**Background**

- Cross-modal reorganization (CMR) occurs when a deprived sensory modality's cortical resources are recruited by other intact modalities.
- Cross-modal reorganization has been proposed as a source of variability underlying speech perception in hearing-impaired cochlear implant (CI) users [1,2].
- Visual and somatosensory cross-modal reorganization of auditory cortex has been documented separately in children with CIs [3,4], but reorganization in these modalities has not been documented within the same subject group.

**Aim of the Study**

- To examine cross-modal reorganization across both visual and somatosensory modalities within a single group of CI children (n=10) using high-density electroencephalography.

**Methods**

- Analyzed evoked potentials in response to visual and somatosensory stimuli [5,6].
- Performed current density reconstruction (CDR) of brain activity sources [7-11].
- Performed speech perception-in-noise testing [12,13].
- CDR patterns were analyzed within the entire subject group and across groups of CI children exhibiting good vs. poor speech perception [13].

**Subject Demographic Characteristics**

<table>
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<tr>
<th>Subject Code</th>
<th>Age (Years)</th>
<th>Age at first CI (Years)</th>
<th>Age at second CI (Years)</th>
<th>First CI Ear</th>
<th>Duration of first CI Experience (Years)</th>
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1. Subjects had progressive hearing losses associated with diagnoses of enlarged vestibular aqueduct syndrome (EVAS).
2. Subject with hearing aided contralateral to cochlear implant.

**Results: Current Density Reconstruction**

**Evidence of Visual Cross-Modal Reorganization**

Children with CIs demonstrate activation of temporal cortical regions in response to visual stimulus, compared to normal hearing (NH) children who demonstrate activation of occipital regions. This is suggestive of cross-modal reorganization by vision.

**Evidence of Somatosensory Cross-Modal Reorganization**

Children with CIs demonstrate activation of auditory temporal cortical regions in response to a somatosensory stimulus, compared to NH children who demonstrate activation of parietal regions. This is suggestive of cross-modal reorganization by the somatosensory modality.

**Results: Relationship Between Visual and Somatosensory Cross-Modal Reorganization**

CI children with good speech perception show expected activation of occipital regions in response to a visual stimulus, while CI children with poor speech perception demonstrate cross-modal recruitment of temporal and frontal regions (suggestive of cross-modal reorganization by vision).

**Results: Relationship between Cross-Modal Reorganization and Speech Perception in Noise**

CI children who had difficulty processing speech in noise with their implants (higher BKB-SIN score) showed more evidence of cross-modal recruitment by vision (earlier CSEP latencies), as seen in previous studies [3].

CI children who had difficulty processing speech in noise with their implants (higher BKB-SIN score) showed more evidence of cross-modal recruitment by somatosensory (earlier CSEP latencies) consistent with previous studies [4].

CI children who showed greater visual cross-modal reorganization (as evidenced by earlier CSEP latencies) also showed greater somatosensory cross-modal reorganization (as evidenced by earlier CSEP latencies).

**Discussion**

- Cross-modal reorganization of auditory cortex by visual and sensory modalities is evident in children with CIs and is negatively associated with speech perception using the cochlear implant.
- Positive correlation between visual and somatosensory cross-modal reorganization suggests that the neuroplasticity in different sensory systems may be interrelated.
- CI children with good speech perception did not show recruitment of frontal or auditory cortices during visual processing, while subjects with poor speech perception did, suggesting that cross-modal recruitment may explain some underlying variability in speech perception outcomes.
- Findings reflect widespread changes in cortical networks in CI children that may impact functional outcomes.

**References**

- The authors do not cite any conflicts of interest.
- Funding: This project was funded by National Institutes of Health grants R0113010545, R01DC006257, T32DC012280, F31DC012070, F31DC013218.

**Disclosures**

- This study was supported by the National Institutes of Health.