Effects of obstruent voicing on vowel fundamental frequency in Dutch

Anne-France Pinget[1,2] & Hugo Quené[1]
[1] *UiL OTS Utrecht University*
[2] *Fryske Akademy, Leeuwarden*

It has been known for a long time and for a wide variety of languages that vowel fundamental frequency (F0) can be affected by the intrinsic properties of the preceding consonants. In particular, F0 following voiceless obstruents tends to be significantly higher than F0 following voiced obstruents (e.g., House and Fairbanks, 1953; Hombert et al., 1979). There has been a long-standing debate about the cause of this phenomenon. Some evidence in previous work is more compatible with a physiological/aerodynamic account of this effect (e.g., Halle and Stevens, 1967; Kirby & Ladd, 2016), while other supports an auditory enhancement account (e.g., Kingston and Diehl 1994).

This paper investigates these consonant-related F0 perturbations in Dutch after initial fricatives (/v f/) and stops (/b p/), as compared to after sonorant /m/, in recordings by Pinget (2015). Dutch is particularly interesting for the investigation of F0 perturbations for two reasons: 1) Dutch – unlike English – is a *true voicing* language and 2) Dutch initial fricatives are currently undergoing a process of devoicing (e.g., Kissine et al., 2003; Pinget, 2015).

The F0 contours in isolated words were analyzed using GAMM (e.g., Wieling 2018) with /m/ as baseline condition. Results show that after unvoiced /p, f/, the F0 at vowel onset is significantly higher than this baseline. Moreover, voicing measures (degree of voicing, duration, and VOT) interact with the main effects of onset consonant on F0. Especially after /v/, F0 at vowel onset increased as the voicing measures of preceding /v/ decreased. Thus, we found no trace of an active gesture to explicitly lower F0 after highly devoiced fricatives, as would be predicted by an auditory enhancement account. In conclusion, these results regarding F0 contours, the time course of the effects and the covariation patterns are taken as evidence to support a physiological/aerodynamic cause of F0 perturbations.

References

Halle, M., & Stevens, K. (1967). Mechanism of glottal vibration for vowels and consonants. *The Journal of the Acoustical Society of America*, 41(6), 1613-1613.

Hombert, J.-M., Ohala, J. J., & Ewan, W. G. (1979). Phonetic explanations for the development of tones. *Language* 55, 37–58.

House, A. S., & Fairbanks, G. (1953). The influence of consonant environment upon the secondary acoustical characteristics of vowels. *Journal of the Acoustical Society of America*, 25, 105–113.

Kingston, J., & Diehl, R. L. (1994). Phonetic knowledge. *Language*, 70, 419–454.

Kirby, J. P., & Ladd, D. R. (2016). Effects of obstruent voicing on vowel F 0: Evidence from "true voicing" languages. *The Journal of the Acoustical Society of America*, 140(4), 2400-2411.

Kissine, M., Van de Velde, H., & van Hout, R. (2003). An acoustic study of standard Dutch /v/, /f/, /z/ and /s/. *Linguistics in the Netherlands*, 20(1), 93–104.

Pinget, A. (2015). *The actuation of sound change*. PhD Dissertation, Utrecht University, The Netherlands.

Wieling, M. (2018). Analyzing dynamic phonetic data using generalized additive mixed modeling: A tutorial focusing on articulatory differences between L1 and L2 speakers of English. *Journal of Phonetics*, 70, 86-116.