Cross-linguistic perception of subphonemic stop contrasts – phonology beats phonetics

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Literature suggests that native speakers are usually sensitive only to the contrasts they are exposed to [1] and that are systemic [2]. Nonetheless, there are studies that show native speaker sensitivity to some subphonemic differences (e.g., underlying voicing in Polish or German, [3, 4]. Thus, even very small contrasts have a potential to be perceived by users. We do not know, however, to what extent they are perceptually salient for speakers of other dialects and languages.

The aim of this paper is to provide a cross-linguistic comparison of perceptual responses to changes in obstruent constriction, based on the example of Spanish stops. Recently, [5] showed that Canarian Spanish distinguishes as many as 6 systematically produced variants of stops given that /p t k/ are variably voiced or approximantised, while /b d g/ are approximantised or deleted intervocalically, and this weakening pattern interacts with preceding segment deletion. To see whether the variants confirmed in production are salient enough to be reliably distinguished in perception, we tested these contrasts on 4 groups of participants: Canarians (n=33), Peninsular Spaniards (n=29), Poles (n=29) and Germans (n=19). Peninsular Spanish has fewer variants than Canarian given the lack of systematic /p t k/ weakening, which is equivalent to maintaining a systematic voicing contrast in stops expected to be confirmed in perception. Like Spanish, Polish is a true voice language attending to the feature [voice], hence voiced contrasts should be easily perceived. By contrast, German is an aspirating language which uses [spread glottis], thus we expected Germans to struggle with the perception of [voice]. Both German and Polish lack non-spirant approximants but use the feature [continuant] to contrast stops with fricatives. We expected that they would exploit this in the perception of Spanish approximants. The study consisted of 1) **a speeded forced-choice AX task** with disyllabic stimuli presented with a short ISI (300ms) aimed at tapping into acoustic perception and 2) **an AXB task** using trisyllabic stimuli with a longer (1 sec) ISI focused on phonological categorization. 5 variants of obstruents were tested: voiceless [p], partially voiced [b̥], fully voiced [b], closed approximant [β] and open approximant [β˞], which gave us 10 pairs of sound contrasts embedded in pseudowords: [gapa], [repe], [supu] (AX task), and [lapafa], [depeha], [nupula] (AXB task). 5 surface variants of each word were produced by eliciting sounds in analogous phonetic contexts and splicing them into the target words.

The results of the AX task indicate that contrasts are recognized by participants based on phonological categories, while allophonic distinctions and minor phonetic details are treated as intra-category. Spaniards had serious difficulties with most of the tested contrasts, while Poles and Germans, who can interpret some of them based on native phonemic differences, fared statistically better: approximants were probably reinterpreted as /v/, which is a separate phoneme in Polish and German as opposed to Spanish; Poles were also above chance in voicing contrasts, as opposed to Germans (33% accuracy). Moreover, in most cases it takes a difference of more than one phonological feature for sounds to be reliably distinguished. Furthermore, we found confirmation that the /p/ - /b/ contrast is in decline in the Canary Islands: Canarians recognized it at random (50%) while other Spaniards at a 67% accuracy level. **In the AXB task**, all participants did much better, except for Germans in their perception of stop voicing. We also see a general tendency for all Spaniards to be worse than Poles and Germans in discriminating between stops and approximants (80% vs. 90% accuracy, < 2 vs. > 2 in d'). However, Canarians are the only group that treats the voiceless-partially voiced contrast differently than voiceless-voiced, which is in line with the production data. Since both variants are variably produced in the same contexts in the dialect, they are associated with different perceptual sensitivities. For other Spaniards, by contrast, partial voicing was perceived the same as full voicing throughout the consonant. **Finally**, Canarians responded systematically faster than all other groups by an average of 300-500ms. Thus, despite comparable accuracy, they were significantly more confident in their answers compared to others. **All in all**, the study shows that although some phonetic sensitivity to consonantal contrasts is observed in perception in native speakers, there is no evidence for (near-)categoricity. Also, native phonological categories prevail in non-natives in guiding both acoustic perception and categorization.

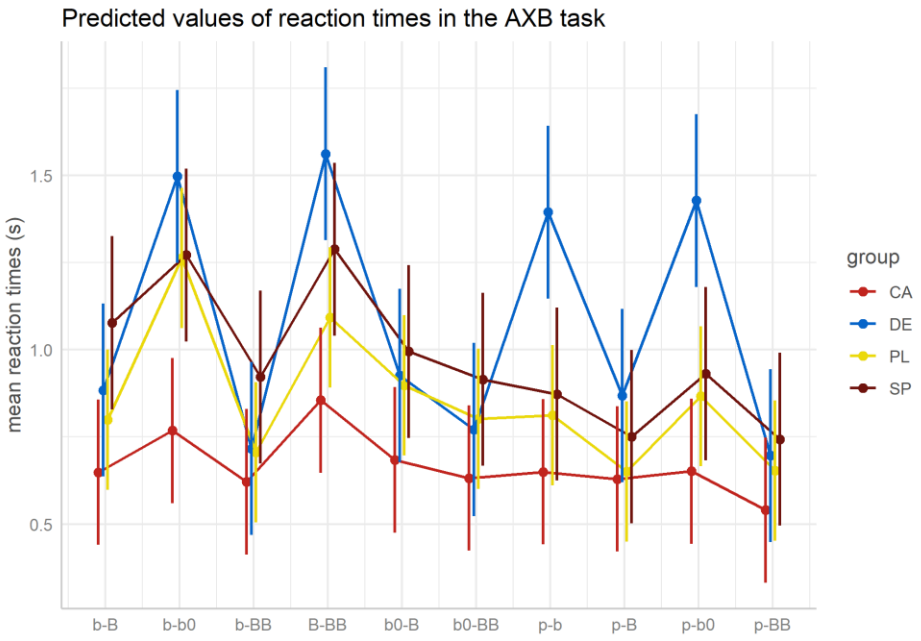
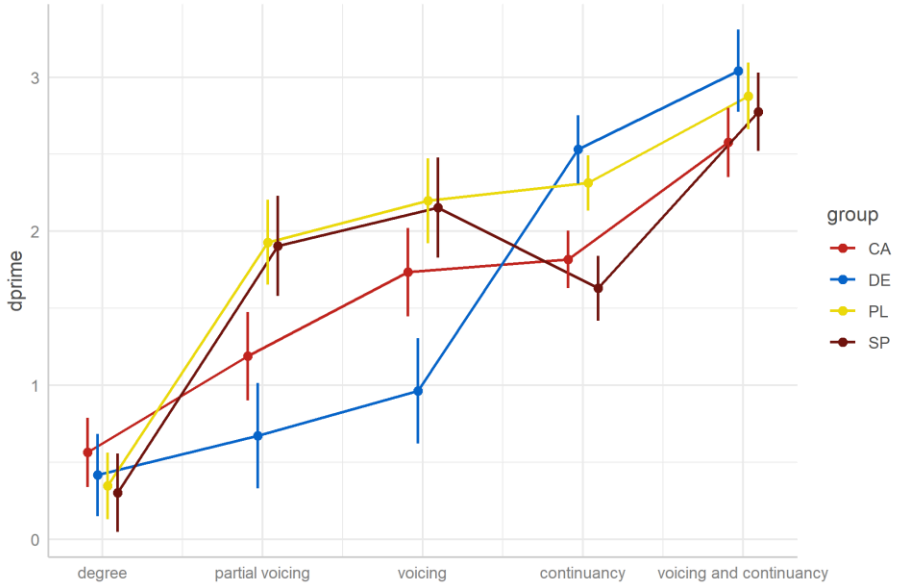


Fig. 1. Reaction times in the AXB task. Values calculated from a linear mixed effects model run on the data, based on *emmeans* for the interaction between contrast type and group. Here, [b̥] is coded as b0, [β] is coded as B, and [β̥] is coded as BB.

Fig. 2.
Predicted values of sensitivity (*dprime*) in the AXB task by contrast type. Here, we reduced the number of categories. "Degree" marks [b] – [b̥] and [β] - [β̥] put together as no reliable differences were observed here. Note that contrasts which included both voicing and continuancy yielded near ceiling sensitivity in all groups (~ 3).



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