

## Investigation of fricative devoicing in Standard Southern British English

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In the production of fricative speech sounds, high oral air pressure is required to sustain friction noise. However, voiced sounds require oral pressure to be low (relative to subglottal pressure) to sustain glottal vibration. Ohala (1983) postulated that due to these competing requirements, voiced fricatives are difficult to produce, leading to fricative devoicing. A solid understanding of fricative devoicing is essential in speech and language therapy (SLT) and could aid the development of speech synthesis and speech recognition systems. For example, if the distinction between voiced and devoiced fricatives is not predicated on vocal fold vibration, then the current SLT practice of listening or feeling for a “buzz” in the larynx may not be the most appropriate method of therapy. Similarly, speech recognition systems should employ additional acoustic cues (e.g., the length of the preceding vowel) to make voicing decisions.

Previous investigations have rarely reported the *amount* of devoicing, i.e., the proportion of the duration of the fricative that is realised without vocal fold vibration. This study measured the amount and frequency of fricative devoicing in 20 speakers of Southern British English and determined the influence of gender, age, place of articulation, and word position. Speech data were obtained from Verhoeven et al. (2011), but their analysis was extended to (a) measure the *amount* of devoicing and (b) make use of acoustic data (not just laryngographic data).

Devoicing may be expected to occur as an assimilatory process when the fricative is adjacent to voiceless sounds. However, the emphasis of this study was on fricative devoicing in *voiced* contexts, as this phenomenon is in greater need of characterisation and explanation. Fricatives were embedded in carrier phrases of the form “*In vend you hear E*” (target: *vend*). In such a phrase, the target word is naturally realised with sentence accent, but the sentence meaning draws the speaker’s attention to the vowel sound within the target, thus reducing the likelihood of over-articulating the fricative. 72 target words were chosen to test four fricatives of English (/v/, /f/, /z/, /s/) at three word positions (initial, medial and final). Voiceless fricatives were included to determine whether perceptual neutralisation occurred.

For word-initial and word-medial fricatives, which were consistently produced in a voiced context, the mean proportion of the fricative that was devoiced was 26.9% (females: 40.9%, males: 12.9%). These results are in close agreement with Thurgood (2016). In terms of incidence, the most common occurrence was full voicing (59% of tokens), while a further 32% of tokens were devoiced for at least half their duration. Thus, intermediate levels of devoicing rarely occurred. Word-final fricatives exhibited the most devoicing (70% of the fricative duration), which was largely due to post-word pausing. Place of articulation demonstrated only a small effect and there was no significant effect of age. The findings did not support the hypothesis that fricative devoicing is purely anatomical in origin, nor that it is more prevalent in speakers with a slower speaking rate. Voiced and voiceless fricatives were perceptually distinct. On average, /f/ was 71% longer than /v/ and /s/ was 51% longer than /z/.

### References

- Ohala, J.J. (1983). The origin of sound patterns in vocal tract constraints. In P.F. MacNeilage (Ed.), *The Production of Speech* (pp.189-216). New York: Springer-Verlag.
- Thurgood, M. (2016). Studies of obstruent devoicing: Methodological implications, *2016 British Association of Academic Phoneticians (BAAP) Colloquium*.
- Verhoeven, J., Hirson, A., & Basavraj, K. (2011). Fricative devoicing in standard Southern British English. In W.S. Lee (Ed.), *Proc. of the 17th International Congress of Phonetic Sciences* (pp.2070-73).