What explains perceptual weighting strategies of children with CIs: Auditory sensitivity or language experience?

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BACKGROUND
Children develop well-defined phonemic categories over the first decade of life. Acoustic cues define those categories. Adults weight those cues differently depending on native language. Children must learn those language-specific weighting strategies. Hearing loss can diminish opportunities children have for learning those strategies because of enhanced difficulty hearing in noise. Acoustic cues are based on various kinds of structure in the speech signal, including spectral and temporal. Cochlear implants (CIs) preserve some of that structure better than others. In particular, CIs preserve duration structure well, but not spectral structure. In sum, both diminished learning opportunities and degraded spectral cues could lead to delays in children’s abilities to acquire mature perceptual weighting strategies for speech perception.

GOALS
1. Measure weighting factors for children with CIs and compare them to those of children with normal hearing (NH), for a duration cue, well-preserved by CIs, and for spectral cues, poorly preserved by CIs.
2. Measure sensitivity to underlying acoustic properties to assess the extent to which any observed delays in developmental weighting shifts should be attributed to degraded acoustic cues.

PARTICIPANTS
100 8-year-olds: 49 with NH and 51 with early CIs; well-matched on socioeconomic status and nonverbal intelligence.

TASKS
Children were tested on two labeling tasks with speech stimuli and two AX discrimination tasks with non-speech stimuli.

Speech Perception: Cues Manipulated
<table>
<thead>
<tr>
<th>Continuous</th>
<th>Binary</th>
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</thead>
<tbody>
<tr>
<td>cop/cob Vowel</td>
<td>Duration</td>
</tr>
<tr>
<td>sa/ʃ</td>
<td>Fricative</td>
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</tbody>
</table>

RESULTS: Labeling
Group labeling results for the cop/cob stimuli
Group labeling results for the sa/ʃ stimuli

RESULTS: AX Discrimination
Children with CIs (who could do the tasks) were as sensitive to the acoustic properties as children with NH.

H2: No significant correlations were found between discrimination and weighting factors. Salience of cues alone cannot explain weighting strategies.

But not all children with CIs could do discrimination tasks.

Was ability to do the discrimination task related to weighting factors?

<table>
<thead>
<tr>
<th>Duration Discrimination</th>
<th>Glide Discrimination</th>
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<tbody>
<tr>
<td>Total</td>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
<td>35</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
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Only one difference was found for children with CIs who could not do a task: For glide discrimination, those children had lower weighting factors for offset transitions than those who could: 1.62 (1.05) vs. 2.44 (1.04), t(47) = 2.73, p = .009.

CONCLUSIONS
1. With salient cues, children with CIs can learn weighting strategies.
2. This appears to point to the saliency of cues as culprit, but no correlations were found between weighting of cues and discrimination.
3. We suggest there is a trade between cue saliency and required learning: more learning needed for less-salient cues.
4. Familiarity with signal matters.

ACKNOWLEDGEMENT
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