Reweighting of binaural sound localization cues in a virtual environment

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Abstract

The auditory system uses binaural cues that are frequency dependent to determine the location of the sound source. The interaural time difference (ITD) is typical for low-frequency (LF) sounds, i.e. frequencies below 1000 Hz. For high-frequency sounds (HF), dominates interaural level difference (ILD), i.e. for frequencies above 1500 Hz. For frequencies between 1000 Hz and 1500 Hz, i.e. midrange frequencies, ITD and ILD contribute in different proportions to determining sound localization. We can express how much ITD/ILD affects localization by measuring their weights. Reweighting can be induced by visual training. A previous study (Spišák, 2021) showed that visually guided training on HF vs. LF components in real environment induces reweighting in the binaural localization cues such that the ILD weight is increased independent of the training type.

We performed experiments in virtual anechoic environment and in real reverberant environment without training to find out if re-weighting of binaural cues is dependent on training of one component or simple change of environment is enough to induce the re-weighting. In real environment the stimulus consisted of 2 sounds coming from 11 loudspeakers in a semicircle with 11,25° spacing in range from -56,25°to 56,25° with frequencies 0.35kHz and 0.7kHz, 2.8kHz, 5.6kHz and 11.2kHz. In virtual environment stimulus was ITD/ILD combination corresponding to one of 40 possible positions in horizontal plane in range from -70.2° to 70.2° with spacing of 3.6°, where positions from -45°to 45° were target positions, the rest were non-target only.

Results from real environment show that change in spectral weighting does not occur, as we expected because no training of HF and LF components was present. Based on previous results we hypothesized that performing an experiment in real room may affect the way subjects answered in virtual environment. However, the results from virtual environment do not show the expected effect and no significant re-weighting occurred from pretest to posttest.

Thus, a change in weighting cannot occur by changing from an anechoic environment to an echoic one, nor does it occur by getting used to an echoic room, but only by appropriate visual training.