Cognitive profiles of children with cochlear implants: Results from a sample of children in the context of a supportive inclusive model, Years 2 and 3

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Disclosure Statement

• River School full-time employee
Background

• Outcomes for children with CIs on measures of language and has ranged widely
  • Focused on language; varying degrees of speech comprehension and understanding\(^1\)
    • Environmental Factors: Age of implantation, residual hearing prior to implantation, maternal sensitivity, and SES\(^2,3\)
    • Nonverbal cognitive abilities mediate language outcomes\(^4,5\)
  • Studies on cognitive profiles of children with CIs
    • Difficult to generalize due to heterogeneity of group
    • Literature suggests lower scores on measures of verbal abilities (including VCI)\(^6,7\) and working memory (including WMI)\(^8,9\)
    • Working memory is critical to the development of spoken language\(^10,11,12\)
  • Variability in hypothesized direction of causal effects between language and working memory development
Purpose and Measures

• The current presentation will share the cognitive profiles of children with CIs, and discuss preliminary findings over a three-year span.

• Investigate how correlations between verbal abilities and working memory predict outcomes over time
  • Measures:
    • Wechsler Preschool and Primary Scales of Intelligence, Fourth Edition (WPPSI-IV)\textsuperscript{13}
      • ages 2:6-7:7 years
    • Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V)\textsuperscript{14}
      • ages 6:0-16:11 years
  • Variables
    • Verbal Comprehension Index (VCI)
    • Working Memory Index (WMI)
## Participants

Table 1:

<table>
<thead>
<tr>
<th>Participant Demographics</th>
<th>Y1 N=19</th>
<th>Y2 n=14</th>
<th>Y3 n=7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (%)</td>
<td>63</td>
<td>50</td>
<td>29</td>
</tr>
<tr>
<td>Age (years: months)</td>
<td>4:8</td>
<td>5:8</td>
<td>7:3</td>
</tr>
<tr>
<td>Racial/Ethnic minority (%)</td>
<td>53</td>
<td>43</td>
<td>57</td>
</tr>
<tr>
<td>Age of hearing loss identification (months)</td>
<td>16.3</td>
<td>14.6</td>
<td>19.0</td>
</tr>
<tr>
<td>Age of activation (months)</td>
<td>29.7</td>
<td>29.4</td>
<td>30.4</td>
</tr>
</tbody>
</table>
Results

- VCI: Significant correlations across all three years, with large effect sizes
- WMI: Significant correlation only with preceding year
- VCI and WMI: Significant correlation with each other in Year 1 and Year 2, with decreasing effect sizes
  - Not significantly correlated in Year 3

Table 2:

<table>
<thead>
<tr>
<th>VCI</th>
<th>WMI 1</th>
<th>VCI 2</th>
<th>WMI 2</th>
<th>VCI 3</th>
<th>WMI 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCI 1</td>
<td>0.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WMI 1</td>
<td></td>
<td>0.67</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCI 2</td>
<td>0.78</td>
<td>0.69</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WMI 2</td>
<td>0.53</td>
<td>0.57</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCI 3</td>
<td>0.91</td>
<td>0.94</td>
<td>0.95</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td>WMI 3</td>
<td>0.45</td>
<td>0.54</td>
<td>0.15</td>
<td>0.74</td>
<td>0.31</td>
</tr>
</tbody>
</table>
Table 3: Changes in average VCI and WMI Standard Score (SS), Y1, Y2, Y3

<table>
<thead>
<tr>
<th></th>
<th>Year 1 (N=19)</th>
<th>Year 2 (n=14)</th>
<th>Year 3 (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average VCI SS</td>
<td>96.21</td>
<td>99.93</td>
<td>106.86</td>
</tr>
<tr>
<td>Average WMI SS</td>
<td>90.74</td>
<td>90.86</td>
<td>92.86</td>
</tr>
</tbody>
</table>

Change in VCI & WMI

Y1: 15 WPPSI-IV; 4 WISC-V
Y2: 9 WPPSI-IV; 5 WISC-V
Y3: 1 WPPSI-IV; 6 WISC-V
Results

• VCI scores continued to improve over time while WMI scores remained relatively consistent

• Correlational strength between VCI and WMI scores decreased over time

Table 4: Change in VCI and WMI over Time (n=7)

<table>
<thead>
<tr>
<th>Time</th>
<th>VCI</th>
<th>WMI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y1:</td>
<td>Y1:</td>
</tr>
<tr>
<td></td>
<td>90.43</td>
<td>92.43</td>
</tr>
<tr>
<td>Y2:</td>
<td>105.14</td>
<td>90.57</td>
</tr>
<tr>
<td>Y3:</td>
<td>106.86</td>
<td>92.86</td>
</tr>
</tbody>
</table>
Conclusion

• Findings consistent with:
  • Results from a cross-sectional study of children with CIs\textsuperscript{15}:
    • WPPSI-IV: Children with CIs had significantly lower VCI and WMI scores compared to hearing controls
    • WISC-V: Group performance indicated improved VCI scores, while WMI scores remained significantly lower
  • Results from a study examining the relationship between cognition and language\textsuperscript{16}:
    • Correlation between working memory and core language was found in children with language scores below average
    • No correlation between working memory and core language in children with above average language scores
Conclusion, continued

• In the context of an educational program that provides specialized supports for spoken language development:
  • Language abilities notably improve with age and experience
  • Working memory abilities remain consistent, regardless of improving language profiles
    - What does this mean for intervention with working memory?
• Strong early correlation between language and working memory
  • (i.e., when language scores are lower)
Thank you

• Thank you for your attention
• Special thanks to:
  • The River School, and the children for their patient participation
• For more information:
  • Elizabeth Adams-Costa, Ph.D. – eadams@riverschool.net
References


References


