Reduction in duration as a cause for lenition
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Consonant lenition refers to a list of phonological processes grouped together by a tendency to occur in similar environments (e.g. intervocally), and under similar conditions (e.g. in faster speech). These processes typically include degemination, voicing, spirantization, approximantization, tapping, debuccalization, and deletion. It is fairly uncontroversial that lenited forms have shorter duration than their unlenited counterparts, everything else being equal (Lavoie, 2001). In contrast, different theories argue for different causal mechanisms that lead to lenition, including effort reduction (Kirchner, 1998), hypoarticulation (e.g. Bauer, 2008), and signaling prosodic boundaries (Kingston, 2008; Katz, 2016). Extending Katz (2016), we propose that durational reduction precedes and motivates the actuation of lenition processes. We show that the proposed account naturally accounts for the conditions that promote lenition and the absence of unobserved processes. Our argument is compatible with existing causal mechanisms for lenition.

Mechanistically, we propose two not mutually-exclusive pathways to lenition through durational reduction. In the phonetic pathway, shortening a segment beyond a certain degree leads to lenited articulation, or perception of lenited forms. Several previous accounts proposed that all lenition processes except debuccalization can be caused by insufficient time for a complete intended gesture, or by the misperception of shortened forms (Bauer, 2008; Westbury and Keating, 1986). In the goal-based pathway speakers opt (e.g. due to the relative ranking of constraints) for a shorter but perceptually similar (as in P-Map, Steriade, 2001) forms rather than the intended target (this is the approach proposed by Katz, 2016). Both pathways propose that reducing the duration of segments beyond a certain point makes them increasingly likely to lenite.

Our proposal predicts the established conditions for increased likelihood of lenition. Fast speech trivially leads to shorter durations. Low information has been shown by e.g. Aylett and Turk (2004) to lead to reduced duration. Casual speech is characterized by more variable pronunciation and speech rate. Study 1 used a mixed effect logistic regression on the Buckeye corpus (Pitt et al., 2007), controlling for word frequency, adjacency to stress, the phonological environment, and position within the word, to show that slow speech does not lead to fortition (null effect, p>.85), but fast speech does lead to lenition (p<10^{-15}).

Study 2 used a mixed-effects linear regression to show that established gaps in lenition typology involve durational lengthening or lack of shortening. Lenition of (a) stops to stridents and of (b) /ʔ/ to /h/ would involve lengthening (all p<10^{-15}), and are indeed typologically rare. (c) Voiced stops (/d/ and /b/) were not durationally longer than same-place nasals (p>.05, and /ɡ/ was only 5ms longer than /ŋ/), explaining why lenition to nasals is unlikely for voiced stops (voiceless stops arguably lenite to voiced stops and not nasals due to perceptual similarity).

Study 3 traced the duration of all frequent non-faithful outputs for segments. For each process we used a mixed effect linear regression controlling for the factors mentioned above to measure whether the processes changed the output’s duration. All detected lenition processes significantly entailed reduced duration. These results are exemplified in Figure 1. Negative values mean the duration of the surface form was shorter than the reference form. Error bars are two standard errors from the mean. Color and shape indicates the process type.
Study 4 shows that the prosodic environments in which American English taps coronal stops are duration-reducing for other stops as well (all p<10^{-15}), even in the absence of lenition. Katz (2016) and Kingston (2008) argue for prosodic-motivated lenition. We argue that prosodic factors cause reduction in duration, which in turn cause lenition.

Our proposal does not necessitate drawing a direct connection between low information and lenition, or the disputed reliance on effort estimations (see Kingston, 2008; Kaplan, 2010, for discussion), and neatly predicts the absence of a range of gaps in the typology of lenition processes. While we build on Katz (2016), our proposal predicts lenition patterns for additional types of lenition processes. Treating durational reduction as a causal factor leading to lenition is an appealing alternative to multiple other causal accounts.

References
Steriade, Donca. 2001. The phonology of perceptibility effects: the P-map and its consequences for constraint organization.