Learning auditory distance perception: experimental studies and computational models.

Dissertation Thesis

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Auditory distance perception is crucial in many everyday situations. Acoustical cues to auditory distance vary from one environment to another and auditory system must adapt to the new acoustical scenes. This thesis presents the results of two behavioral experiments and a modeling study that examined two types of learning in auditory distance perception. The first study focused on spontaneous learning that occurs when the listener is exposed to a new reverberant environment over several days. It aimed to test whether auditory distance perception refines after spontaneous learning when the sound level cues are made unreliable in a distance localization task and the listener is forced to rely only on the reverberation-related cues. Auditory distance perception improved over seven days of training. The subjects learned more when the sound level systematically varied with the distance of auditory targets. A plausible explanation is that the subjects were using both room reverberation and sound level cues even when the cues were congruent. The second study examined visually guided recalibration of auditory distance perception, by examining the ventriloquism effect and aftereffect in the distance dimension. The results showed that there is an asymmetry between inducing the recalibration by using closer vs. farther visual adaptors. The asymmetry was largely related to the compression observed in localization of the audio-visual stimuli that were aligned in distance. A linear weighted model showed that the ventriloquism effect in distance can be explained as a combination of the visual component and auditory components assuming that the auditory component is weighted more than an optimum model would predict. These results provide further insight into perceptual mechanisms used by the brain to cope with new stimuli and environments in distance dimension.