

Tongue root advancement and vowel duration: a gradient effect?

Stefano Coretta

The University of Manchester, UK

stefano.coretta@manchester.ac.uk

Background: Tongue root advancement (TRA), shortened VOT and increased duration of vowels preceding voiced stops are all known correlates of voicing, albeit they are utilised to a different degree in different languages (Westbury 1983). Previous research also demonstrates that TRA is inversely correlated with VOT duration (Ahn 2015). This paper further shows that TRA in voiced stops is correlated with the duration of vowels preceding them. I set out to test the correlation by examining two languages reported to differ with respect to the presence/absence of the so-called ‘voicing effect’ (VE): in Italian, vowels are longer preceding voiced stops (Farnetani & Kori 1986), whereas in Polish vowel duration is not affected by the voicing of the following stop (Keating 1984).

Methods: Ultrasonic and audio recordings were obtained from four speakers of Italian (2 F, 2 M) and four speakers of Polish (2 F, 2 M). The target words were of the form $C_1V_1C_2V_2$, where $C_1 = /p/$, $V_1 = /a, o, u/$, $C_2 = /t, d, k, g/$, $V_2 = V_1$. The words were embedded in prosodically similar sentences (Italian *Dico X lentamente* ‘I say X slowly’, and Polish *Mówię X teraz* ‘I say X now’). Statistical significance was assessed with linear mixed-effects regressions for the durational data and generalised additive mixed models for the tongue contour data.

Results: In Italian, vowels are 22 ms longer when followed by a voiced stop ($\chi^2(3) = 18.5$, $p < 0.001$). Surprisingly, Polish shows a smaller but significant effect of voicing on vowel duration (8 ms, $\chi^2(1) = 5.4$, $p < 0.05$). In Italian, the tongue root at the onset of acoustic closure and within stop closure is significantly more anterior in voiced stops. For Polish, the root in voiced and voiceless stops doesn’t differ, except for one speaker (PL05), who showed advancement in voiced stops both at closure onset and within closure. It is worth noting that PL05 also had a high random coefficient estimate for the effect of voicing on vowel duration compared to the other Polish speakers, who did not have TRA.

Discussion: These results show that TRA in voiced stops correlates with the presence of the VE, although in an unexpected way. A VE was found, not only in Italian, but also in Polish (contrary to previous findings), but the magnitude of the effect is bigger in those speakers who also have TRA, independent of their language. The differences in VE size between speakers raises the question of whether a gradient correlation between the degree of TRA and the magnitude of the VE underlies the link between presence/absence of TRA and that of the VE. I will discuss the implications of this interpretation, by drawing on an older account by Halle & Stevens (1967) that ascribes the increased vowel duration to properties of articulatory timing in voiced stops.

References

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