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SHORT AND SWEET

Familiarity, expertise, and change detection: Change deafness is worse in your native language

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Abstract. We first replicated the language-familiarity effect for voice discrimination and found better voice discrimination in familiar languages. However, when listeners were not cued to listen for changes, both English and Spanish speakers exhibited greater change deafness in their familiar language. Results suggest that lexical/semantic attention in a familiar language and increased indexical processing in an unfamiliar language can produce greater change deafness in familiar languages.

Keywords: change deafness, language familiarity effect, expertise

A classic example of change deafness occurs when listeners fail to notice that one voice has been replaced with another (Vitevitch, 2003). As voices become more dissimilar, listeners are more sensitive to such changes. For example, a change from a male to a female voice is detected more often than a same-sex change (Fenn et al., 2011). Thus, increased sensitivity to stimulus differences reduces the incidence of change deafness (Gregg & Samuel, 2008; Gregg & Snyder, 2012).

The *language-familiarity effect* shows that listeners are more sensitive to voice differences in a familiar language because they can use both linguistic and paralinguistic information to discriminate between voices (Goggin, Thompson, Strube, & Simental, 1991; Levi & Schwartz, 2013; Perrachione, Pierrehumbert, & Wong, 2009; Winters, Levi, & Pisoni, 2008). Thus, the language-familiarity effect predicts greater change deafness in an unfamiliar language where linguistic information is unavailable.

However, this prediction is at odds with previous change deafness work using stimuli with a lexical/semantic component. When attention to the lexical/semantic component of speech competes with attention to the indexical characteristics of the voice, change deafness increases (Mullennix & Pisoni, 1990; Rama, Relander-Syrjanen, Carlson, Salonen, & Kujala, 2012; Vitevitch, 2003). In other words, 'listening to the message' can interfere with 'attending to the voice'. In an unfamiliar language, listeners cannot process lexical/semantic information and are able to focus on only indexical voice characteristics. They may also spend more time trying to process the unfamiliar speech, which allows more thorough processing of indexical information (McLennan & Luce, 2005; Vitevitch & Donoso, 2011). These processes would predict greater change deafness in a familiar language. Here we tested these competing predictions.

We recorded two English/Spanish bilingual women reading the same passage in both English and Spanish (see supplementary online material at http://dx.doi.org/10.1068/p7665 for details). The recordings were then edited yielding two English and two Spanish versions of 'part 1' and 'part 2' of the passage. Native English speakers and native Spanish speakers were instructed to listen to the story in either English or Spanish and count the number of breaths taken by the talker. At the halfway point listeners reported the number of breaths counted. The story then resumed in the same language, and listeners continued counting breaths. However, part 2 of

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the story was completed by a different talker (see figure 1a). Listeners reported the number of breaths in part 2 and were then asked three standard change deafness questions (Vitevitch, 2003): (1) "Did you notice anything unusual about the experiment?" (2) "Was the first half of the experiment the same as the second half of the experiment?" (3) "Was the voice in the first half of the experiment the same voice in the second half of the experiment?" Question 3 responses were used as the unit of analysis.

Prior to the experiment we ran a discrimination study to ensure that listeners could tell the difference between the two voices when directed to listen for a change. We asked eighty native English and eighty native Spanish listeners (none from the current study) to make same/different judgments about four pairs of single sentences from the recordings in English or Spanish from the two bilingual women. We found that the two voices were highly discriminable with $d' = 2.5$. Hit rates were subjected to a 2×2 between-subjects ANOVA. No main effects were significant. However, the significant interaction between speech language and participant language confirmed the language-familiarity effect ($F_{1,156} = 9.19$, $p = 0.003$, $\eta_p^2 = 0.19$). Native Spanish listeners showed significantly better discrimination in Spanish, and native English listeners showed significantly better discrimination in English (see table 1).

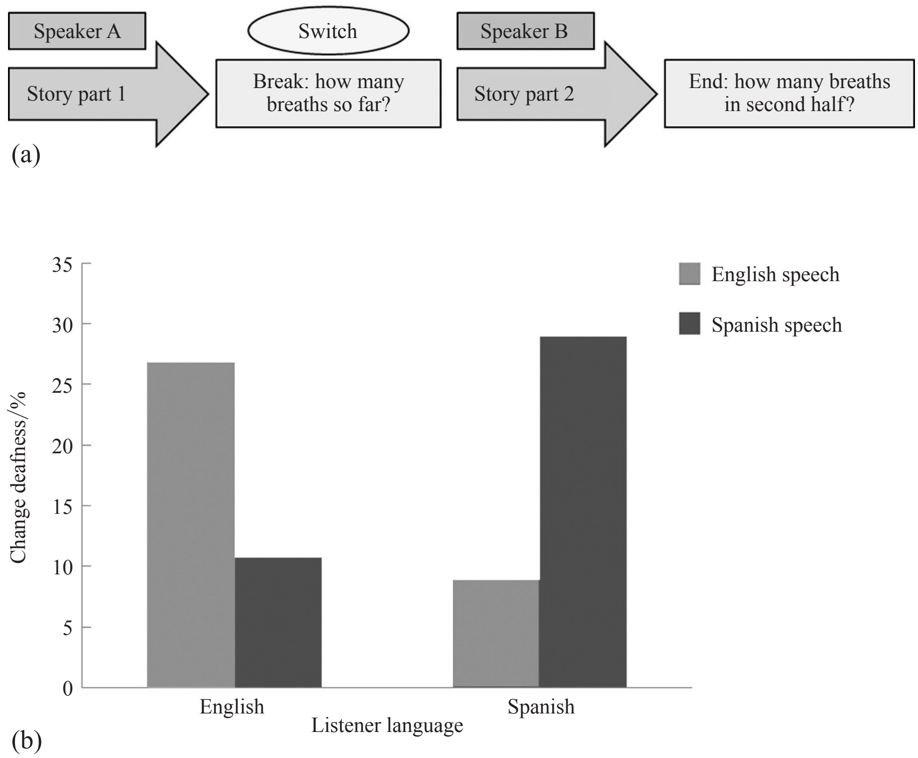

Figure 1. (a) Sequence of story, talker switch, and breath count reports. Order of speakers A and B was counterbalanced across participants. (b) Percentage of participants exhibiting change deafness. Native English ($N = 112$) and native Spanish speakers ($N = 90$) both exhibit significantly greater native language change deafness.

However, despite better voice discrimination in a familiar language, participants demonstrated better voice change detection in an *unfamiliar* language. In an analysis of the voice change question, only 8.9% of our Spanish-speaking participants failed to detect a talker change when listening to English, while 28.9% failed to detect a change when listening to Spanish ($\chi^2 = 4.64$, $p = 0.031$, Yates correction). Similarly, only 10.7% of our

Table 1. Mean (SD) hit rates, a posteriori *t*-tests, and effect sizes (*d*) for Spanish/English speech heard by Spanish/English listeners in the discrimination task.

	Spanish speech	English speech	*t*	df	*p*	*d*
Spanish listener	0.95 (0.15)	0.83 (0.31)	2.28	78	0.025	0.49
English listener	0.81 (0.33)	0.94 (0.20)	2.03	78	0.046	0.47

English-speaking participants failed to detect a talker change when listening to Spanish, yet 26.8% failed to detect a change when listening to English, ($\chi^2 = 4.75$, $p = 0.029$) (see figure 1b). There were no significant differences in the number of breaths counted. These findings demonstrate a 'price of expertise' whereby experts in a language exhibit greater change deafness than novices. Expertise effects have also been found in inattentional blindness studies where expert radiologists failed to detect a gorilla superimposed on a CT scan, though unlike the present study, novices did not outperform experts (Drew, Vo, & Wolfe, 2013).

Attention to lexical/semantic speech information is automatic and occurs even when it is not required of the task at hand (Connolly, Stewart, & Phillips, 1990; Parmentier, 2008). However, lexical/semantic processing also competes for attentional resources that would otherwise be available for indexical change detection (Vitevitch, 2003). Our results suggest that attention to lexical/semantic information can override the language-familiarity effect when listeners are not cued to listen for changes, resulting in greater change deafness in familiar languages.

More broadly, our results provide some insight about the role of expertise in change detection and the allocation of attention during an automatic process. The attentional processes invoked by experts and novices differentially influence change detection. In this case, expertise allows access to linguistic information and reduces the likelihood of detecting an indexical change. It may be fruitful to examine whether a similar interaction of expertise and attention occur in other auditory domains (eg music, earwitness identification) or in similar visual domains.

References

Connolly, J. F., Stewart, S. H., Phillips, N. A. (1990). The effects of processing requirements on neurophysiological responses to spoken sentences. *Brain and Language*, **39**, 302–318.

Drew, T., Vo, M. L. H., Wolfe, J. M. (2013). The invisible gorilla strikes again: Sustained inattentional blindness in expert observers. *Psychological Science*, **24**, 1848–1853.

Fenn, K. M., Shintel, H., Atkins, A. S., Skipper, J. I., Bond, V. C., Nusbaum, H. C. (2011). When less is heard than meets the ear: Change deafness in a telephone conversation. *Quarterly Journal of Experimental Psychology*, **64**, 1442–1456.

Goggin, J. P., Thompson, C. P., Strube, G., Simental, L. R. (1991). The role of language familiarity in voice identification. *Memory & Cognition*, **19**, 448–458.

Gregg, M. K., Samuel, A. G. (2008). Change deafness and the organizational properties of sounds. *Journal of Experimental Psychology: Human Perception and Performance*, **34**, 974–991.

Gregg, M. K., Snyder, J. S. (2012). Enhanced sensory processing accompanies successful detection of change for real-world sounds. *NeuroImage*, **62**, 113–119.

Levi, S. V., Schwartz, R. G. (2013). The development of language-specific and language-independent talker processing. *Journal of Speech, Language, and Hearing Research*, **56**, 913–920.

McLennan, C. T., Luce, P. A. (2005). Examining the time course of indexical specificity effects in spoken word recognition. *Journal of Experimental Psychology: Learning Memory and Cognition*, **31**, 306–321.

Mullennix, J. W., Pisoni, D. B. (1990). Stimulus variability and processing dependencies in speech perception. *Perception & Psychophysics*, **47**, 379–390.

Parmentier, F. B. R. (2008). Towards a cognitive model of distraction by auditory novelty: The role of involuntary attention capture and semantic processing. *Cognition*, **109**, 345–362.

Perrachione, T. K., Pierrehumbert, J. B., Wong, P. C. M. (2009). Differential neural contributions to native- and foreign-language talker identification. *Journal of Experimental Psychology: Human Perception and Performance*, **35**, 1950–1960.

Rama, P., Relander-Syrjanen, K., Carlson, S., Salonen, O., Kujala, T. (2012). Attention and semantic processing during speech: An fMRI study. *Brain & Language*, **122**, 114–119.

Vitevitch, M. S. (2003). Change deafness: The inability to detect changes between two voices. *Journal of Experimental Psychology: Human Perception and Performance*, **29**, 333–342.

Vitevitch, M. S., Donoso, A. (2011). Processing of indexical information requires time: Evidence from change deafness. *Quarterly Journal of Experimental Psychology*, **64**, 1484–1493.

Winters, S. J., Levi, S. V., Pisoni, D. B. (2008). Identification and discrimination of bilingual talkers across languages. *Journal of the Acoustical Society of America*, **123**, 4524–4538.