Exploring the front fricative contrast in Greek:
A study of acoustic variability based on cepstral coefficients

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Classification methods based mainly on traditional acoustic measures for fricatives (e.g. spectral peak location, amplitude, and duration) yielded lower success rates (66%) with front fricatives [f, v, θ, ð], compared to 88% with sibilant fricatives [s, z, ʃ, ʒ] in English [1]. Perceptual studies show that human listeners also have difficulty distinguishing these sounds, and an acoustic investigation employing both traditional and more innovative measures did not find any cues "even modestly invariant for place of articulation in non-sibilants" [2]. Partially explaining these results, an articulatory study using magnetic resonance imaging showed that labiodental fricatives exhibited the most variability across speakers [3]. In the current study, we explore the factors underlying the difficulty in acoustic classification/perception of front fricatives by taking a closer look at variability in the production of Greek speakers. We apply a novel classification tool based on cepstral coefficients (following [4]) in order to classify front fricatives from an experimental corpus with 25 subjects, and employ statistical methods to classify the tokens from each place of articulation into as many different prototypes as possible. The overall classification rate we obtained is only slightly higher compared to previous work (74%), but we were able to identify distinct subgroups within the four main categories, each with specific characteristics. Our study documents the properties of fricatives in a new language, adds to our understanding of acoustic variability, and sheds more light on the lack of invariance in the production of front fricatives.

References

[1] Jongman, A., Wayland, R., and Wong, S. 2000. Acoustic characteristics of English fricatives, *Journal of the Acoustical Society of America* 10/2000; 108 (3 Pt 1), 1252–1263.

[2] McMurray, B., and Jongman, A. 2011. What information is necessary for speech categorization? Harnessing variability in the speech signal by integrating cues computed relative to expectations. *Psychological Review* 118, 219–246.

[3] Narayanan, S., Alwan, A. A., and Haker, K. 1995. An articulatory study of fricative consonants using magnetic resonance imaging. *Journal of the Acoustical Society of America*, 98, 1325–1347.

[4] Spinu, L. and Lilley, J. 2016. A comparison of cepstral coefficients and spectral moments in the classification of Romanian fricatives. *Journal of Phonetics* 57, 40–58.