Discrimination Training and Reweighting of Interaural Level vs. Time Difference Cues

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Background: Normal-hearing listeners weight binaural localization cues depending on the sound's frequency content. Interaural time differences (ITDs) dominate at low frequencies, and interaural level differences (ILDs) dominate at high frequencies. The contribution of each cue to an azimuthal localization percept also depends on environmental factors such as room acoustics. Furthermore, using visual feedback, ITD/ILD weighting was shown to change for stable sound conditions through lateralization training in virtual reality (VR). This study aims to induce similar reweighting using a simple left/right discrimination task without VR. And, it examines how the resulting reweighting depends on the target azimuth and spatial disparity between target components.

Methods: Participants were divided into three groups, a group trained to increase their ILD weighting (n=10), a group trained to increase the ITD weighting (n=14), and a no-training control group (n=11). All the groups completed an identical pre- and post-assessment involving a relative discrimination task without feedback, using various spatially inconsistent ITD and ILD combinations. The stimuli consisted of pairs of narrowband noises (f_c = 2.8 kHz) generated such that the first noise contained ITD corresponding to one azimuth and ILD corresponding to another azimuth, while the second noise had the azimuths corresponding to ITD and ILD swapped. The subject indicated whether the perceived location of the noise moved to the left or to the right. The training groups completed three sessions of adaptive relative discrimination training, including feedback (correct/incorrect) always consistent with the ILD azimuth (ILD training) or the ITD azimuth (ITD training). After each incorrect response, the auditory stimulus was repeated with the correct answer shown on the screen.

Results: Responses followed the ILD azimuth significantly more often in the posttest than in the pretest for the ILD training group, while the effect of training was much weaker and not significant in the ITD training group, and no effect was observed in the control group. And, while the relative weight varied with target location and spatial disparity, the increased ILD weight in the ILD group was independent of these spatial factors.

Conclusions: Binaural cue reweighting can be achieved by a simple discrimination training when the goal of training is to increase the ILD weight, but not when it is to increase the ITD weight. A possible reason for this asymmetry is that the study was performed in virtual anechoic environment in which the ITD weight is already maximized as the ITDs are not distorted by reverberation in this environment.

[Work supported by VEGA 1/0350/22 and APVV DS-FR-19-0025].

Keywords: Binaural Cue Reweighting, Discrimination Training, ITD/ILD trading ratio