Tonal contrast in Drenjongke (Bhuntia): an Electroglottograph study

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Introduction This paper explores the tonal contrast in Drenjongke with electroglottographic (EGG) data. Drenjongke (Bhuntia), a Tibeto-Burman language spoken in Sikkim, India, is a two-tone language (low (L) and high (H) tone). The two tones are lexical in vowels and sonorant-initial syllables, but post-lexical in obstruent-initial syllables. In Lee et al. (2018), acoustic data showed that f0-based contrast is realized on the sonorant onset, but not in the following vowel. In Lee et al. (2019), it was found that devoiced plosives are associated with a higher F1, most probably due to the jaw opening, in addition to lower F0 in the vocalic portion following the plosive.

Research questions We report EGG data to investigate whether the previously tonal contrast observed in the acoustic signal is also observable in the EGG, and whether the L-tone induced in devoiced consonants is realized with breathy phonation.

Methods Recordings of 12 Drenjongke speakers are analyzed for the four laryngeal types. Both the consonantal and the vocalic components of acoustic and EGG signals were annotated. Eggno (Villegas 2020) was used to extract open quotient—OQ values. From 2439 tokens, 196 tokens (8%) were discarded because of time-misalignments between EGG and audio recordings or because of problems when extracting OQ from the EGG signal.

Analysis Data were analyzed using a Generalized Mixed-Effect Model. OQ was logit transformed, scaled, and centered. We computed the mean of the transformed values per speaker and tone (grouping all repetitions). To observe the evolution of OQ throughout a segment, the analyses were performed at each of the time terciles. Only short vowels [a, i, y, u, 'e, ø, o, æ] were used in the analyses.

Results Confirming our first research question, tone had a significant effect on OQ throughout the whole vowel. Low tones presented higher OQ in comparison to High tones as shown in Figure 1. The analysis of sonorants was performed separating the consonant [n, j, n, m, l] from the vowel segment [a]. Significantly lower values of OQ were observed for High tones, but only in the middle and last part of the consonant as summarized in Figure 2. For obstruent onsets, four laryngeal contrasts were considered: ‘Voiceless,’ ‘Aspirated,’ ‘Voiced,’ and ‘Devoiced’ before an [a]. When the effect of Tone was found significant, a post-hoc analysis based on Tukey’s multiple comparisons was performed to find significant OQ differences between the laryngeal contrasts. Significant differences in OQ were found at the beginning of the vowel as shown in Fig. 3. Considering these results with those of Fig. 1, it seems that L-tone induces devoicing, and that such phonation is produced breathier than voiced and voiceless phonation.

Discussion In general, the OQ values were higher than 50% in this corpus suggesting that phonemic contrast between creaky and breathy tones is unlikely. Additionally, an increase on the value of OQ at the end of the segments was observed. In the presented results differences (if any) were neutralized towards the end of the segments with exception of the vowels in isolation. The absence of significant differences at the beginning of the consonant in sonorants may be explained the lack of realization of the consonant. Interestingly, the OQ contrast gets neutralized in the vowel as previously observed in Lee et al. (2018) on the analysis of the acoustic signal of the same corpus. An additional study of OQ with actual words along with a perceptual study are currently being performed, these studies could elucidate whether OQ plays phonemic role in Drenjongke.
References

Figure 1. Effect of tone on OQ for vowels in isolation. Low tones have higher OQ compared to High tones. Unless otherwise noted, error bars show 95% CI.

Figure 2. OQ on sonorants. Consonant and vowel segments in the top and bottom row, respectively.

Figure 3. OQ on the vowel portion of laryngeal contrasts. Significant differences between laryngeal contrasts are denoted with brackets and asterisks (***<.001, **=.01, *=.05).