

## Do changes in shadowing predict those in subsequent productions?

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Speakers converge to model speech they have just heard. For instance, English speakers spontaneously imitate extended voice onset time (VOT) of voiceless stops both in shadowing (i.e., immediate repetition of target words) (e.g., Shockley et al. 2004) and in delayed imitation (e.g., Nielsen 2011). Kwon (2019) claims that phonology of the language mediates the imitative changes. Seoul Korean speakers in Kwon (2019), in delayed productions after shadowing aspirated stops with either high post-stop fundamental frequency (f<sub>0</sub>) or long stop VOT, produced aspirated stops with higher post-stop f<sub>0</sub>, arguably because post-stop high f<sub>0</sub> is the primary cue and VOT is a secondary cue for differentiating aspirated stops from stops of other laryngeal categories (e.g., Silva 2006).

This study examines if the phonological structure mediates the relation between patterns of convergence (or divergence) during shadowing and post-shadowing productions, in two spontaneous imitation experiments. Experiment 1 determines whether an individual speaker who converges to, or diverges from, a model talker during shadowing retains the altered productions in her post-shadowing productions. Experiment 2 investigates the influence of the phonological structure on the relation between shadowing and post-shadowing productions along specific acoustic properties.

**Experiment 1.** Fourteen native speakers of American English (7F/7M) (1) read English words beginning with /t/ (baseline), (2) heard and shadowed the words (shadowing), and (3) read the words again (post-shadowing). All blocks included filler words. The model speech that the participants were exposed to during shadowing had the VOT of the word-initial /t/ extended.

VOT of the participants' own /t/ productions in baseline, shadowing, and post-shadowing productions was measured. To assess whether the participant converged to the model speech, and if so, to what extent, the VOT measurements were converted to difference-in-distance (DID) scores:  $DID = |\text{baseline} - \text{model}| - |\text{shadowing/post-shadowing} - \text{model}|$  (e.g., Pardo et al. 2017). Greater DID indicates greater convergence, i.e., a greater decrease in the distance between the model speech and the participants' own production after being exposed to the model speech.

To statistically evaluate the relation between the shadowing and the subsequent productions, a linear mixed effects model was built with the post-shadowing DID as the dependent variable and shadowing DID as the predictor. Random-effects included by-speaker and by-word random intercepts. The results reveal that shadowing DID is indeed a significant predictor of post-shadowing DID [ $\beta = 0.449$ ,  $t = 6.578$ ,  $p < .001$ , Fig. 1], suggesting that the perceptually induced changes during shadowing persisted to the post-shadowing productions in which there are no immediate targets to imitate.

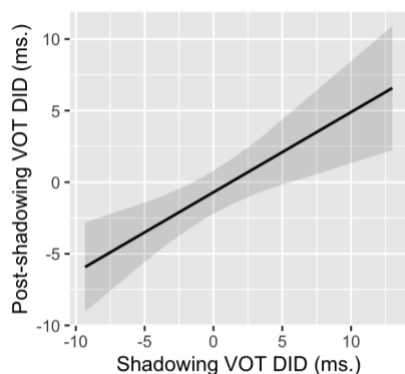
**Experiment 2.** Experiment 2 examines spontaneous imitation of Korean aspirated stop /t<sub>h</sub>/ by Seoul Korean speakers, employing a parallel design to Experiment 1. Nineteen native speakers of Seoul Korean (12F/7M) were tested in two separate sessions, using the model speech containing Korean words beginning with /t<sub>h</sub>/. Each session involved the model speech with one of the two acoustic manipulations, namely, raised post-/t<sub>h</sub>/ f<sub>0</sub> or extended /t<sub>h</sub>/ VOT. The two acoustic properties, VOT and post-/t<sub>h</sub>/ f<sub>0</sub>, of the participants' own /t<sub>h</sub>/ productions in baseline, shadowing, and post-shadowing productions were measured, and DID scores were separately calculated for each acoustic property.

Separate linear mixed effects models were fitted to post-shadowing VOT DID and f<sub>0</sub> DID, to determine whether a speaker's shadowing DID of a specific acoustic property predicts her post-shadowing DID. The predictors were shadowing DID of the same acoustic property as the dependent variable and the

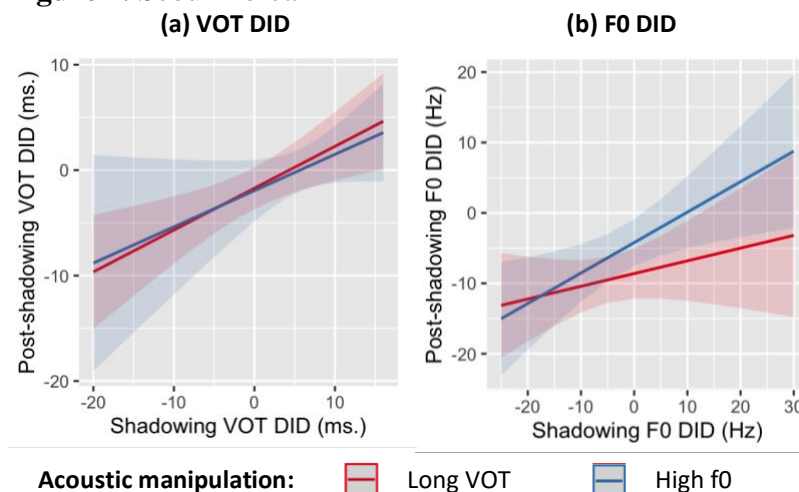
manipulation condition (Long VOT vs. High f0). The results indicate that shadowing DID predicts post-shadowing DID only when the model speech has the same acoustic property enhanced (See Fig.2). That is, shadowing VOT DID is significantly correlated with post-shadowing VOT DID in the long VOT condition [ $\beta = 0.397$ ,  $t = 3.064$ ,  $p = .004$ ], but not in the high f0 condition [ $\beta = 0.344$ ,  $t = 1.703$ ,  $p = .098$ ]. On the other hand, shadowing f0 DID predicts post-shadowing f0 DID in the high f0 condition [ $\beta = 0.432$ ,  $t = 2.630$ ,  $p = .013$ ], but not in the long VOT condition [ $\beta = 0.181$ ,  $t = 1.093$ ,  $p = .282$ ]. This suggests that the changes in the unmanipulated acoustic property in the post-shadowing productions, i.e., the increase in post-stop f0 after shadowing aspirated stops with longer VOT, reported in Kwon (2019) may not stem from the imitative changes during the shadowing. The changes targeting in the abstract phonological category arguably emerge in the post-shadowing productions.

Taken together, the current findings suggest that an individual speaker's changes in one acoustic property during her shadowing productions are related to the changes in her post-shadowing productions, but the relation between shadowing and post-shadowing productions may not be necessarily at the individual acoustic properties. The post-shadowing productions distal from the immediate acoustic targets to imitate can include convergent changes absent in the shadowing productions that are targeting the abstract categories.

**Figure 1.** English VOT DID



**Figure 2.** Seoul Korean



**Selected references:**

Kwon, H. 2019. The role of native phonology in spontaneous imitation: Evidence from Seoul Korean. *Laboratory Phonology: Journal of the Association for Laboratory Phonology* 10, 1-24.

Nielsen, K. 2011. Specificity and abstractness of VOT imitation. *Journal of Phonetics* 39, 132-142.

Shockley, K., Sabadini, L., & Fowler, C. A. 2004. Imitation in shadowing words. *Attention, Perception, & Psychophysics* 66, 422-429.

Silva, D. J. 2006. Acoustic evidence for the emergence of tonal contrast in contemporary Korean. *Phonology* 23, 287-308.

Pardo, J. S., Urmanche, A., Wilman, S., & Wiener, J. 2017. Phonetic convergence across multiple measures and model talkers. *Attention, Perception, & Psychophysics* 79, 637-659.