

Modeling Co-articulatory-Acoustic Relations in Sociophonetic Variation

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It is a well-stated assumption that synchronic variation within a community is a necessary condition for language change (Bloomfield 1933). But how does variation emerge in the first place? Why do some factors prompt or inhibit variation? These questions underlie the general problem addressed in this paper: how variation is produced, or suppressed. I consider this issue in relation to patterns of vocalic variation in dialects of North American English (Labov 1991) by reporting on an experiment designed to model internal constraints on vowel shifting in Canadian English.

In vowel shifts currently underway in Canada and the U.S., an adjacent nasal consonant plays an important role in the phonetic patterning of (æ). In the Northern Cities Shift, adjacent nasals greatly favor raising of (æ) (e.g. Gordon 2001) In the Canadian Vowel Shift (Clarke et al. 1995) a following nasal consonant has been found to inhibit lowering and retraction of (æ) (e.g. De Decker 2002). This paper focuses on the relationship between articulatory and acoustic phenomena to offer an explanation of this inhibitory effect of nasal co-articulation.

Following the work of Goldstein (1983), a computer-simulated vocal tract model (Boersma 1998) was used to study how changes in tongue position affect acoustic output for the vowel (æ). Boersma's model produces a range of vocal tract shapes by independently adjusting muscles that control tongue position. Taking the mean values of F1 and F2 produced by a Canadian female in her late teens, a target value for the vowel (æ) was modeled by setting parameter values for the hyoglossus and genioglossus (the muscles that control vertical and horizontal tongue movement, respectively). To simulate articulatory variation, the parameter values of these muscles around the target value were permuted, producing 100 different tongue positions. The effects of these perturbations on the acoustic output are reported. Using the same articulatory permutations, the effect of nasal co-articulation was modeled by coupling the model's oral and nasal tracts, producing nasalized variants of (æ). The two data sets were compared to determine the effect of nasalization on (æ).

In assessing the initiation and inhibition of vocalic variation, some results from this experiment are considered. In particular, the difference in patterns of oral and nasalized (æ) are striking. The primary observable effect of nasalization on the formant values for (æ) is a reduction in acoustic variability despite changes in tongue position. These results suggest that the patterns of (æ)-shifting are not random. Rather, the path itself is borne out of the relation between articulatory variation and acoustic phenomena. Likewise, with respect to the overarching question of what initiates change, it is evident from these results that the resonance properties of the vocal tract play a crucial role.

While data presented in this paper come from a simulated computer model, the results should be of interest to those studying sociolinguistic variation of human language. This paper shows that techniques used in laboratory/experimental phonetics are valuable tools for hypothesis testing and explaining

community-wide patterns of variation that would otherwise be impossible or difficult to obtain in a standard sociolinguistic investigation.

Key Words: laboratory sociolinguistics, sociophonetic variation, Canadian English

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