the glottal stop occurs in all of the environments SJZK /<sup>?</sup>/ is not expected to occur. Compare (5f) ([a<sup>?</sup>tim] /a<sup>?</sup>-tim/ ‘rifle’) in SJZK with (13)h) in Ja’a Kumiai. While the glottal

stop can be realized as glottalization on a sonorant consonant in (12), the most frequent pattern is realization as glottalization on the preceding vowel, the vowel of the affix, which does not occur in SJZK. The following spectrograms in (14) demonstrate the variable realization of glottal stops in Ja'a Kumiai.

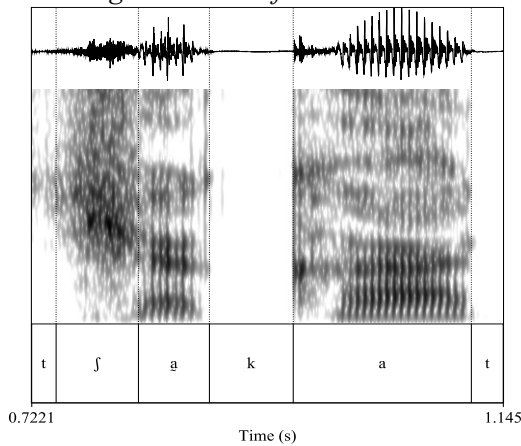
(14) a. [tʃaʔjou] ‘song’  
DIH0106:05:53.8  
*canonical glottal stop*



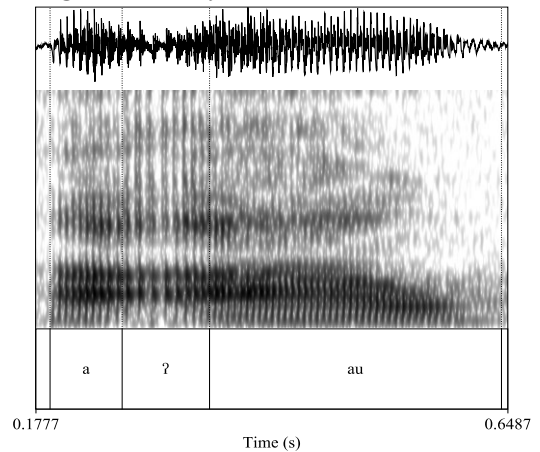
b. [tʃaʔwau] ‘milpa’  
DIH0106:08:04.8  
*laryngealization of both segments*



c. [tʃakat] ‘scissors’  
DIH0110:37:03.8  
*laryngealization before a consonant*



d. [aʔau] ‘fire’  
DIH0138:05:17.2  
*laryngealization of the vowel*



The data in (14)a-c) exemplify the nominalized construction. In (14)a) there is a canonical glottal stop with the associated creak leading in to the closure on the vowel and out of the closure on the glide. In (14)b), there is glottalization mostly on the vowel of the affix, but also into the transition into the glide. In (14)c), glottalization is realized on the vowel. In

(14d), glottal stop is realized as creak voice. There is no synchronic evidence that (14)d is a nominalized form.<sup>4</sup>

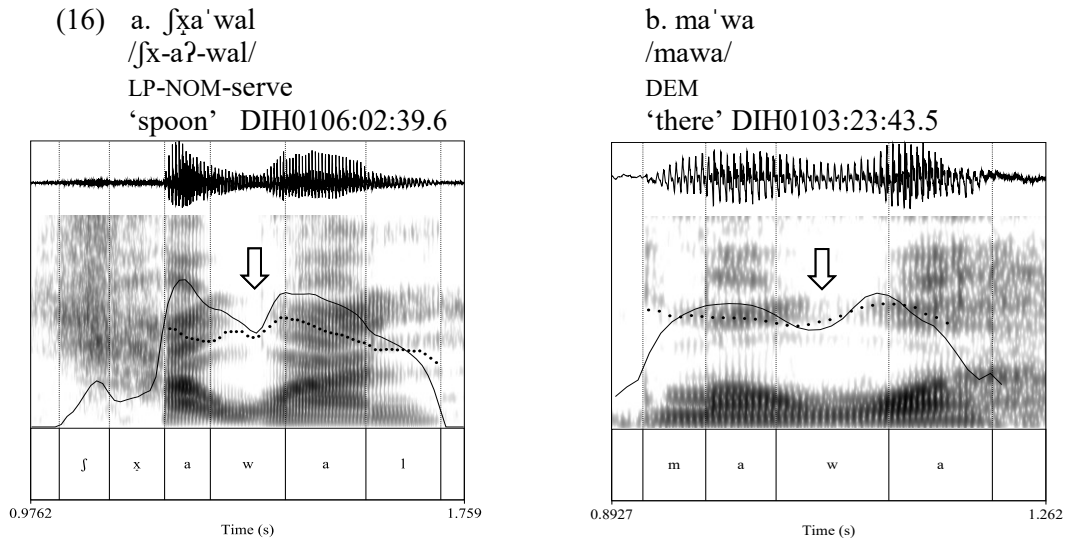
Further adding to the discussion of the variable realization of glottal stop in Ja'a Kumiai, which also differs from what is reported in SJZK, is that glottal stops can be severely reduced in the context of any consonant. In these cases, impressionistically, the glottal stop has been deleted. However, acoustic evidence suggests that traces of laryngealization might persist despite the high degree of reduction. The following examples show this. Note that the [ʔ] is reduced glottalization in a phonetic transcription and not a representational difference (as in SJZK).

- |   |  |
|---|--|
| <p>(15) a. fjiou<br/>/tʃ-jou/<br/>LP-sing<br/>'to sing' DIH0106:05:40.9</p> | <p>b. tʃaʔjou<br/>/tʃ-aʔ-jou/<br/>LP-NOM-sing<br/>'song' DIH0106:05:40.9</p>     |
| <p>c. imeʔt<br/>/i-meʔt/<br/>LP-sing<br/>'to dance' DIH0106:08:39.7</p>     | <p>d. aʔmaʔt<br/>/aʔ-maʔt/<br/>NOM-dance<br/>'a large dance' DIH0106:08:39.7</p> |
| <p>e. pap<br/>/pap/<br/>bake<br/>'to bake' DIH0110:28:33.3</p>              | <p>f. aʔpap<br/>/aʔ-pap/<br/>NOM-bake<br/>'oven' DIH0110:28:36.4</p>             |

Perturbances in f0 and intensity have been shown to be cues of, or accompany glottalization (Hillenbrand & Houde 1996, Gerfen & Baker 2005, Hargus 2016). The spectrograms in (16) show the effect of reduced glottalization on f0 and intensity.

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<sup>4</sup> Langdon 1970 gives the pair *ara:w* 'to warm' (1970: 125) and *ʔa:w* 'fire' (1970: 36) suggesting that perhaps, Ja'a and SJZK *ʔa:w* might have historically been a nominalized form.



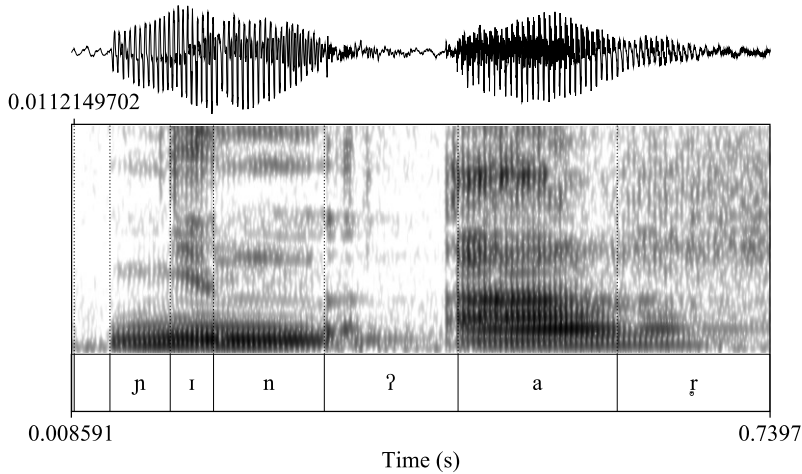
In (16a), the spectrogram is of *ʃxawal* /ʃxaʔwal/ ‘spoon’ (cf. (11)f) *ʃxaʔwal*), a nominalized form that, at least impressionistically, has no glottal stop realized in this token. However, when comparing intensity (and in some tokens f0) in similar sequences, there is a consistent pattern of a stronger dip in sonorant sounds which are underlyingly co-occurring with a glottal stop. This stands in contrast to the realization of monomorphemic words like (16b) *mawa* /mawa/ ‘there’: this word features a similar stress pattern, but has no underlying glottal stop. As observed in (16b), there is no comparable dip in the realization of the labio-velar glide in this form, which I attribute to the lack of a laryngeal articulation. This acoustic evidence is only an observation that needs to be assessed quantitatively in future work.

There is further evidence of the systematic phonotactic restrictions on the realization of glottal stops in the inverse /ʔ-/ construction, for which the templatic root determines the locus of affixation. The verbs [nar] ‘to steal’ and [nap] ‘to braid’ are near minimal pairs, phonologically equivalent in having a nasal-initial segment. However, the ʔ- prefix is realized differently in these two words because of the difference in their morphological structure. In [nar] ‘to steal’ (17a), the initial [n] is a lexical prefix. As a result, glottal stop is realized canonically between the nasal and the vowel. In contrast, in the verb [nap] ‘to braid’ (17b), the initial [n] forms part of the templatic root. Thus, the locus of affixation is a nasal-initial base and the glottal stop is realized as creak on the nasal.

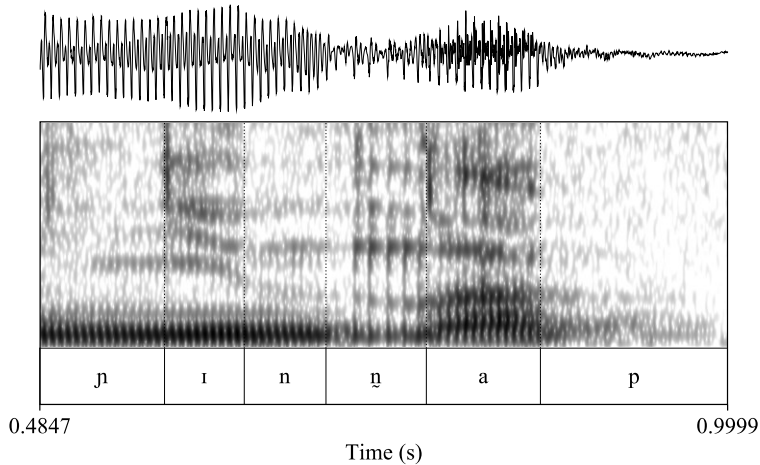
- (17) a.  $[\text{n}^{\text{h}}\text{n}^{\text{h}}\text{a}^{\text{h}}]$   
 /n-n-ʔ-ar/  
 IOBJ-LP-INV-steal  
 ‘s/he steals from me’  
 DIH0147:01:35.3
- b.  $[\text{n}^{\text{h}}\text{na}^{\text{h}}]$   
 /n-ʔ-nap/  
 IOBJ-INV-braid  
 ‘she braids me (my hair)’  
 DIH0147:03:09.0

This difference in realization of inverse marking depending on the root structure is consistent. This is shown in the spectrograms in (18). In (18)a), there is a clear canonical glottal stop, while in (18)b), the glottal stop is realized on the second half of the nasal stop.

- (18) a. [nʰnʔar̥] /n-n-ʔ-ar/  
 ‘s/he steals me’, ‘me roba (a mi)’ DIH0147:01:35.3



- b. [nʰn̩ap] /n-ʔ-nap/  
 ‘s/he braids me (my hair)’, ‘me trenza’ DIH0147:03:09.0



These spectrograms demonstrate that the surface realization reflects that the laryngeal segment underlyingly occupies a different position within the morphological template, which means the base for affixation is different: the base of affixation in *nar* ‘steal’ is vowel initial, while the base of affixation in *nap* ‘to braid’ is nasal initial. The phonotactics determine the realization of the glottal stop such that it can be realized as a canonical glottal

stop before a vowel, or as creak on a nasal on a nasal-initial roots. This is consistent with what has been observed in other morphological constructions such as the /-a(?)-/ nominalizing prefix, where nasal-initial bases can also be laryngealized. There is thus a single set of phonologically general phonotactic constraints on the realization of a single underlying representation.

#### **4. Conclusion and next steps**

The data presented here show that the best analysis for the status of the laryngeal sounds in Ja'a Kumiai is one in which there is a single glottal stop segment in the inventory with a range of phonetic realizations on the surface. Acoustic analysis shows that while there is a tendency for canonical realization intervocally and post consonantly, there is much variation which include creaky voice on vowels and sonorant sounds. All glottal stops can undergo a high degree of reduction leaving only traces of the underlying glottal stop on the surface.

The next steps in this research involve looking at the cases of reduced glottal stops using detailed acoustic analyses of f0 and intensity, using quantifiable methods on vowels and sonorants in the context of underlying glottal stops. At the same time, more comprehensive documentation is needed to investigate the larger phonological and morphological structures and patterns of this critically endangered language.

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