Acoustic and electroglottographic study of native and heritage Gujarati speakers

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The present experiment is an acoustic and electroglottographic study of Gujarati vowels, which contrast breathy and modal phonation (Pandit, 1957; Ladefoged & Maddieson, 1996), and the aim of this study is to determine the parameters that distinguish breathy and modal vowels. Electroglottography (EGG) is a method for measuring the contact quotient (CQ) which is the portion of time for which the vocal folds are in maximum contact during one period of the glottal cycle (Baken, 1992). This study is an extension of an experiment conducted by Khan (2012) on Gujarati vowels. A main feature of the current study is that it compares not only breathy and modal vowels but also two groups of Gujarati speakers: native and heritage. Native Gujarati speakers are those who were born in India, learned Gujarati as their first language, and arrived in Canada between 2013-2016. Heritage speakers are those people who were either born in Canada or arrived in Canada before the age of seven years. The heritage speakers learned Gujarati as their first language however their main language of communication is English. Thirteen native speakers and six heritage speakers completed the experiment.

The stimuli consisted of 40 words which included the modal and breathy pairs of the vowels /a/, /e/, and /o/ and filler words. The experimental procedure was as follows: The participants were asked to think of a sentence containing a target word and repeat the sentence five times. Measurements, such as H1-H2, H1-A1, H1-A2, harmonic-to-noise ratio (HNR), cepstral peak prominence (CPP), and CQ were calculated at nine points throughout the vowel duration. For example, CQ is expected to be higher for modal vowels than breathy vowels. Also, it is expected that breathy and modal vowels of heritage speakers will be more similar in terms of CQ that those of native speakers. Keeping in line with Khan, repeated measures ANOVAs were done on each of the nine intervals, and additionally, Smoothing Spline (SS) ANOVAs were also conducted to see the extent to which the results of both analyses corroborated.

The analysis of spectrograms of breathy vowels showed that different speakers produce breathy vowels in different ways. Some speakers produce a sequence of [VhV], while others do not have a fricative in their breathy vowels. The results also show significant difference between breathy and modal vowels for native speakers for various parameters, such as H1-A1, H1-A2, HNR, CPP, and CQ. Figures 1 and 2 display SS ANOVA results of CQ across the nine intervals for the two phonation types. Native speakers show a significant different in the first half of the vowel whereas the phonation types of heritage speakers are not significantly different at any point. Phonation also interacts significantly with vowel quality for native speakers. For heritage speakers, however, there are fewer parameters with significant differences between breathy and modal vowels and there is very little interaction with vowel quality. The results suggest that the breathy and modal vowels of heritage speakers are much similar to each other compared to the breathy and modal vowels of native Gujarati speakers.
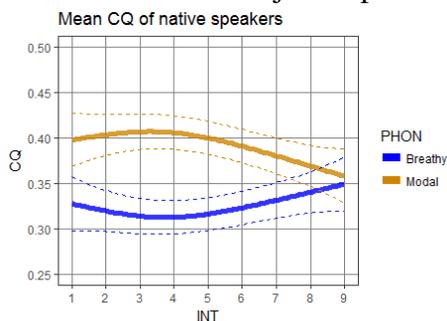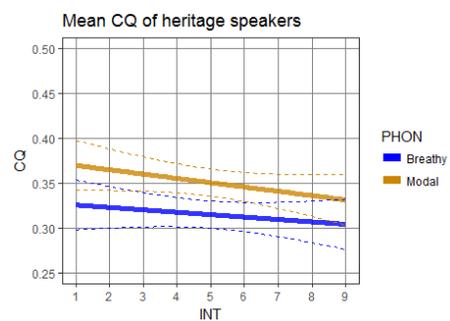

Figure 1: Contact quotient of native speakers   Figure 2: Contact quotient of heritage speakers

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