Contrast preservation at the level of the individual: Evidence from Spanish plosive lenition
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Simultaneous lenitions within a natural class of consonants have been argued to occur to preserve the contrasts between sets of sounds, termed chain shifts [1]. Recent studies have shown quantitatively that the majority of lenitions do not result in neutralization [2] and that phonological contrasts with a high functional load are less likely to be lost [3]. Given that inter-speaker variation in the case of two phonologically contrastive series such as /ptk/ and /bdg/ is ubiquitous, a question that arises is how contrast preservation presents synchronically. That is, do speakers who lenite the stronger set in the chain more also lenite the weaker set in the chain more to maintain contrast between the sets in their own speech?

To answer this question, I examine the simultaneous lenition of intervocalic /ptk/ and /bdg/ in Modern Spanish as spoken in Lima and Cuzco, Peru and Valladolid, Spain. Modern Spanish exhibits both variable voicing and spirantization of intervocalic /ptk/ and variable constriction weakening and deletion of intervocalic /bdg/ (typically realized as approximants [βðɣ] intervocally), but to differing degrees in different dialects, and with variation between speakers of the same dialect [c.f. 4-8]. It has been observed that the simultaneous lenition of both sets allows voiced spirantized /ptk/ to remain distinct from approximant /bdg/ in terms of constriction degree as measured by intensity difference with the following vowel [4], but individual variation in the realization of this contrast has not been examined. Previous qualitative studies have found that Lima Spanish participates in both lenitions, while Cuzco Spanish has unstressed vowel devoicing, which should be inconsistent with a large degree of intervocalic /ptk/ voicing [9-11], with Peninsular Spanish possibly at an intermediate stage. These dialects should thus provide variation across a wide spectrum in the lenition processes. I hypothesize that speakers with more /ptk/ voicing, having a diminished difference in voicing between the two sets of consonants, will also have more /bdg/ constriction weakening to maintain contrast between the sets in terms of constriction degree.

To test this hypothesis, 38 speakers (8 Lima, 30 Cuzco; balanced for gender) participated in a read speech task and informal interviews, and data from 18 untrained Speakers in Valladolid were taken from the Glissando Spanish task-dialogue subcorpus. A total of 5284 intervocalic plosives were analyzed (Cuzco: 1459 /bdg/, 1415 /ptk/; Lima: 442 /bdg/, 421 /ptk/; Valladolid: 799 /bdg/, 748 /ptk/). Boundaries were placed at the beginning and end of the VCV sequence, with additional boundaries placed to contain the minimum intensity of the consonant in Praat. If no evidence of a consonant was present (no cessation of voicing and no dip in the intensity contour during the VCV sequence), the token was classified as elided. For non-elided tokens, a Praat script written by the author extracted the intensity difference between the minimum in the consonant and maximum in the following vowel, and the duration of the voiceless period if present using pitch point gap detection [c.f. 11] in the VCV sequence. For elided tokens of /bdg/, both variables were set to zero.

Linear mixed effects regressions were run on the voiceless period duration and intensity difference of /ptk/ and the intensity difference of /bdg/ for each city separately. Place of articulation, stress, preceding vowel, following vowel, and gender were included as fixed effects in all regressions; for Lima and Cuzco, style was also included since the participants participated in two tasks; and for Cuzco, age group (over 40 vs. 40 and under), education level (university vs. no university) and bilingualism (Spanish monolingual vs. Spanish-dominant Quechua bilingual) were additionally included, as the Cuzco data comes from a more diverse sample collected for a separate sociolinguistic study. The maximal random effects structure for speaker supported by the data was included in each case. Estimates for the mean voiceless period duration and intensity difference for /p/, /t/ and /k/ and the mean intensity difference for /b/, /d/ and /g/ in three different stress conditions (before a stressed vowel, after a stressed vowel, or between two unstressed vowels) for each speaker were extracted from the models. A generalized additive model was then run on the /bdg/ intensity difference estimates with splines for /ptk/ voiceless period duration and intensity difference fit for each combination of place of articulation and stress (that is, /p/ before a stressed vowel was compared to /b/ before a stressed vowel, etc.). If contrast preservation plays a role at the level of the individual, the splines should show significant positive trends.
Examination of the point estimates reveals that, considered as groups, Cuzco speakers lenited both /ptk/ and /bdg/ the least, Lima speakers lenited both sets the most, and Valladolid speakers occupy an intermediate stage. At the individual level, the spline for /ptk/ voiceless period duration was significant (p<.001) with positive trends for all combinations of place of articulation and stress (Figure 1). The estimates for /ptk/ intensity difference were (expectedly) highly correlated with the voiceless period duration estimates, and so did not contribute anything to the model beyond the contribution of the voiceless period duration. The splines for /ptk/ voiceless period duration account for 57.9% of the deviance in the /bdg/ intensity difference estimates (Adjusted R-squared 0.557). These results confirm that speakers who voice /ptk/ more (and therefore have a smaller /ptk/ intensity difference) also weaken the constriction of /bdg/ more relative to other speakers. This study thus provides evidence that contrast preservation plays a role in the realization of phonological contrasts undergoing simultaneous lenition at the level of the individual.

Figure 1. GAM splines for /ptk/ voiceless period duration predicting /bdg/ intensity difference. All cities are analyzed together, and each point represents estimates for one speaker.