The Velar Myth and Uvular Mystery: An Acoustic Analysis of Georgian Back Obstruents

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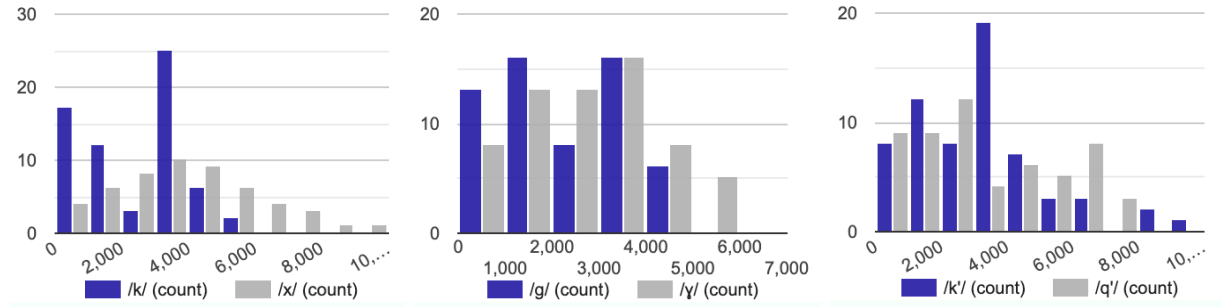
One of the most understudied features of the Georgian language is its backmost or "guttural" phonemes, represented by the letters ხ, ღ, and ყ in the Mkhedruli script and commonly notated as /x/, /ɣ/, and /q'/ respectively. Linguists have variably attributed /x/ and /ɣ/ to velar, uvular, and post-velar placements, with inconsistent attestations of whether supposed variation is free, complementarily distributed, or between speakers (Aronson, 1990; Hewitt, 1995). /q'/ is especially perplexing, as the most comprehensive study of the phoneme to date found that it appears to exhibit free variation among [q' qʼˠ χ' ʔ] (Shosted & Chikovani, 2006). However, that study only examined word-initial environments.

In line with Shosted & Chikovani's proposal of a comprehensive review of word-medial representations, we conducted a case study, collecting 364 speech tokens of Georgian back obstruents from one native speaker to ascertain the phonetic representation(s) associated with these phonemes, dependent on environment. We measured the centre of gravity, skew, and kurtosis for each in a variety of vocalic contexts and compared them to those of corresponding velar stops /k/, /g/, and /k'/ in order to determine place of articulation. We conducted additional qualitative investigation into acoustic components via spectral analysis.

For /x/ and /ɣ/, we find evidence challenging their transcription as underlyingly velar. A 2013 study on Tlingit found that uvular consonants have a higher centre of gravity and lower skewness and kurtosis than velar consonants (Denzer-King). For each of these metrics, we observed that Georgian /x/ and /ɣ/ shifted from their corresponding velar stops in the direction expected of uvular articulations. Notably, a significant difference for each spectral moment was demonstrated between /x/ and /k/.



Figures 1-3. Histograms of distribution of centre of gravity for corresponding back obstruents.

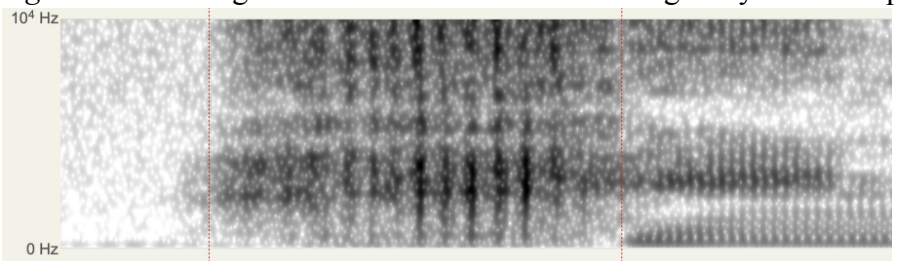


Figure 4. Spectrogram for /xi/ [χi] in /xind͡ʒi/

A notable feature of these phones, observable as dark bands in the spectrograms, is that they exhibit partial trilling. While trilling is most extreme in amplitude for /q'/, it is also almost always present for /x/ and /ɣ/ as well. Trilling is not possible at the velum, so these realizations must be uvular. Figure 4 depicts substantial trilling in /xi/, confirming that surrounding /i/ does not guarantee a velar realization. Thus, /x/ and /ɣ/ may be more accurately designated /χ/ and /ʁ/. The abundance of trilling found in our speech data for these sounds may prompt further investigation into their classification as trills or having a trilled component.

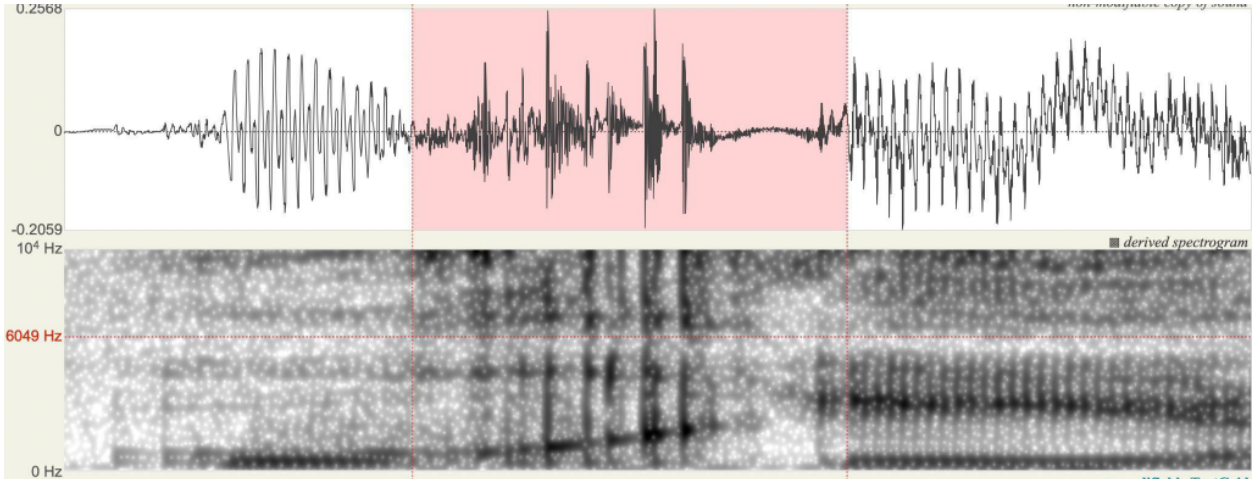


Figure 5. Oscillogram and spectrogram for /uq'i/ [uχ'i] in /uq'iani/. Note F2 transition.

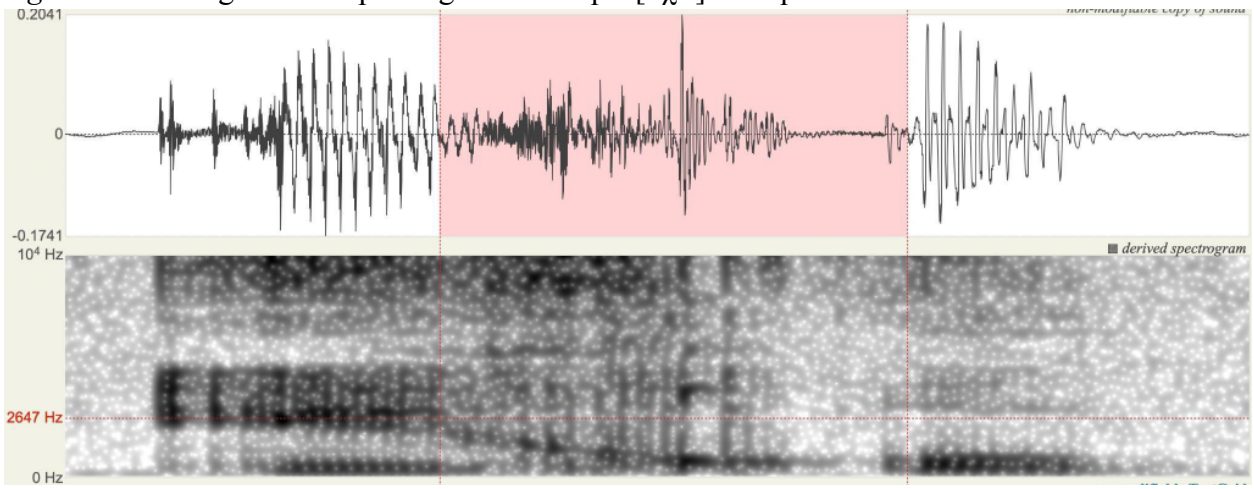


Figure 6. Oscillogram and spectrogram for /iq'u/ [iχ'u] in /iq'uphebs/. Note F2 transition.

For /q'/, we find consistent realizations of allophones unattested in prior literature, including trilled and fricative components. The stop bursts we would expect to see for [q'] are not present anywhere in our data, and it often takes on the features of a trill, as mentioned prior. Figure 6 provides a useful depiction of the phoneme as having initial high-frequency frication (around 8000-10000Hz) that grows in amplitude before transitioning into a lower-frequency, high-amplitude signal with features of a trill. Thus, to add to realizations documented elsewhere ([q'], [χ'], [qχ'], and [ʔ]), we tentatively propose [χʀ̥'].

Selected References

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