Spectral and Binaural Cue Reweighting in Sound Localization in Reverberant Environments

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Background:
The auditory system uses binaural cues to determine the sound source location. The cues are weighted mainly depending on the frequency content. For low-frequency (LF) sounds, the interaural time difference (ITD) is the dominant cue. For high-frequency (HF) sounds, the interaural level difference (ILD) is the dominant cue. The transition between these frequency regions is at around 1500 Hz, where both ITD and ILD contribute in different proportions to sound localization. A previous study (Spišák et al., ARO Abstract #PD117, 2019) showed that visually guided training on HF vs. LF components in a real reverberant environment induces spectral reweighting, i.e., an increase in the weight of either the HF or LF component, when that component is reinforced. However, when testing the generalization of this reweighting to binaural cues in a virtual anechoic environment, an increase in the ILD weight was observed independent of the reinforced cue. Here, follow-up experiments were performed in a virtual anechoic environment and in a real reverberant environment without training to test whether simple exposure to reverberant environment prior to anechoic binaural weight testing is sufficient to induce the increase in ILD weight.

Methods:

Two groups completed two test sessions (no training), performed on different days, either with only a virtual binaural weight measurement in an anechoic environment (Aonly group), or with both a virtual binaural and a real spectral weight measurement (AR group). In the real reverberant environment testing, stimuli consisted of 2 or 4 one-octave noise bands, together covering the range 0. 7 – 11. 2 kHz, presented from neighboring speakers selected from a range of 11 speakers spanning the angles of -56° to 56°. In the virtual anechoic environment testing, narrowband noise stimuli (Fc = 2.8 kHz) had ITD/ILD combinations corresponding to one of 40 possible positions in the horizontal plane ranging from -70.2° to 70.2° and ITL/ILD separation of up to 25.2°. Participants' task was to localize the auditory stimuli. The relative weight of HF vs. LF components and ITD vs. ILD components was derived from the response locations re. the component locations.

Results:

The AR group showed no change in spectral weighting, as expected because no training of HF or LF components was present. Contrary to our hypothesis, no reweighting was observed in the binaural testing in either group, even though an increase in ILD weight was expected for the AR group.

Conclusion:

The ILD weight increase observed in Spisak et al. (2019) cannot be explained by a previous exposure to the reverberant environment, at least not if that exposure does not include active training. However, what aspect of the training is important is still unknown.

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