More velar than /g/: consonant coarticulation as a cause of diphthongization

Many dialects of American English feature a unique pronunciation of *short a* before the velar nasal of 'bang, ' distinct from *short a* in other contexts (typically [æ], as in 'bad'). Historically both vowels were identical (Sweet 1874), but in most dialects of American English *short a* and *long a* (the vowel in 'bade') have apparently merged in this context. In some dialects the merger has occurred before [g] as well, so that 'hag' is homophonous with 'Hague' (Zeller 1997). We present acoustic and aerodynamic evidence to support the hypothesis that these mergers are the result of coarticulation with the following velar consonant.

Sound changes are often considered to be conventionalized coarticulation (e.g. Janda 1999). Such an explanation is available for this apparent merger before velars. Narrowing the vocal tract near the velum results in a change in the vowel formants: falling F1, rising F2, falling F3—the characteristic 'velar pinch.' These formant perturbations are consistent with a change from an [æ]-like pronunciation of *short a* to an [e]-like one.

Short and *long a* have merged before [ŋ] in many dialects, but before [g] in only a proper subset of those dialects. This suggests that the pre-nasal context presents a greater phonetic motivation for merger than does the pre-[g] context; in this sense [ŋ] is "more velar" than [g]. One reason to expect the coarticulatory pressure to be greater for the nasal is that in [ŋ], two factors lead to narrowing of the vocal tract near the velum. The tongue dorsum raises, but the velum also lowers anticipatorily for the nasal consonant. This double-narrowing may produce the extra coarticulation needed to explain the sound pattern.

To test this hypothesis, measurements were collected from 13 speakers of Western American English. If [ŋ] causes greater velar pinch than [g], the degree of velar pinch is expected to be positively correlated with the extent of velic lowering. Nasal airflow was measured and taken to be an indicator of the height of the velum (high flow corresponds to a lowered velum; low flow corresponds to a raised velum). Velar pinch was measured as the difference in Hz between F3 and F2.

A linear statistical model was created to determine whether velum height contributed to the extent of velar pinch in nasalized vowels. A model that accounted for velar pinch as a function of time was compared to a model that included nasal flow as well. The model that incorporated nasal flow accounted for significantly more variance ($p < 0.001$). This statistical result confirms that velum height contributes to velar pinch, and supports the hypothesis that [ŋ] provides greater phonetic pressure for a shift from [æ] to [e] than does [g].