C-6 An acoustic study of dental vs. alveolar contrast in Tshivenḓa nasals

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1. Introduction

Tshivenḓa, a southern Bantu language spoken in South Africa and Zimbabwe, has a contrast between dental and alveolar consonants. This contrast in place of articulation exists across various manners: nasal, lateral and plosives. While Tshivenḓa is studied relatively well (Poulos 1990, Cassimjee 1992 among others), there is no known acoustic study of this dental and alveolar contrast. In this talk, we focus on the contrast in nasals and report acoustic parameters and articulatory settings that may play an important role in distinguishing dental and alveolar places. All data from four Tshivenḓa speakers (2 male and 2 female) were collected in South Africa.

The dental vs. alveolar contrast is relatively uncommon (Jongman et al. 1985). The contrast is reported in Australian (Nunggubuyu in Hughes & Leeding 1971), Nilo-Saharan (Kadugli in Tucker & Bryan 1966), Dravidian (Malayalam), Araucanian (Mapudungun in Sadowsky et al. 2013 and Fasola et al. 2016) etc. A detailed acoustic study of this contrast focuses on plosive consonants only (cf. Jongman et al. 1985). Other studies on this contrast utilize loqus equations (LEs), a measure that use the correlation of F2 in a preceding vowel (before a consonant), and in a following vowel (after a consonant) (cf. Graetzer et al. 2015). LEs are also used in examining the dental vs. alveolar contrast in Mapudungun (Fasola et al. 2016). This study reports preliminary results of a LE analysis and other analyses in order to understand the nature of the dental vs. alveolar contrast in Tshivenḓa.

2. Acoustics of dental and alveolar

Data collection was conducted in Thohoyandou, South Africa. The stimuli consist of 18 dental nasals and 16 alveolar nasals in word-initial position. In the stimuli set, these target consonants were followed by 5 different vowels [a, i, u, e, o]. We also varied the tonal context: High and Low. All target words were produced three times in a frame sentence. The target words were presented in a powerpoint and advanced by an experimenter. The 408 tokens (34 targets * 3 repetitions * 4 speakers) were annotated using Praat for the onset and offset of nasal and its following vowel.

In figure 1, locus equations (LEs) are represented based on the F2 value of a vowel following the target nasal. LE plots the F2 value at the onset against the midpoint of a vowel following the target sound. A side-by-side comparison of loqus equations of alveolar and dental nasals demonstrates that dental nasals have lower F2 onset values compared to alveolar consonants for a F2 value at the mid-point of the vowel.

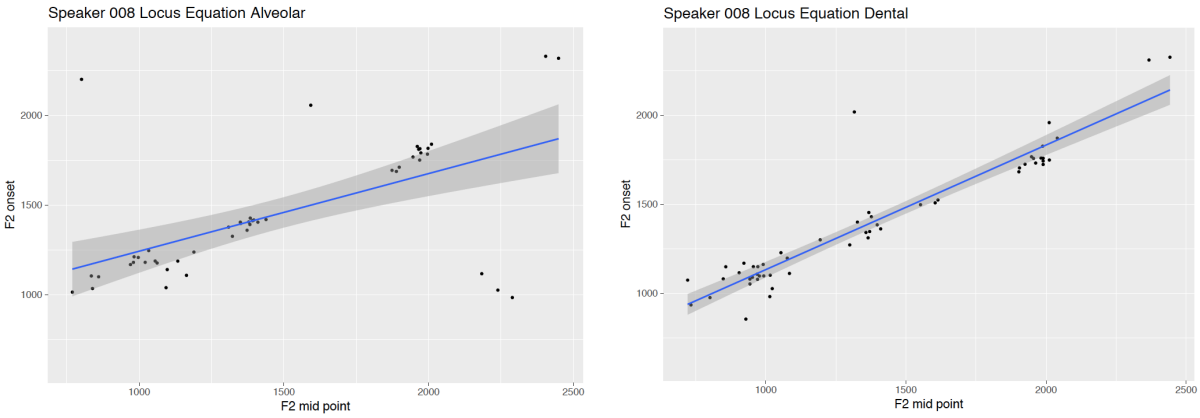

Figure 1. F2 values plotted for the vowel following a nasal consonant. The LE after an alveolar is plotted on the left, and that after a dental is plotted on the right.

In figure 2, LEs of all four speakers are shown. The effect of dental on LEs is greater in speakers 3 and 8, but not in speakers 4 and 12. This type of individual variation needs further investigation.

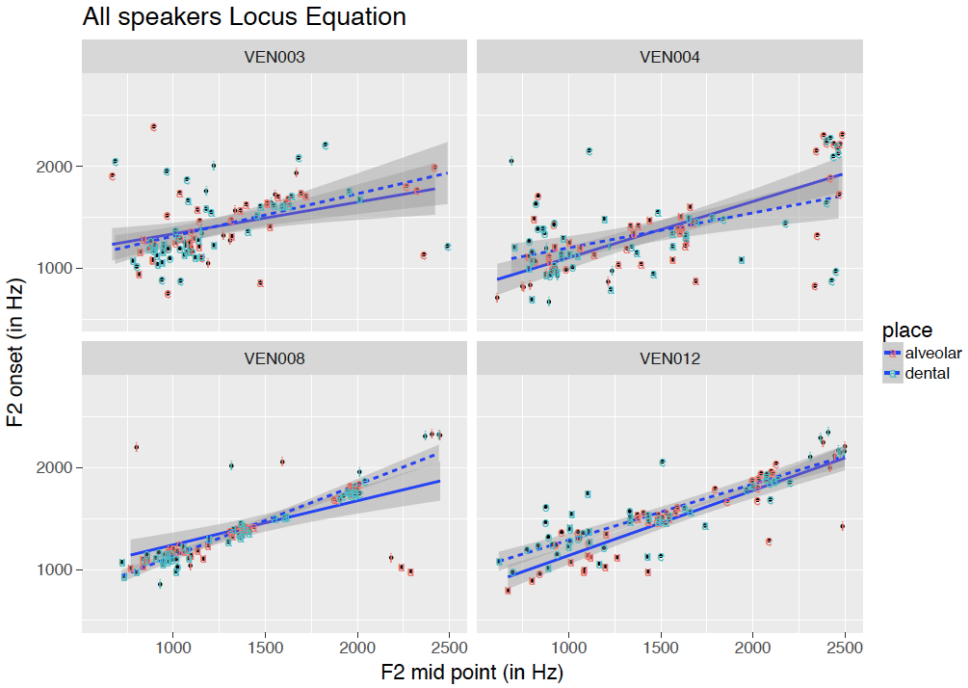

Figure 2. The plot of F2 mid point against F2 onset (loqus equations) in 4 speakers.

The duration of the two types of nasals as well as the F3 values were also compared, but no significant differences emerged. The nasal duration for all speakers is shown in figure 3. While speakers 3 and 8 produce slightly longer duration for dental nasals, speakers 4 and 12 don't.

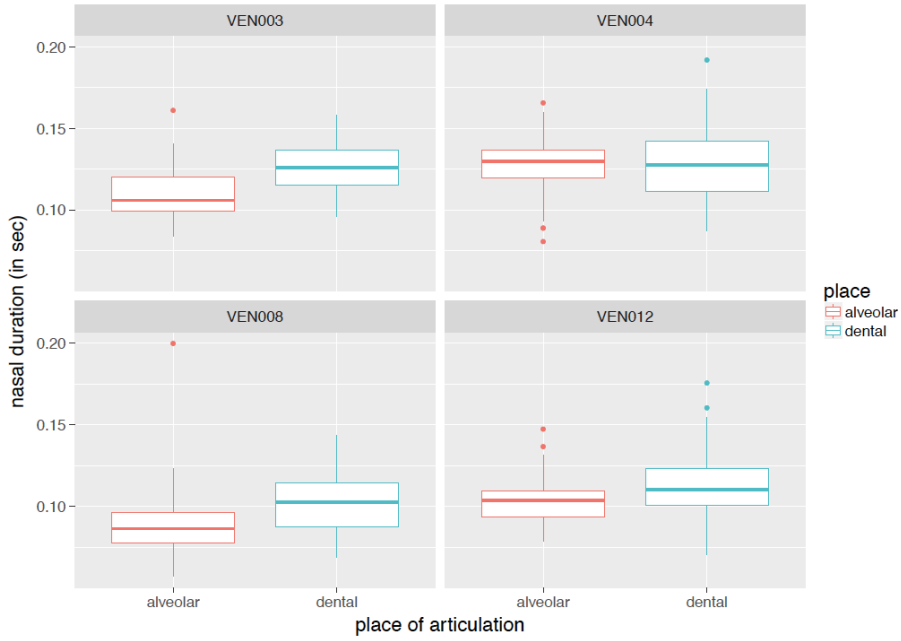

Figure 3. The duration of alveolar nasal vs. dental nasal.

3. Articulation of dental nasals

In addition to the acoustic recordings, we also video recorded the area around the mouth of the subjects in order to visually examine the articulation of the dental consonants. The audio portion of video files was extracted using the CD format function in VLC. The sound file was then annotated using Praat. Thereafter, a video and its corresponding sound file as well as annotated textgrids were imported on ELAN. Using this method, we were able to extract picture frames of a dental or an alveolar nasal.

Frames extracted from a video recording in figure 3 show that dental nasals are produced with the protrusion of the tongue between the teeth at the onset of a dental nasal. This articulatory setting suggests that the place of articulation of a Tshivenḓa dental nasal should be described as interdental as the frame (a) shows.

a. Onset b. Midpoint c. Offset

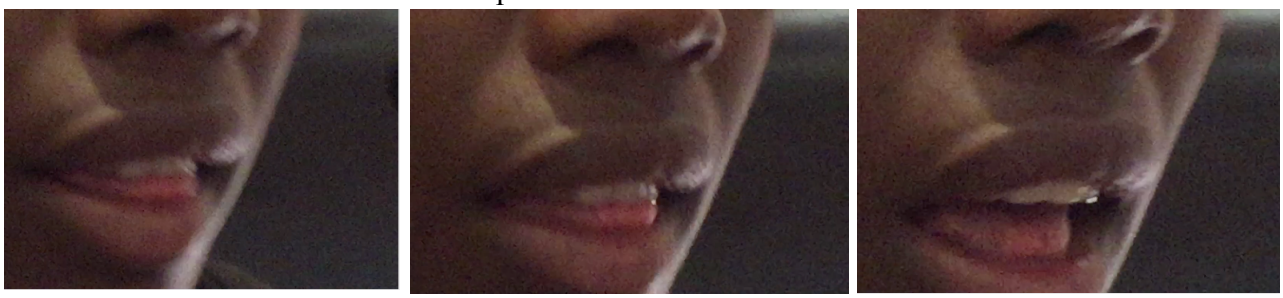

Figure 3. Three frames extracted from the onset, midpoint and offset of a dental nasal (VEN003)

One more observation can be made from figure 3. The protrusion of the tongue undergoes a rapid retraction. Thus, the tongue is not any more in the interdental position at the offset of the dental nasal.

4. Conclusion

This paper has presented some acoustic and articulatory observations in dental and alveolar nasals in Tshivenḓa. The dental is a laminal interdental sound judging from the frames taken from a video recording. Acoustically, loqus equations show the place difference between dental and alveolar. While the contrast between dental and alveolar is uncommon cross-linguistically, speakers of Tshivenḓa produce them with acoustic and articulatory differences.

In the future, we plan to conduct a perception study in order better understand what acoustic variables Tshivenḓa speakers utilize in perceiving the contrast, which are often perceived as identical by non- Tshivenḓa speakers.

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