Kaqchikel (Mayan) plain and glottalized voiceless stops: An acoustic survey

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This paper analyzes the acoustics of the stop inventory of Kaqchikel (ISO 639-3: cak), a Mayan language in the K'ichee'an branch, spoken by ~400,000 people in south-central Guatemala (Heaton & Xoyón, 2016. Kaqchikel contrasts two series of stops at four places of articulation—one plain series of voiceless stops of variable aspiration and one series of glottalized stops. In addition to these eight stop phonemes, Kaqchikel also features a phonemic glottal stop, four affricates, and three fricatives, which fall outside of the scope of the current study.

All descriptions of Kaqchikel agree that the plain stops feature unaspirated and aspirated allophones and that the glottalized coronals and velars are ejectives. However, the literature also varies in its description and transcription of stops, notably the glottalized labials and uvulars. The variation observed in this stop inventory is shown in Table 1.

Table 1: Kaqchikel stop variants

Place / Series	Labial	Alveolar (Dental)	Velar	Post-velar (Uvular)
Plain	p~p^{h}	t~t^{h}	k~k^{h}	q~q^{h}~q^{x}
Glottalized	ɓ̥~p'~ɓ~ʔ	t'	k'	q'~ɢ̊~ɢ̥~ʕ

Campbell (1973), in countering Greenberg's (1970) generalization that dorsals are only implosive if the sounds in front of them are also, describes both the labial and uvular glottalized stops in Kaqchikel as imploded. Patal Majzul et al. (2000) use the symbol <ɓ̥> for the glottalized labial, describing it as voiceless and noting two allophones: implosive [ɓ̥] and ejective [p'], as well as a less common variant [ʔ]. Their phonemic symbol for the glottalized uvular is /ɢ̊/, but give [ʕ], [q'], and [ɢ̊] as observed variants. Brown et al. (2006) describe the glottalized labial as voiced but give only <ɓ'> as its transcription. They describe the uvulars as having a post-velar place of articulation but do not expand on the nature of its glottalization. Bennett (2016) uses data from Kaqchikel to illustrate the variation in realizations of glottalized labials in Mayan languages, reporting productions of both [ɓ̥] and [p']. Bennett et al. (2018) expand on this characterization for the glottalized uvular, reporting realizations as either [q'] or [ɢ̥].

The current study provides quantitative data for these qualitative observations by analyzing these stops in initial onset, medial onset, and final coda positions. In this primary fieldwork, the five first language speakers producing these stops come from the southern area of traditional Kaqchikel territory, near Antigua. The productions themselves are from readings of a wordlist composed of 79 target words within a carrier phrase. Acoustic measures used in this analysis include Voice Onset Time (VOT), closure duration, burst duration, and pitch on the adjacent vowel.

Preliminary analysis confirms the voiceless implosive nature of the glottalized labial and glottalized post-velar stops. No onset stops, including these implosives, feature negative VOT indicative of voicing, which is unsurprising given the lack of voiced obstruents elsewhere in the language. Meanwhile, glottalized stops in coda position feature shorter closures, indicative of their use of the glottalic airstream, and matching Kingston's (1985) characteristics of slack ejectives. Additionally, all glottalized stops have shorter burst durations than the plain stops at their respective places of articulation. These findings immediately contribute to the study of the adult acquisition of Kaqchikel phonetics and phonology, while informing Kaqchikel language teaching practices as to which acoustic effects teachers, learners, and analysts should focus on.

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