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Title: Adaptation to Room Reverberation in Nonnative Phonetic Training

Background: Speech communication often occurs in adverse listening conditions, such as noisy and reverberant environments. Room reverberation distorts the speech signal and hampers intelligibility, an effect particularly pronounced for nonnative listeners (e.g., Nábělek and Donahue, 1984, J. Acoust. Soc. Am. 75: 632-634). There is evidence that prior exposure to consistent reverberation is beneficial for native listeners, resulting in improved speech intelligibility (Brandewie & Zahorik, 2010, J. Acoust. Soc. Am. 128: 291-299), but less is known about the patterns of interference and adaptation to room reverberation for nonnative listeners during the acquisition of novel phonetic categories. In the present study we investigate these issues, addressing in particular the differential effects of phonetic training in multiple reverberant rooms versus a single anechoic environment on the perception of nonnative phonemes in anechoic and reverberant conditions.

Methods: Listeners were trained on a difficult dental-retroflex phonetic distinction. Stimuli were CV syllables coming from a Hindi speaker and were presented in anechoic space or in simulated reverberant environments, crossed with supervised and unsupervised training. Supervised training consisted of a 2AFC task with trial-by-trial performance feedback. Unsupervised training employed a videogame which promoted stimulus-reward contingencies. Before and after training, participants were tested using the trained voice and trained rooms, as well as using an untrained voice and untrained rooms.

Results: When tested with the trained voice, participants showed significant improvements for trained and untrained stimuli and rooms. Exposure to the stimuli in three different rooms vs. exposure only in anechoic room resulted in similar amounts of learning and generalization to untrained rooms. Supervised training resulted in larger improvements than unsupervised training. No generalization of learning to an untrained voice was observed for either type of room simulation.

Conclusions: The results show that phonetic categorization training of the dental-retroflex distinction in nonnative listeners is robust against variation in room characteristics, but also that it does not benefit from exposure to the stimuli in different reverberant environments. The lack of generalization of learning to an untrained voice suggests that listeners encoded talker-specific, non-phonetic details. While these results confirmed that acquisition of novel phonetic categories for nonnative listeners is robust against reverberation variations, it is likely that the extent to which phonetic learning and reverberation adaptation interact depends on the specific acoustic and phonetic features important for the trained discrimination.

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