Variation in prenasal allophony across dialects of English

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Background: Nasalization of vowels causes compression in the F1 dimension, leading to changes in vowel height in nasalized vowels crosslinguistically (Beddor 1993). We examine patterns of vowel quality variation prenasally vs preorally across English dialects, and ask whether this variation falls along a continuum, or whether dialects fall into discrete categories. In American English, vowels are reported to have a large extent of nasalization before nasal consonants, suggesting an "allophonic" or "controlled" implementation, in contrast to e.g. Spanish, which has a "minimal" amount of "automatic" nasal coarticulation (Solé 1992). However, American English speakers have also been shown to vary substantially in the extent of prenasal coarticulation (Beddor 2009), and the nasal coarticulation patterns of other varieties of English are much less well studied. Additionally, Southern US English and African American English are said to merge /ɛ/ and /ɪ/ prenasally (Labov et al. 2006), causing homophony between pairs such as pin and pen in these dialects. Conversely, Scottish English has only a marginal acoustic contrast between /ɪ/ and /ɛ/ in all contexts (Aitken 1981), which is nonetheless stable over time and has not been described as neutralized prenasally. Thus, Southern US English and Scottish represent possible extremes along two different dimensions: the baseline (preoral) contrast between /ɪ/ and /ɛ/, and the difference between the /ɪ/-/ɛ/ contrast prenasally compared to preorally.

Methods: The data consist of 18 force-aligned corpora (1,203 speakers, 628 f) from the SPADE project (Sonderegger et al. 2022), a subset chosen to represent a broad range of expected behavior prenasally: Southern US (merged prenasally), other North American (no merger but substantial prenasalization), Scottish (marginal contrast both preorally and prenasally), and other UK (no prior expectations). Speakers in each corpus were further subdivided by dialect label, resulting in 25 "dialects" (corpus-by-dialect pairs). F1 and F2 were extracted at 1/3 of the vowel duration (Mielke et al. 2019) using PolyglotDB (McAuliffe et al. 2017) Stressed tokens from the KIT and DRESS lexical sets (Wells 1982) were extracted (n tokens = 390,271), so that that the same set of words were used across all dialects using the UNISYN lexicon (Fitt 2000). For each dialect, F1 and F2 were jointly modeled using a multivariate Bayesian mixed-effects model (Vasishth et al. 2018, Bürkner 2018) with fixed effects for *vowel*, *context* (oral, nasal) and by-speaker random intercepts and slopes for *vowel* and *context*, as well as a range of controls (for *duration*, *phonological context*, *word*). Estimates for Bhattacharyya Affinity (BA) (Johnson 2015) were calculated for both prenasal and preoral contexts, for each speaker in a dialect, as well as an "average speaker" in each dialect, using the model's posterior. BA quantifies distinctness between two distributions, with 1 corresponding to two identical distributions and 0 corresponding to no overlap between distributions.

Results: **Figure 1** shows by-speaker distributions of BA prenasally and perorally for each dialect, ordered from most merged (left) to least merged (right). Treating preoral BA as the "baseline" level of category distinctness, dialects vary in that baseline, with Scottish dialects having the least distinct categories (highest BA), as expected. Scottish dialects have almost identical distributions prenasally as preorally, which contrasts with the Southern US dialects, which, like Scottish, have high prenasal BA but relatively low preoral BA, in line with the rest of the non-Scottish dialects. **Figure 2** shows the difference between prenasal and preoral BA (the effect of the prenasal environment) plotted against preoral BA (the baseline contrast), for the average speaker of each dialect, with 95% CredI's. The blue triangle shows the range of "reasonable" values: dialects are mathematically confined to the left side of the diagonal line; in general, dialects do not have a negative difference, (consistent with what we expect from the acoustics of nasalization); and in general, dialects do not have prenasal BA lower than 0.4 (which appears to be a property of the /ɪ/-/ɛ/ contrast in English). Within this triangle, a dialect's preoral BA and BA difference appear to vary independently. This suggests that, within the bounds of what is mathematically possible, the acoustic effects of nasalization, and the nature of this contrast, dialects can continuously along a continuum of prenasal coarticulation.

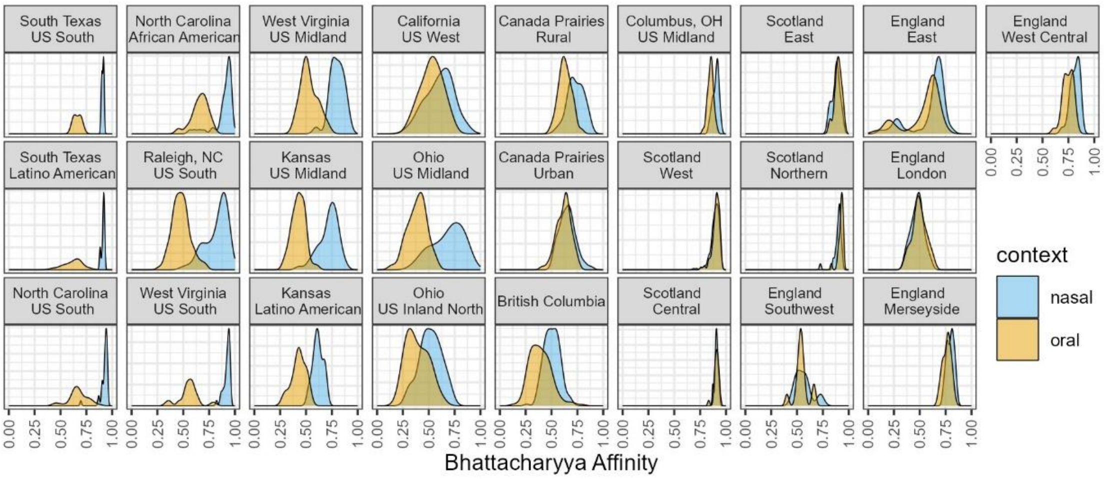

Fig. 1. Distribution across speakers of prenasal and preoral Bhattacharyya affinity between /ɪ/ and /ɛ/ for each dialect

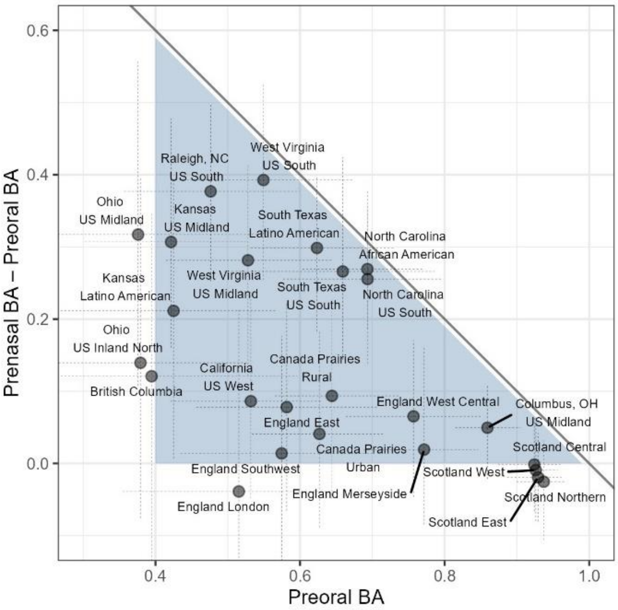

Fig. 2. BA difference vs preoral BA for the "average speaker" of each dialect, with 95% credible intervals. The blue triangle roughly highlights the extent of cross-dialectal variation along these two dimensions

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