

## Sensitivity to pitch contrasts in second language perception and storage

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Pitch contrasts carry different linguistic functions across languages (e.g. a lexical function in Japanese, while a post-lexical or paralinguistic function in German). The present study explores whether the notion of non-lexical intonational pitch contrasts in one's first language (= L1) is helpful in discriminating second language (= L2) lexical pitch contrasts.

48 German L2 learners of Japanese, 24 German non-learners and 24 Japanese L1 listeners participated in a speeded AX task with short and long inter-stimulus intervals (= ISIs, 300 ms. vs. 2500 ms) to discriminate pitch contrasts (flat vs. falling pitch). Following the theory of working memory (Baddeley and Hitch, 1974; Baddeley *et al.*, 1998), the task condition with short ISIs tested speech perception without necessarily requiring participants to access mental representations, because the acoustic correlates of stimuli were still available to them. The task with long ISIs, on the contrary, required the accessing of mental representations, as acoustic information had already decayed and was no longer accessible. The following outcomes were predicted: 1) If an L2 prosodic category can be assimilated to a category of listeners' L1 prosodic system across different linguistic levels (So, 2010; So and Best, 2011, 2014), Japanese and German listeners' performance should not differ in either ISI conditions, because German listeners are familiar with pitch contrasts in their L1 intonation system. 2) If it is crucial that a prosodic cue exhibits a linguistically meaningful contrast at the same linguistic level in one's L1 and L2 (Wayland and Guion, 2004) and therefore a non-native prosodic category cannot be assimilated to a specific category in the listeners' L1 across different linguistic levels, German listeners' performance should decrease in the long ISI condition compared the short ISI condition. In the short ISI condition, they could still perceptually rely on the acoustic correlates of the stimulus contrast and discriminate a contrast correctly. 3) Finally, it may also be that German and Japanese listeners' performance will already differ in the short ISI condition, because listeners whose L1 uses  $F_0$  lexically established sensitivity to pitch contrasts by associating lexical meaning with pitch, which presumably leads to generally better pitch processing (cf. Deutsch *et al.*, 2006; Pfordresher and Brown, 2009) than the listeners whose L1 does not use  $F_0$  lexically, but instead post-lexically or only paralinguistically. Participants' sensitivity to the contrasts ( $d'$  scores, Macmillan and Creelman, 2005) and their reaction times were analysed.

The analysis with linear mixed effects regression models (LMER) showed a significant main effect of language group both for  $d'$  scores (the  $d'$  scores of Japanese listeners were higher than those of learners,  $\beta = 0.86$ ,  $SE = 0.28$ ,  $t = 3.1$ ,  $p < 0.001$ , followed by those of non-learners,  $\beta = 1.24$ ,  $SE = 0.32$ ,  $t = 3.9$ ,  $p < 0.001$ : the latter two groups did not differ from each other,  $\beta = -0.38$ ,  $SE = 0.27$ ,  $t = -1.4$ ,  $p = 0.16$ ) as well as for RTs (Japanese listeners' RTs were shorter than those of non-learners,  $\beta = -152.0$ ,  $SE = 57.4$ ,  $t = -2.6$ ,  $p < 0.01$ , followed by those of learners,  $\beta = -340.0$ ,  $SE = 50.0$ ,  $t = -6.8$ ,  $p < 0.001$  and finally non-learners' RTs were shorter than those of learners,  $\beta = -187.8$ ,  $SE = 48.5$ ,  $t = -3.9$ ,  $p < 0.001$ ). Visual analysis using CI bars also confirmed the result of LMER.

Japanese L1 listeners displayed higher discrimination performance than the L2 listener groups regardless of ISI conditions, confirming higher sensitivity to pitch contrasts for listeners whose L1 exhibits  $F_0$  lexically than for those whom their L1 does not. The phonological representations of pitch contrasts in the German intonational system apparently did not help German participants achieve sensitivity to the contrasts as high as the one that of Japanese listeners. Combined with my previous work (Asano, 2014), I further argue that the performance difference found in the short ISI condition is evidence that the short ISI did not necessarily prevent listeners from accessing their stored phonological representations. Instead, listeners already involve the representations in the

short ISI condition to aid effective speech processing (Wayland and Guion, 2004). Phonological representations were co-activated with the acoustic correlates of the stimuli in the short ISI condition (Darcy *et al.*, 2012), proposing that no strict dichotomous separation may exist between phonetic and phonological processing.

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