Acoustic correlates of the voicing contrast in Lebanese Arabic singleton and geminate plosives

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This study examines the phonetic implementations of the voicing contrast in Lebanese Arabic (LA) singleton and geminate plosives in medial position and their implications for the phonological representation of voicing in LA. Geminates are known to have a longer hold phase, which is typically accompanied by devoicing due to the Aerodynamic Voicing Constraint (Ohala, 1997). They also exhibit a host of non-temporal manifestations which share properties with fortis consonants, e.g. increase in *f*0 and F1 frequencies and *H*1-*H*2 amplitude differences at the offset of the preceding vowel, and the opposite pattern for the following vowel, potentially due to trochaic stress patterns (Al-Tamimi & Khattab, 2015). These patterns are shared with those in aspirating languages specifically in medial position (Beckman, Jessen, & Ringen, 2013; Castleman & Diehl, 1996; Jessen, 2001). But given that the voicing contrast in Arabic stops is believed to be based on a true [voice] distinction, we set out to investigate whether a closer look at the temporal and non-temporal properties of geminates in LA can help us distinguish them from those of fortis plosives, teasing apart the effects of laryngeal specifications from secondary tenseness in geminates. Data from 20 LA speakers (10 males) were obtained for /b t tˤ d dˤ k/ in medial position in 410 real words with one of five disyllabic structures, with V1 and V2 as /a/ or /a:/, depending on phonological length: ˈCV1CV2(C); ˈCV:1CV2(C); ˈCV1C:V2(C); ˈCV:1C:V2; CV1ˈC:V:2C). The words were produced in isolation at a normal speech rate and with distractors. A total of 32274 measurement points were assessed via Linear Mixed Effects Modelling and Random Forests. The results showed that when compared to singletons, geminates had longer hold phase, shorter V1 and longer V2 but, crucially, only the burst phase of the release was lengthened. There was an increase in devoicing in C which had an impact on non-temporal correlates, causing a decrease in intensity at V2 onset and edges of the release phase, and decreased *f*0 and F1 frequencies and *H*1*-*H*2* at V2 onset and an increase at V1 offset. Random Forests showed extremely high classification rates at 92.5% with the hold phase being primary. Our results match those observed in fortis plosives but are different from those in true aspirating languages. Gemination in LA shows some common correlates (mainly temporal) between voiceless plosives and those found in true aspirated plosives, and tenseness as secondary correlate. These results offer strong evidence for a distinction between the phonetic patterns of languages with a true voice contrast and those with a spread glottis distinction, and highlight the importance of looking at both temporal and non-temporal cues in both the closure phase and the release.

References

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