

## **Spatial Hearing Skills in Children and Adults Fitted with Bilateral Cochlear Implants**

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In recent years there has been a marked increase in the number of patients receiving bilateral cochlear implants. Our research group is concerned with understanding what benefits, if any, can be measured in young bilateral implant users, as well as in adults.

In children, we are concerned with whether the age at which bilateral hearing is activated is an important factor to consider and how post-implantation experience affects performance. To date, over 60 children ages 2.5 to 14 have participated in our studies. Measures include speech perception in quiet and in the presence of competing sounds, left-right discrimination of sound location (minimum audible angle; MAA) and sound localization in a multi-loudspeaker array. In children under age 3 we are also investigating the emergence of word learning skills. Results to date suggest that spatial left-right discrimination of sounds in free field emerges over a 12 to 24 month period; MAA thresholds decrease from  $\sim 50^\circ$  to  $\sim 15^\circ$  during this period. Children with post-lingual deafness show an especially early emergence of this skill, with MAA thresholds reaching  $5\text{-}15^\circ$  within 2-3 months of bilateral hearing, suggesting that early acoustic input facilitates localization acuity with bilateral cochlear implants. Sound localization in a multi-loudspeaker situation emerges more slowly than the right-left discrimination. This is unlike our findings in post-lingually deafened adults whose localization abilities emerge within 3 months of bilateral hearing, suggesting that development of a spatial map may depend on exposure to acoustic cues earlier in life, and is otherwise slow to emerge. Studies on speech understanding in noise show that the extent to which children can experience benefits from listening with 2 cochlear implants compared with a single implant is similar to the effects measured in adult populations. The benefit appears within 3 months following activation of bilateral hearing, and does not change significantly with additional experience.

Studies in adults were conducted using the Spear3 research processor. Pitch-matched electrodes in the right and left cochleae were directly stimulated with biphasic pulse trains. The age of onset of deafness in adults has a significant impact on sensitivity to interaural timing cues but not on sensitivity to interaural level cues. This work impacts our thinking about auditory plasticity and the types of cues that children might most benefit from with early exposure.

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