An Apparent Time Study of Turbulent Sounds in Raleigh, NC English

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The current project investigates the changing nature of sibilants and stops in an English speaking community in North Carolina, using 140 sociolinguistic interviews drawn from the Raleigh corpus (Dodsworth & Kohn 2012). The first set of analyses centers around changes involving the phonetic realization of /s/ and /ʃ/. Figure 1 presents fitted values from a linear mixed effects model fitted to a data set of 99,150 voiceless sibilant tokens. The phenomenon of (str) retraction (Shapiro 1995; Lawrence 2000; Durian 2007; Baker et al. 2011; Gylfadottir 2015) is currently underway in the community, but restricted to female speakers producing tokens in medial word position (e.g. 'restructure'). This change in progress is contrasted with broader changes in the men's productions. While not currently participating in (str) retraction, men's sibilant spaces are seen to expand over apparent time, with a broadening of the acoustic space between /s/ and /ʃ/. This adds a challenging dimension to the already complex nature of measuring turbulent sounds: how do we normalize phonetic features when the whole system is in motion?

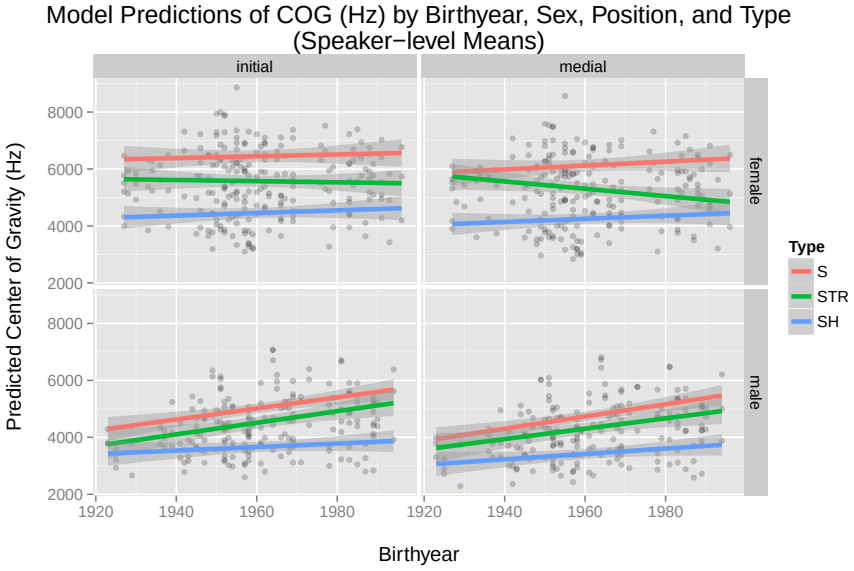
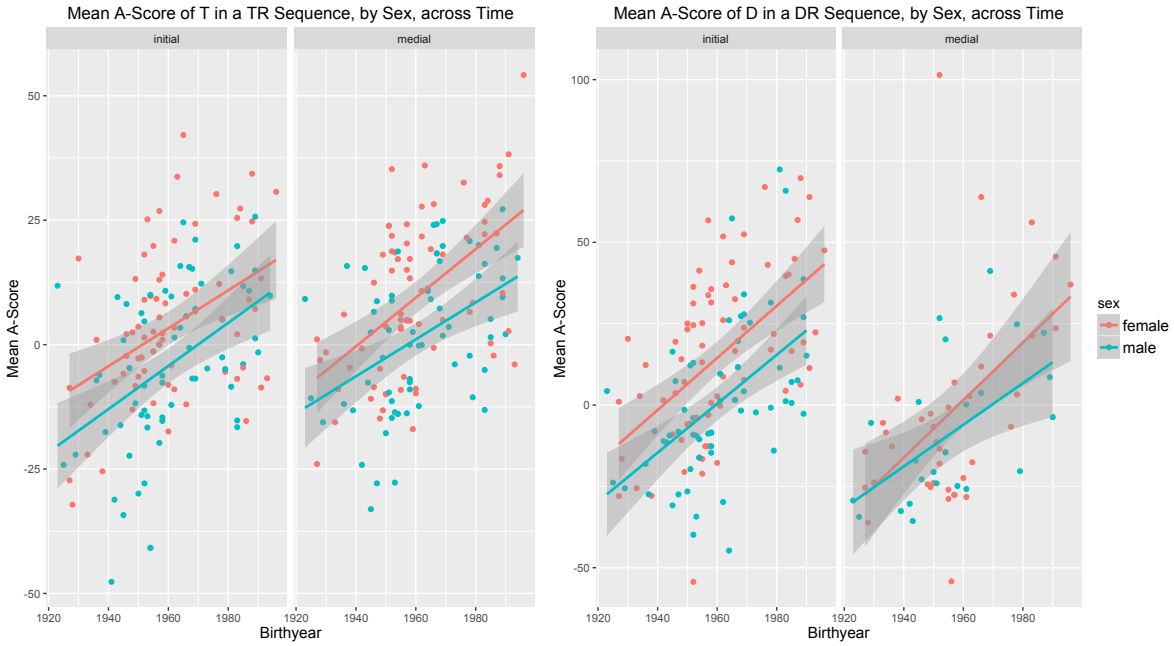


Figure 1: Model Predictions of COG (Hz). Points represent speaker-means.

The second set of analyses centers around a related but under-investigated phenomenon: the affrication of alveolar plosives preceding /ɹ/, where e.g. 'truck' is produced as [tʃɹʌk]. While (str) retraction is heavily influenced by the presence of /ɹ/ (Baker et al. 2011; Shapiro 1995), there are arguments that it is the affrication of /t/ before /ɹ/ that leads to retraction (Lawrence 2000). We explore the changing realization of the plosives in /tɹ/ and /dɹ/ clusters in the same corpus of 140 speakers.

Preliminary attempts to apply acoustic measures such as COG and normalized rise time (onset to peak intensity divided by duration), while successful in laboratory data (Smith 2013), have proven inadequate for capturing contrasts between stops and affricates in the spontaneous data set (33,500 tokens). We adopt an automatic classification scheme following Yuan & Liberman (2011) in which plosives in /tɹ/ and /dɹ/ contexts are classified as [t] or [tʃ] and [d] or [dʒ], respectively, using forced alignment (P2FA's 16 kHz acoustic models, Yuan & Liberman 2008). An A(ffrication)-Score is then calculated for each token by subtracting the probability associated with its classification as an affricate from the probability of its classification as a stop, with higher A-Scores indicating greater probability of affrication. Figures 2a-2b present the results of this analysis, showing A-Score by birth year for speakers' /t/ and /d/ productions before /ɹ/, in both intital and medial position. It can be observed that a change in progress is occurring in the Raleigh community, with younger speakers' /t/ and /d/ productions in clusters with /ɹ/ more strongly classified as affricates.

These data paint a picture of the changing nature of turbulent sounds in this community, and demonstrate the merit of combining traditional acoustic measures with automatic classification through speech recognition



(a) Mean A-Score /tɹ/ by Speaker

(b) Mean A-Score /dɹ/ by Speaker

Figure 2: A(ffrication)-Score Classification using P2FA forced alignment (16 kHz, Yuan & Liberman 2008)

tools. We are investigating possible links between changes in /s/ and /ʃ/ realizations and affricated productions of /t/ and /d/, and how these changes interact with the broadening of acoustic space. By simultaneously analyzing the phenomena of (str) retraction and /tɹ/-/dɹ/ affrication in a single corpus of spontaneous speech, we are able to explore questions such as whether (str) retraction is the result of long-distance assimilation with /ɹ/ (Shapiro 1995), or assimilation with an (already) affricated /t/ (Lawrence 2000). Finding effective ways to capture and model these interactions is a critical step in understanding the dynamic nature of turbulent sounds and how they change over time.

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