1. Introduction

- Bilateral cochlear implant (BiCI) users have poor localization ability compared to normal hearing (NH) listeners.
- Normal hearing listeners have access to a full range of acoustic cues, such as interaural time and level differences (ITDs and ILDs).
- However, BiCI users have limited access to interaural cues (specifically ITDs), which is likely to degrade localization abilities.
- Traditionally, localization experiments have utilized mainly stationary sounds, which may overestimate the ability of BiCI users to localize in realistic listening environments.
- No study to date has investigated localization of moving sounds in BiCI users, nor has there been an evaluation of the importance of particular cues.
- The aims of the present study were:
  1. To investigate localization of moving sounds in bilateral cochlear implant users.
  2. To determine whether reducing access to a particular binaural cue decreases localization of moving sounds for NH listeners.

2. Methodology

- **Binaural Recordings**
  - Auditory motion was simulated using Vector Base Amplitude (VBA) 2.
  - To determine whether reducing access to a particular binaural cue decreases localization of moving sounds in BiCI users, nor has there been an evaluation of the importance of particular cues.

- **Stationary Sounds**
  - Moving sounds were white noise recordings made with binaural microphones placed in the ears of a KEMAR manikin (Fig. 1).
  - Dynamic ITDs were verified by performing short-duration cross-correlation functions on the binaural recordings (Fig. 2).

3. Sound Localization Task

- **Normal Hearing Testing**
  - Presented via Sennheiser HD600 circumaural headphones.
  - Three frequency ranges:
    - Low-pass: 2 – 6 kHz
    - Mid-pass: 100 – 1.5 kHz
    - High-pass: 0.25 – 0.5 kHz

- **Bilateral CI Testing**
  - A BiCI user listened to their own everyday processor settings.

4. Results

- **Localisation Performance**
  - All NH listeners and the BiCI user were able to localize moving sounds.
  - Localization performance in the NH listeners was consistent across durations (Fig. 5).
  - The BiCI user performed within the range observed in the NH listeners, for all conditions with a duration of 500 ms (Fig. 6).

5. Across Group Comparisons

- **Stationary Sounds**
  - The BiCI user displayed the best localization when the stimulus duration was 500 ms. This could have been due to the subject not perceiving the moving sounds as motion but rather stationary since short angular ranges of 10° and 20° were employed.
  - Future studies may need to access the effect of stimulus duration on localization error in BiCI users by testing angular ranges and angular velocities not used in this experiment.

6. Conclusions

- The presence of a particular binaural cue in the low and high pass conditions for NH listeners exhibited a similar performance to the control condition for all stimuli.
- Dynamic cues do not appear to aid in the localization of moving sounds compared to stationary sounds for this BiCI user or in NH listeners.
- The BiCI user displayed the best localization when the stimulus duration was 500 ms.
- This could have been due to the subject not perceiving the moving sounds as motion but rather stationary since short angular ranges of 10° and 20° were employed.
- Future studies may need to access the effect of stimulus duration on localization error in BiCI users by testing angular ranges and angular velocities not used in this experiment.

References


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