INTRODUCTION

In the normal hearing binaural system, the brain uses interaural differences to map spatial cues with the location of sounds and detect a signal in noise.

In the lab, sensitivity to interaural differences is often measured by...

a. applying an interaural level or timing difference (ILD; ITD) to a stimulus and finding the smallest detectable change in direction.

b. the binaural masking level difference (BMLD), which is the difference in signal-to-noise ratio needed to detect a tone when presented dichotically vs. diotically.

For children with bilateral cochlear implants...

Ehlers et al. (2017) found that while all children had ILD sensitivity, less than 50% had ITD sensitivity.

Todd et al. (2016) found that some of the children from the Ehlers study who had no measurable ITD sensitivity had measurable BMLDs.

METHODS

Participants:
Five children with bilateral Cochlear Nucleus devices.

Table 1. Participant hearing history. Ages reported in years; months.

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age at Testing</th>
<th>Age at 1st Implant</th>
<th>Inter-device Interval</th>
<th>BIC Exp.</th>
<th>Etiology of deafness</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIAY</td>
<td>M</td>
<td>17.8</td>
<td>5.1</td>
<td>0:10</td>
<td>11.8</td>
</tr>
<tr>
<td>CIBW</td>
<td>F</td>
<td>13.10</td>
<td>1.0</td>
<td>2:8</td>
<td>10:1</td>
</tr>
<tr>
<td>CIEF</td>
<td>F</td>
<td>15.2</td>
<td>2.7</td>
<td>8:3</td>
<td>4:3</td>
</tr>
<tr>
<td>CIBK</td>
<td>M</td>
<td>17.1</td>
<td>2.1</td>
<td>4:11</td>
<td>10:1</td>
</tr>
<tr>
<td>CICL</td>
<td>M</td>
<td>11.11</td>
<td>1.5</td>
<td>2:1</td>
<td>9:3</td>
</tr>
</tbody>
</table>

Stimuli:
- Presented to a medial pair of interaurally pitch-matched electrodes, with either a nonzero ILD or ITD, using a bilaterally synchronized research platform (Cochlear RF GeneratorXS).
- Stimuli were 100 pulse per second biphasic electric pulse train with 25 µs phase width and 300 ms duration.

Tasks:
- Responses were taken using a touch screen. ILD and ITD JNDS were measured using 2 tasks:
  - 2-interval, 2-alternative forced-choice (2I-2AF: right vs. left discrimination task).
  - 3-interval, 2-alternative forced-choice (3I-2AF: odball detection task).

Analysis:
A psychometric function was fitted to the ILD and ITD data to obtain a JND threshold at 70.7% correct.

RESULTS

- All children demonstrated sensitivity to ILDs, regardless of task type (Fig. 2).
- All children demonstrated elevated thresholds in the 3-3 interval, 2AF task compared to the 2-2 interval, 2AF task (Fig. 2 & 3).
- Three out of four children tested demonstrated ITD sensitivity. Lack of sensitivity appears to be independent of task (Fig. 3).
- For children with ITD sensitivity, the 3-3 interval, 2AF task resulted in the elevation or elimination of ITD thresholds (Fig. 3).

CONCLUSIONS

- Measurement of binaural hearing thresholds can be influenced by the task.
- Contrary to initial expectation, children with ITD sensitivity had elevated thresholds in the 3I-2AF compared to the 2I-2AF task. This difference in performance may be due to a higher auditory memory load in the 3I-2AF task.
- Children who had measurable BMLDs but not ITD JNDS may be using different strategies when completing the BMLD task, such as discriminating binaural decorrelation of the different intervals.

REFERENCES