

## Is duration a causal factor of lenition? Evidence from Spanish

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Alongside other variables, reduced duration is thought to be one of the main lenition markers across the world's languages. Numerous quantitative studies to date have shown that processes of lenition are correlated with reduced segmental duration, as well as increased intensity, which can be associated with greater vowel-likeness and openness, especially in postvocalic and intervocalic positions (Lavoie 2001, Szigetvári 2008). Theories of lenition have built on these observations, pointing to the crucial characteristics of lenition: increasing the continuity of the speech stream by increasing the relative intensity of consonants with respect to the flanking vowels (Kingston 2008, Katz 2016), reduced effort-related gestural reduction (Kirchner 1998) and/or articulatory undershoot (Bauer 2008). At the same time, several extrinsic and prosodic factors have been associated with promoting lenition, the main contributors being fast speech, low information content and proximity to stress (Kirchner 2004, Gurevich 2011). It would be interesting to know whether these different factors and markers can be somehow disentangled.

In 2020, Cohen Priva & Gleason proposed that duration is primary to intensity changes and hence acts as a mediator between the extrinsic factors promoting lenition and the increased intensity of the segment in question (see Fig. 1B). Their mediation analysis based on the Buckeye corpus shows that once duration is controlled for, the influence of speech rate, information content and stress on intensity can no longer be confirmed. This relationship does not go the other way around, i.e. controlling for intensity in a model predicting duration does not change the statistical significance of the three primary factors, which means that those factors likely cause duration effects directly and intensity changes only indirectly.

The aim of this paper is to provide a replication of Cohen & Gleason's analysis based on a similarly-sized corpus from a different language. I built models for data gathered in the course of spontaneous speech of 44 native speakers of dialectal Spanish, analysing 13,688 underlying postvocalic stops which undergo different degrees of lenition involving voicing and approximantisation. The analysis shows that while the weakening of /p t k b d g/ involves both intensity and durational changes, showing expected patterns of differences between sound categories, the relationship between the two variables does not seem to be causal. In a model predicting intensity, controlling for the effect of duration does not cancel out the effects of stress or position in a word, suggesting that durational changes do not act as a mediator but rather as an end product and another factor involved in lenition on a par with increased intensity (Fig. 1A). In a model predicting duration, the same happens, i.e. no causal relation seems to ensue. Speech rate was only significant in models with duration while word status did not reach significance in any model (Table 1). Furthermore, the relationship between the two markers of lenition is as expected only in a subset of sounds. While we would expect greater sound intensity to correlate with decreased sound duration, this is not the case, and there is a discrepancy between surface approximants and voiced stops in this respect (Fig. 2). The study thus disconfirms the causal structure of lenition proposed for English as a universal lenition property, showing that different languages, and perhaps even different dialects may have different structural, functional and causal relations between the variables and acoustic correlates.

**References:** Cohen Priva, U. & Gleason, E. 2020. The causal structure of lenition: A case for the causal precedence of durational shortening. ☞ Bauer, L. 2008. Lenition revisited. ☞ Gurevich, N. 2011. Lenition. ☞ Harris, J. 2003. Grammar-internal and grammar-external assimilation. ☞ Katz, J. 2016. Lenition, perception and neutralisation. ☞ Kingston, J. 2008. Lenition. ☞ Kirchner, R. 1998. *An effort-based approach to consonant lenition*. ☞ Kirchner, R. 2004. Consonant lenition. ☞ Lavoie, L.M. 2001. *Consonant strength: Phonological patterns and phonetic manifestations*. ☞ Szigetvári, P. 2008. Two directions for lenition.

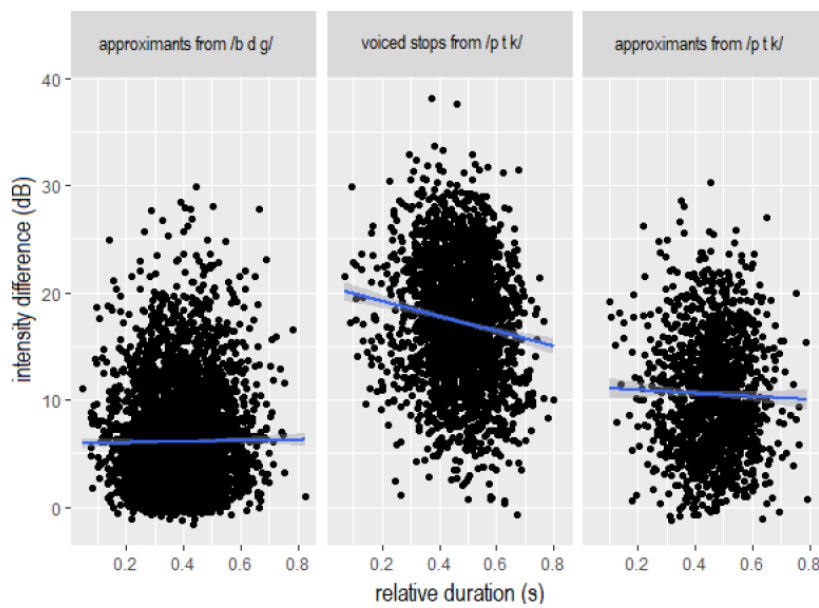
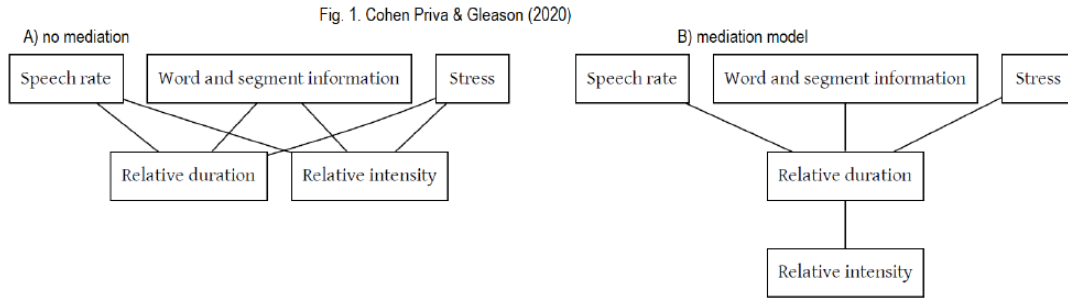


Fig. 2. Lack of a positive correlation between intensity difference and sound duration in approximants and an unexpected negative correlation in the case of voiced stops resulting from lenition. Intensity difference is measured as a difference between minimum sound intensity and the maximum intensity of the preceding vowel. The smaller the difference, the more lenited the sound. The data confirm that duration cannot be the causal factor of intensity changes and suggest that there are more factors involved.

Table 1. Summary of linear mixed models used in a mediation analysis replicated from Cohen Priva & Gleason (2020). The statistical analyses were conducted in R, with the *lmer* package.

Intensity models	Model without duration			Model with duration		
	<i>estimate</i>	<i>t value</i>	<i>p value</i>	<i>estimate</i>	<i>t value</i>	<i>p value</i>
spechrates	-0.04	-0.460	0.645	-0.033	-0.378	0.705
word_status:function_word	0.09	0.480	0.631	0.089	0.472	0.637
position:medial	-0.718	-5.986	<0.001	-0.691	-5.747	<0.001
stress:stressed	-0.431	-3.782	<0.001	-0.394	-3.457	<0.001
relative_duration				-2.344	-5.836	<0.001
Duration models	Model without intensity			Model with intensity		
	<i>estimate</i>	<i>t value</i>	<i>p value</i>	<i>estimate</i>	<i>t value</i>	<i>p value</i>
spechrates	0.003	2.142	0.0326	0.003	2.047	0.041
word_status:function_word	0.0005	0.149	0.8818	0.001	0.209	0.835
position:medial	0.012	4.749	<0.001	0.011	4.463	<0.001
stress:stressed	0.015	6.368	<0.001	0.015	6.179	<0.001
intensity difference				-0.001	-5.645	<0.001