Measurement error and stability in vowel formant extraction: A simulation experiment

TYLER KENDALL
University of Oregon

CHARLOTTE VAUGHN
Northwestern University

Recent years have seen increased focus on methodologies for acoustic vowel study. Much work has focused explicitly on techniques for vowel analysis, such as through the development and evaluation of vowel normalization procedures (e.g., Clopper 2009, Fabricius et al. 2009, Flynn 2011, Thomas and Kendall 2007), resulting in more rigorous methods. However, sources of error exist in other facets of acoustic vowel research and these other potential problems have been addressed less frequently. Specifically, it is clear that there are limitations in the accuracy and precision of vowel measurements (e.g., Harrison 2004, 2007), as a function of linear predictive coding (LPC) methods, as well as, of course, noise in the acoustical signal being studied. For instance, different measurement points and different LPC settings (such as for the formant analysis procedure in Praat) are known to yield different results (Boersma & Weenink 2013, Duckworth et al. 2007). Researchers are generally well aware of the need to consider inter-analyst differences in their acoustic work. Yet, less research has explicitly or quantitatively studied the extent to which these differences matter for the outcome of an investigation (Duckworth et al. 2007, Harrison 2004, 2007). In this presentation, we consider the sources of error in common formant extraction techniques, investigating the extent to which the delimitation of vowel boundaries and software (Praat) settings influence the formant values obtained. To do this, we report on the results of a vowel measurement simulation where, rather than extracting a single measurement for each vowel, thousands of measurements are taken for each vowel with varied settings in jittered measurement locations (seeded by measurements from a human analyst) and vowel tokens are treated as distributions of probable formant frequencies instead of simple points or vectors in scatter plots. Such a consideration, we argue, sheds important insight into the bounds of measurement error in vowel work.