Structured variability across acoustic dimensions to the intervocalic non-coronal stop voicing contrast in North American and British Isles Englishes

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Introduction The realisation of intervocalic stop voicing (e.g. *rapid-rabid*) has been famously described as being signalled by a wide range of acoustic features, including burst presence, closure voicing, duration, and spectral intensity, pointing towards a single 'degree of lenition' (Lisker, 1986). In English, the focus on socially-salient lenition patterns of alveolar stops (Chodroff & Foulkes, 2023) leaves open the question of what underlying patterns of phonetic variability exist for non-coronal stops across English dialects, including how the realisation of the intervocalic stop contrast may vary across dialects, and how multiple acoustic dimensions may align to signal the voicing contrast across varieties (e.g. Tanner et al., 2020). Through the analysis of a large multi-dialect speech dataset of North American and British Isles Englishes, we examine the implementation of phonological voicing in labial and velar stops across multiple acoustic properties, addressing two research questions: 1) *how consistent is the implementation of phonological voicing across multiple dimensions to stop realisation across many dialects of English?*; and 2) *how are multiple acoustic properties related to each other in signalling the voicing contrast across dialects?*

Methods 123,130 unstressed labial and velar stops were extracted from 31 speech corpora, corresponding to 15 dialects of North American and British English (5408 speakers, Sonderegger et al., 2022). A Bayesian multivariate regression model was fit, consisting of sub-models for the DNN-predicted presence of a stop burst (Tanner et al., 2025), stop duration, the maximum velocity of reduction in intensity, and the degree of voicing during the stop interval (VDI). Phonological voicing, place of articulation (POA), voicing×POA, and (log) speech rate were included as predictors, with voicing, POA, and voicing×POA included as random slopes by dialect, corpus, and speaker. Correlations for random intercepts, as well as the voicing, POA, and voicing×POA slopes were also included to estimate the cross-cue relationships.

Results Despite overall dialectal variation across dimensions, the size of the voicing effect is consistent across these properties, in particular for duration, stop intensity, and VDI (Fig 1, left), indicating that the phonetic realisation of English intervocalic stop voicing is highly structured, where voiced stops appear more lenited across dimensions. Moreover, while acoustic properties exhibit little correlation in their average values, we observe structured variability in the realisation of the voicing contrast across dialects (Fig. 1, right), suggesting that the intervocalic voicing contrast is structured across multiple dimensions in the direction of varying degrees of lenition (e.g. Ennever et al., 2017).

References

Chodroff, E. & Foulkes, P. (2023). *Sociophonetics and stops*, (pp. 143–175). Routledge. Ennever, T., Meakins, F., & Round, E. R. (2017). A replicable acoustic measure of lenition and the nature of variability in Gurindji stops. *Lab. Phon.*, 8, 1–32. Lisker, L. (1986). "Voicing" in English: A catalogue of acoustic features signaling /b/ versus /p/ in trochees. *Lang. Speech*, 29, 3–11. Sonderegger, M., Stuart-Smith, J., McAuliffe, M., Macdonald, R., & Kendall, T. (2022). Managing data for integrated speech corpus analysis in SPeech Across Dialects of English (SPADE). In *Open Handbook of Linguistic Data Management*. Cambridge: MIT Press. Tanner, J., Sonderegger, M., & Stuart-Smith, J. (2020). Structured speaker variability in Japanese stops: Relationships within versus across cues to stop voicing. *JASA*, 148, 793–804. Tanner, J., Sonderegger, M., Stuart-Smith, J., Mielke, J., & Kendall, T. (2025). Automatic classification of stop realisation with wav2vec2.0. In *Interspeech 2025* (pp. 2270–2274).

Figure 1: Left: model-estimated values for burst likelihood, duration, minimum intensity velocity, and stop interval voicing (VDI) for each dialect as a function of phonological voicing. Points indicate posterior medium with lines indicating 95% Bayesian credible interval. Right: pairwise correlations between estimated dialect voicing contrasts for each acoustic cue.