Against phonetic realism as the source of root co-occurrence restrictions

Introduction: Kaqchikel is a K'ichean-branch Mayan language spoken in southern Guatemala. Like all Mayan languages, Kaqchikel has a phonemic contrast between plain voiceless stops (/p t k q/) and 'glottalized' stops at corresponding places of articulation (implosive /ɓ/ and ejective /tʔ tsʔ tʃʔ kʔ qʔ/). As in other Mayan languages, stops in underived /CVC/ roots are subject to a long-distance co-occurrence restriction: multiple ejectives are not allowed in a /CVC/ root, unless they are identical (Edmonson 1988:60-72). Hence /qʔaqʔ/ 'fire' and /tʔotʔ/ 'snail' are attested roots, but */qʔatʔ/ */tʔokʔ/, etc. are not; schematically, */$T^{ʔ}_{\alpha}VT^{ʔ}_{\beta}$/$_{ROOT}$, $\alpha \neq \beta$. The labial implosive /ɓ/ and glottal stop /ʔ/ are exempt from this restriction, and freely combine with ejectives at any place of articulation in /CVC/ roots (e.g. /-ɓiqʔ/ 'to swallow', /kʔaʔ/ 'incense', etc.; Brown et. al 2010).

Previous approaches: Existing analyses of this type of root-based morpheme structure constraint (MSC) fall into one of two categories. Some authors have treated this pattern as a case of dissimilation for the articulatory feature [CONSTRICTED GLOTTIS], essentially reducing the MSC to some form of the Obligatory Contour Principle (MacEachern 1999, Mackenzie 2009). The non-participation of /ɓ ʔ/ and the exemption of identical ejectives from the MSC are accounted for by additional mechanisms. An alternative is offerred by Gallagher (2010), who proposes that this type of root MSC is grounded in considerations of acoustic similarity. In Gallagher's system, stops are classified according to acoustic features which reflect their surface phonetic properties: most importantly [LONG VOT], [LOUD BURST], and [CREAK]. Roughly speaking, Gallagher proposes that the root MSC described above amounts to dissimilation in the auditory feature [LOUD BURST]. Since Gallagher assumes that ejectives, but not /ɓ ʔ/, are characterized by loud bursts in languages like Kaqchikel, the exemption of /ɓ ʔ/ from the root MSC follows naturally. However, Gallagher (2010:131) acknowledges that the validity of this analysis hinges on the precise phonetics of the stop consonants, which have not yet been studied for Kaqchikel. This study aims to assess the predictions of Gallagher (2010) by directly examining the phonetics of stop consonants in Kaqchikel.

Acoustic corpus: To assess an acoustically-grounded analysis of the Kaqchikel root MSC, we conducted an acoustic analysis of stop consonants in a corpus of semi-spontaneous spoken Kaqchikel, gathered in Sololá, Guatemala. Sixteen native speakers contributed to the corpus (19-84 years old, mean=33, median=28; 6 male); they were recorded using a headset microphone at a 48kHz sampling rate and 24 bit quantization rate. Speakers were asked to share a spontaneous narrative of their own choosing for the recording. The entirety of the corpus was transcribed by a native-speaker linguist, and a subset of the corpus (~1 hour) was annotated with forced alignment (Gorman et al. 2011) for the purposes of acoustic analysis.

Acoustic results: Focusing on the three phonetic features most pertinent to the acoustic theory of root MSCs (burst intensity, creak, and burst duration), we find that the surface phonetic patterning of the Kaqchikel stop series consistently fails to reflect their phonological classhood. Ejectives in Kaqchikel have relatively weak bursts, which are comparable in their intensity to the burst of the implosive /ɓ/, or even weaker (Fig. 1). Both ejectives and the implosive /ɓ/ induce creaky phonation on adjacent vowels, as indicated by relatively low values for H1-H2 in the CV or VC transition (Gordon & Ladefoged 2001; figure omitted for space). The acoustic features [LOUD BURST] and [CREAK] therefore fail to characterize a natural class which includes /ɓ/ but not the ejectives. While there are distinctions in release duration (≈VOT) which separate implosive /ɓ/ from most ejectives, glottalized /qʔ/ is typically realized with a short release phase (Fig. 2). Phonetically, this groups /qʔ/ together with implosive /ɓ/ rather than the other ejectives /tʔ tsʔ tʃʔ kʔ/. This is consistent with previous claims that uvular /qʔ/ may be at least variably realized as implosive [ɠ], [ɢ̥], or [ɢ] in Kaqchikel (e.g. Pinkerton 1986). The acoustic feature [LONG VOT] therefore also fails to generate the natural classes needed for the root MSC.

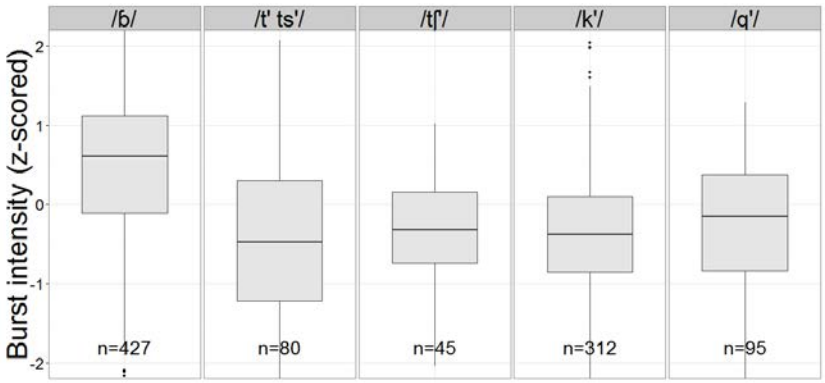

Fig. 1: burst intensity for glottalized /ɓ tˀ/tsˀ tʃˀ kˀ qˀ/
(very few instances of /tˀ/ in the corpus, so /tˀ/ and /tsˀ/ are merged here)

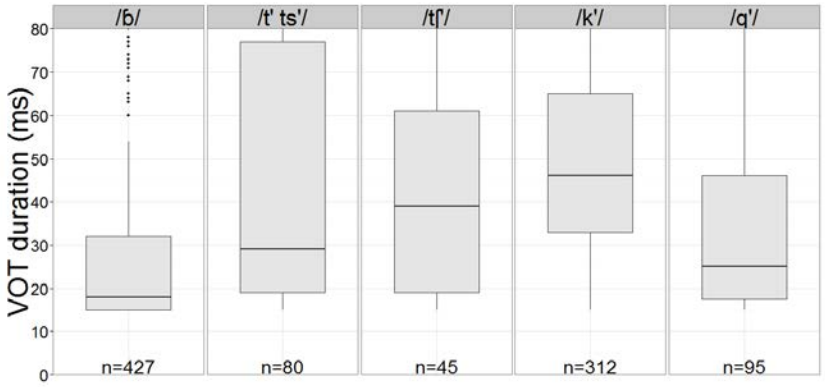

Fig. 2: release duration for glottalized /ɓ tˀ/tsˀ tʃˀ kˀ qˀ/

Conclusions: The natural class consisting of ejective /tˀ tsˀ tʃˀ kˀ qˀ/, but not /ɓ/, cannot be neatly characterized in terms of the acoustic features proposed by Gallagher (2010). In a sense, this is unsurprising: while the phonetics and allophonic patterning of glottalized stops have been reported to vary rather widely between Mayan languages (e.g. Pinkerton 1986), the root MSC described here is quite stable. For example, the glottalized labial in some varieties of Poqomam (also K'ichean) is consistently realized as ejective [pˀ] rather than implosive [ɓ], but for historical reasons [pˀ] is still exempt from the root MSC considered here (Smith-Stark 1983). Although the fine phonetics of glottalized stops in Mayan remain to be studied in detail, at least for Kaqchikel we can conclude that the synchronic morpho-phonology of root MSCs cannot be reduced to the synchronic phonetics of the consonant series. The analytical consequence of this result is that not all root MSCs can be analyzed in acoustic terms: for at least some languages, root MSCs must be stated in terms of abstract (articulatory) features like [CONSTRICTED GLOTTIS] and [VOICE]. For Kaqchikel, the operative restriction appears to be a ban on non-identical [-VOICE,+C.G.] oral stops within the same /CVC/ root.

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