

Utilizing mediation to understand variable consonant lenition

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Consonant lenition is a much-studied phenomenon in historical linguistics, phonetics, and phonology. At least since the 19th century, two phonetic aspects of lenition received much attention: increased intensity and reduced duration (Bouavichith & Davidson, 2013; Honeybone, 2008; Katz, 2016; Lavoie, 2001). In formal treatments of lenition, increased sonority (associated with intensity in Parker, 2002) is often regarded as the key aspect of phonologized lenition (Smith, 2008; Szigetvári, 2008). However, current phonetic accounts do not regard either one as more fundamental. We utilize mediation analysis to see if one aspect mediates the effect of established lenition correlates (e.g. word frequency) on the other aspect. Complete mediation would imply that the mediating aspect is in some sense more fundamental to lenition than the other.

We used the Buckeye corpus and an alignment of words' CMU representation with their surface forms (Cohen Priva, 2015). We focused on variable processes affecting intervocalic obstruents (excluding /t,d/ for which phonologized lenition exists). Relative intensity was defined as the difference between each token's minimum intensity and the speaker's mean minimum intensity for that phoneme. This approach has better self-consistency than comparison to neighboring vowels ($r=.76$ vs. $r=.66$, $p<.0001$). We defined relative duration as the log ratio between token duration and speaker's mean duration for that phoneme. We then performed mediation analysis (Baron & Kenny, 1986) and piecewise structural equation modeling (Shipley, 2000), using speech rate, word frequency, contextual predictability, and following stress as the main predictors. Log distance from both word boundaries were used as controls (all standardized). Random intercepts included word, phoneme, speaker, and random slopes supported by the data.

Word frequency, fast speech, following stress, and distance from word end correlated with increased intensity. However, that effect was completely mediated by changes in duration: no variable predicted relative intensity when relative duration was controlled for. Furthermore, Bayesian model-comparisons (using LOO, Bürkner, 2018) explicitly showed that removing all direct influence of lenition predictors on intensity did not hurt the predictive power of the model. Conversely, a model with relative intensity mediating relative duration proved inadequate: all the correlates of lenition significantly affect relative duration even when intensity is controlled for. Figure 1 shows the comparison between the direct and indirect effects of the mediation using a sampling-based approach (Bürkner, 2018). For speech rate and syllable stress, no residual direct effect exists, but it may exist alongside an indirect effect for word frequency. Together this means that with the possible exception of word frequency, the causal relationship between the correlates of lenition and intensity is likely mediated via changes in duration.

The results are naturally compatible with lenition-as-undershoot accounts (Bauer, 2008), though effort-reduction (Kirchner, 1998) is also often driven by reduced duration. The mediation predicts that variable lenition would be absent in duration-increasing environments, and that it would always include reduced duration. Teleological lenition accounts (e.g. to mark prosodic non-boundary, Katz, 2016) could be modified to have short duration as the actual goal with increased intensity as a byproduct. Finally, duration has the advantage of being readily measurable (e.g. unlike articulatory undershoot or effort), which should facilitate future research of lenition. One auxiliary study further shows that all the processes which would be regarded as lenition in the Buckeye corpus involve significant reduction in duration. Another auxiliary study shows that the effect of information theoretic variables on vowel centralization is also indirect, and mediated by reduced vowel duration. In sum, we show that reduced duration is in some sense more fundamental to variable consonant lenition than increased intensity. Our results have since been replicated by Katz & Pitzanti (2019) in Campidanese Sardinian.

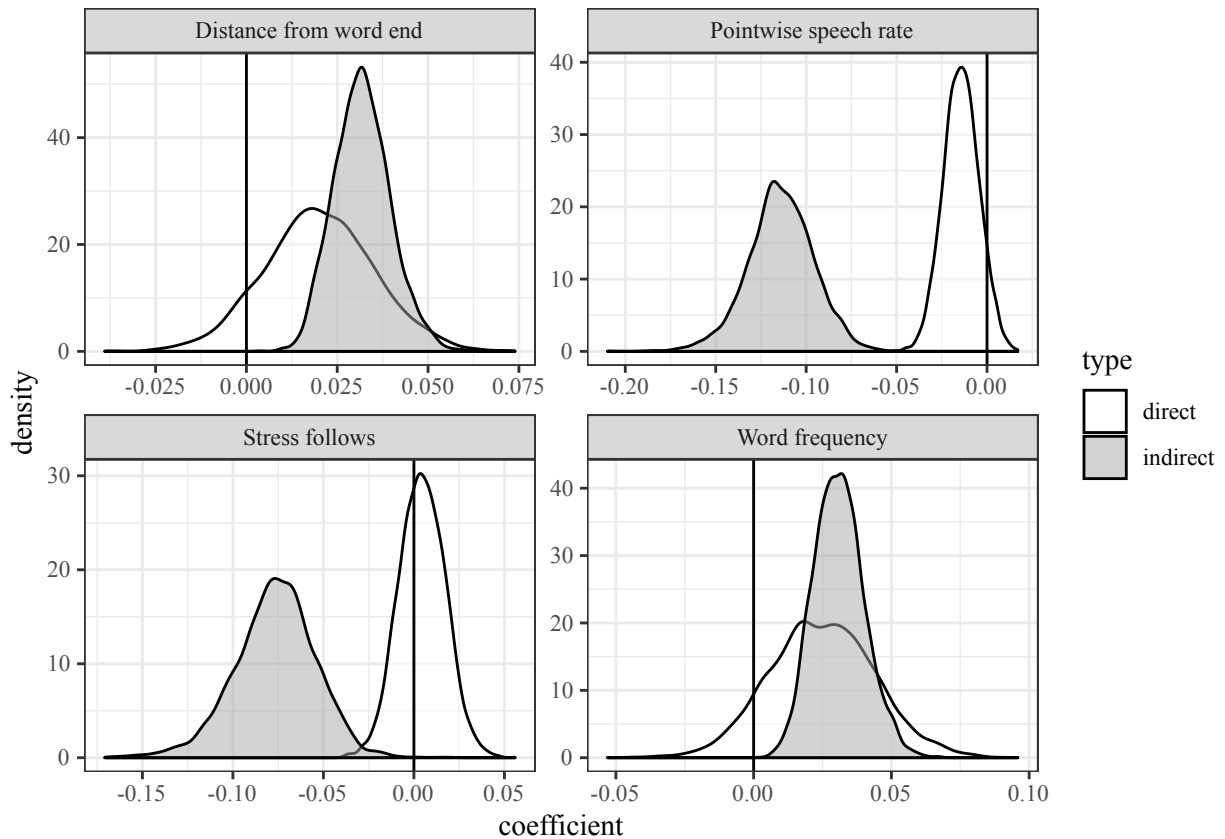


Figure 1: A comparison of the direct vs. indirect effect of distance from word’s end, speech rate, whether stress follows, and word frequency on consonant intensity. With the exception of word frequency, for which a non-significant (but still uncertain) effect may exist, it is evident that most of the effect of the correlates of consonant lenition on intensity are mediated by duration (in grey) and not direct (in white).

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