Balanced Spanish-Basque bilinguals produce language-specific voice onset time in prevoiced plosives

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Bilinguals either merge [1] or separate [2] voicing categories during speech production in their two languages. Voice onset time (VOT) is a primary cue to voicing that distinguishes 'voiced' from 'voiceless' plosives [3]. Languages with this kind of two-way distinction either use prevoicing (negative VOT) or aspiration (long lag VOT) to mark 'voiced' and 'voiceless' categories, respectively. However, most of the research has examined bilinguals with different L1-L2 voicing system combinations [2; 4] (L1 prevocing versus L2 aspiration languages, or vice versa), since in this scenario 'voiceless' plosives in prevoicing languages and 'voiced' plosives in aspiration languages overlap acoustically. Nevertheless, languages with the same voicing system can also differ in VOT [3]. The same is true even for dialects of the same language [5], meaning that speakers fine-tune their voicing systems to their languages' specific VOT. Testing bilinguals with similar voicing systems could bring new insights into this kind of fine-grained language-specific tuning of their voicing systems.

The aim of this study was to investigate differences in VOT production in Spanish (S) and Basque (B), both of which use the presence versus absence of prevoicing as a primary cue to voicing. Specifically, we aimed at investigating whether differences in bilingual experiences lead to different VOT production of word-initial plosives in both languages.

Twenty Spanish-Basque bilinguals (M_{age} = 23.9 years; SD = 4.59; range = 19–34 years) with different combinations of language of dominance (LDS, LDB) and language most exposed to (ExpS, ExpB) participated in two picture naming tasks (one per language). All Spanish-Basque bilinguals were highly proficient in Spanish, and they were also highly proficient in Basque, which they acquired before the age of 2. It should be noted that all LDS bilinguals were more exposed to Spanish than to Basque.

Sixty target words were chosen for each language, all of them plosive-vowel initial (10 target words for each of the plosives under study: /b/, /d/, /g/, /p/, /t/, /k/), mostly disyllabic, and matched for vowel height. Seventy-four pictures were used from the MultiPic database [6], and forty-six were found and/or created by us. The language of the task was used as the language of interaction with the participants, since the language of interaction has been shown to affect VOT production and trigger monolingual-like VOT [2].

Data were analyzed using linear mixed effects models [7] in R [8]. Analyses revealed that all Spanish-Basque bilinguals merged their 'voiceless' plosive categories in production (Figure 1), but produced language-specific VOT for 'voiced' plosives (Figure 2). Both LDB-ExpB bilinguals (n = 7, β = -9.66, t = -3.94, p < .001) and LDB-ExpS bilinguals (n = 7, β = -15.26, t = -6.09, p < .0001) produced distinct VOT for 'voiced' plosives in each language, with longer durations of prevoicing in Spanish than Basque. This was not the case for LDS bilinguals (n = 6, β = 0.07, t = 0.03, ns), whose productions in Spanish and Basque 'voiced' plosives were similar. Further analyses revealed that LDB-ExpB bilinguals produced significantly different VOT for 'voiced' plosives in each language compared to LDS-ExpS bilinguals (β = -9.73, t = -3.12, p < .001), producing longer durations of prevoicing in Spanish. This was also true for the LDB-ExpS bilinguals compared to the LDS-ExpS bilinguals (β = -15.33, t = -4.69, p < .0001). Finally, LDB-ExpB and LDB-ExpS bilinguals did not significantly differ in language-specific VOT production for 'voiced' plosives (β = 5.6, t = 1.97, ns), although LDB-ExpS bilinguals produced numerically longer durations of prevoicing in Spanish.

These results indicate that bilinguals can produce language-specific VOT of 'voiced' categories, when both L1 and L2 are prevoicing languages. To our knowledge, this is the first study showing this kind of differentiation in 'voiced' plosives. Moreover, bilinguals with early exposure to two languages seem to maintain the ability to separate their L1 and L2 later in their life: This ability however, seems to be mediated by the higher exposure to bilinguals' L2 than L1.

References
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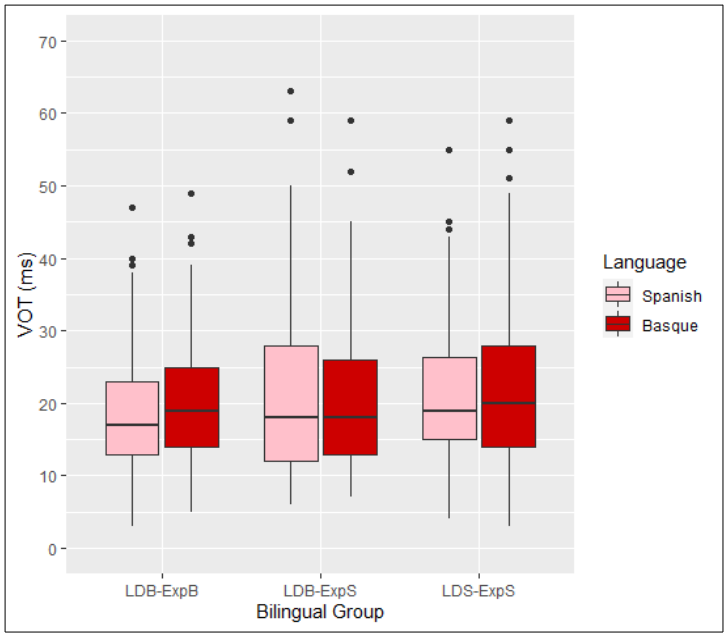

Figure 1. VOT measurements for 'voiceless' plosives by Language and by Bilingual Group.

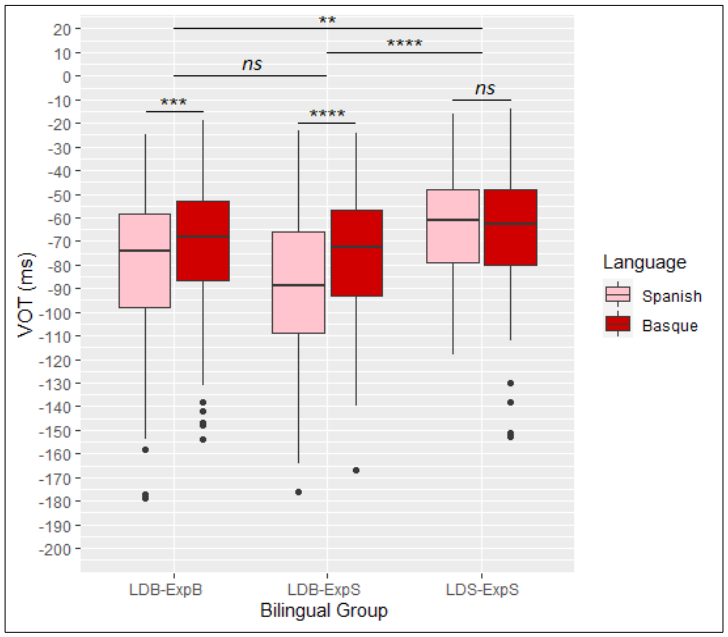

Figure 2. VOT measurements for 'voiced' plosives by Language and by Bilingual Group.