Spectral Trajectories of Spanish /s/: Temporal Variability, Vowel Context, and Duration

Eric Wilbanks — North Carolina State University — wilbanks.ericw@gmail.com

Although the earliest acoustic research on fricatives focused on their invariant spectral characteristics, recent work has investigated the temporal variability of fricatives (Haley et al., 2010; Jesus & Shadle, 2002; Jongman et al., 2000; Munson, 2001; Recasens & Espinosa, 2009; Shadle et al., 2008). Iskarous et al. (2011) directly investigated the articulatory and acoustic dynamics of English /s/ and found that temporal variability in fact characterized adult productions of the fricative. Coarticulatory forces of the surrounding segments affected both the spectral peak and temporal trajectory of /s/. Reidy (2015) expanded upon these findings and conducted several analyses on the dynamic spectral properties of both English /s/ and /ʃ/ as well as Japanese /s/ and /ɕ/ in the perception and production of adults and children.

Unlike work on English fricatives, spectral analysis is relatively infrequent in work on Spanish fricatives (though c.f. notable exceptions: Erker, 2010; File-Muriel & Brown, 2011). To my knowledge, the time-varying aspects of Spanish fricatives have not yet been investigated in any capacity. The current project analyses the temporal spectral characteristics of Spanish /s/, utilizing a subset of a corpus of sociolinguistic interviews. A subset of 20 speakers of Mexican or Salvadoran descent were force-aligned and all Vowel-/s/-Vowel tokens were extracted. Due to low token count, tokens with /u/ in left or right position are excluded. Additionally, tokens with durations less than 60ms or greater than 270ms were excluded. Following Iskarous et al. (2011), nine 30ms Hamming windows were placed throughout each /s/ and Center of Gravity (COG) measurements were taken at each window. These 25,173 observations (2,797 tokens of /s/ * 9 windows per token) were used to fit a series of Generalized Additive Mixed Models (Wood, 2011). The best fit model includes random smooths of window by speaker, left and right contexts, speaker sex, and a non-linear interaction (via tensor smooth) between log duration and window by sex. I find that /s/ in context of /i/ is consistently produced with a higher COG, though this effect is greater for left context than right context.

The fitted values representing the relationship between the tensor smooth interaction of Log Duration, Window, and Sex are plotted in the figure below. It can be observed that men and women vary in their target fricative durations and peak COG locations within the fricative. Women tend to produce /s/ with a later COG peak when compared to men, who tend to produce a peak at the midpoint of the segment. Additionally, male productions of /s/ with peak COG tend to be shorter in duration than those produced by women.

Though somewhat restricted by a sample size of 20 speakers, the current study adds to our knowledge of the temporal variability of fricatives in languages other than English. Data on the role of vowel context, fricative duration, and sex differences in the acoustic trajectory and realization of Spanish /s/ have been presented. The coarticulatory force of /i/ on /s/ realizations has been replicated, and interesting differences between male and female treatments of COG peak location and duration have been presented.
References


