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Influence of head movements on sound localization with cochlear implants

M. F. Müller, K. Meisenbacher, W.-K. Lai, N. Dillier

Laboratory of experimental audiology, University hospital Zurich, Switzerland

Bilateral Cochlear Implant (CIs) users encounter difficulties to localize sound sources in realistic environments, especially in the presence of background noise. They show significant directional errors and large front-back confusions occur compared to normal hearing subjects in the same conditions. To date, most past studies have been carried out in mostly quiet laboratory settings with fixed head positions. Real-world sound localization is usually done in much more complex acoustic environments with the presence of noise and reverberation. In such circumstances, head movements provide essential additional information about the position of a source. We know that the normal hearing listeners use differences in interaural information provoked by head movements to resolve ambiguities in source position, especially front back confusions. It is however still unknown to what extent CI users can take advantage of head movements and how much it helps for sound localization.In order to evaluate CI users in realistic conditions, we simulated a noisy cafeteria using 12 loudspeakers set up in a circle with a diameter of 3m. We asked the test subjects to localize a male speaker in cafeteria noise. They were instructed to move their head freely in the horizontal plane. The test subjects were equipped with a head tracking sensor to monitor their head movements. The length of the speech signals was varied to limit the range of possible head movements. The speech signals were taken from the OLSA test material. Three signal durations were implemented from 460ms (one name) to 2.16s (one sentence). Two signal-to-noise ratios were tested to cover quiet and noisy environments: 15 and 0 dB SNR. Additionally, the experiment was repeated with the test subjects instructed to keep their head fixed.Pilot results show an increase in localization performance when head movements are allowed. The CI users were however not able to resolve all the front-back confusions, in contrast to normal hearing listeners who could perform this task easily. We noticed large differences in performance and head trajectories between the subjects indicating that not all CI users tested could take advantage of the variations in interaural information.