Predicting growth in reading skills from change in white matter properties in children born preterm and full term

DEPARTMENT OF PEDIATRICS MEETING
THURSDAY, MAY 20
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Background

- Differences in white matter characteristics between children born PT and full-term (FT) persist to school age.

- Children born PT also show poorer reading skills than their age-matched FT peers.

- White matter tracts have been implicated in the neurobiology of reading development.
Objective

To determine if change in the characteristics of white matter tracts from age 6 to 8 years predicts reading growth in children born PT and FT during the same period.
**Methods: Diffusion MRI**

- Diffusion MRI is a specific MRI sequence sensitized to movement of water molecules.
- Patterns of water diffusion in white matter reflect the tissue microstructure: Fractional anisotropy (FA) quantifies how strongly directional the diffusion of water molecules is.
Methods: Diffusion MRI Tractography

- The main diffusion direction relates to the direction of fiber orientations and can be used for fiber tracking.
- An automated probabilistic tractography pipeline was used to identify in each child our four tracts of interest: left inferior longitudinal fasciculus, left arcuate fasciculus, and the left and right optic radiation.
Methods: Study Design

PT birth < 32 weeks gestational age

FT birth ≥ 37 weeks gestational age

Exclusion: Neurological/Medical conditions (other than prematurity or its complications) that might impact learning to read.

Visit 1: 6 years
- Neurocognitive: IQ, Language & Reading
- MRI: Diffusion (96dir, b=2500)

Visit 2: 7 years
- Neurocognitive: Reading (WRTM-III)

Visit 3: 8 years
- Neurocognitive: IQ, Language & Reading
- MRI: Diffusion (96dir, b=2500)
## Results: Cohort Characteristics

<table>
<thead>
<tr>
<th>N = 68</th>
<th>Preterm (n = 34)</th>
<th>Full term (n = 34)</th>
<th>t or X²</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%) or M (SD)</td>
<td>N (%) or M (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>22 (64.7)</td>
<td>16 (47.1)</td>
<td>2.15</td>
<td>.143</td>
</tr>
<tr>
<td>SES</td>
<td>54.6 (12.6)</td>
<td>58.8 (10.1)</td>
<td>-1.50</td>
<td>.138</td>
</tr>
<tr>
<td>GA (weeks)</td>
<td>29.6 (2.50)</td>
<td>39.5 (1.54)</td>
<td>-19.6</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Birthweight (grams)</td>
<td>1323 (501)</td>
<td>3361 (447)</td>
<td>-17.7</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Age at time 1</td>
<td>6.17 yrs (2.27 mon)</td>
<td>6.20 yrs (2.26 mon)</td>
<td>-0.80</td>
<td>.429</td>
</tr>
<tr>
<td>Age at time 2</td>
<td>7.17 yrs (2.44 mon)</td>
<td>7.14 yrs (1.72 mon)</td>
<td>0.86</td>
<td>.392</td>
</tr>
<tr>
<td>Age at time 3</td>
<td>8.22 yrs (2.32 mon)</td>
<td>8.16 yrs (1.99 mon)</td>
<td>1.33</td>
<td>.188</td>
</tr>
<tr>
<td><strong>Reading proficiency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WID at time 1</td>
<td>8.33 (8.74)</td>
<td>12.4 (10.4)</td>
<td>-1.63</td>
<td>.109</td>
</tr>
<tr>
<td>WID at time 2</td>
<td>16.9 (7.22)</td>
<td>19.6 (8.02)</td>
<td>-1.44</td>
<td>.156</td>
</tr>
<tr>
<td>WID at time 3</td>
<td>24.6 (5.06)</td>
<td>26.2 (6.92)</td>
<td>-1.10</td>
<td>.275</td>
</tr>
</tbody>
</table>
Results: Reading Growth

- **Model 1**: Time and birth group were entered as fixed factors to examine reading growth as indexed by WID.
- Reading scores increased over time in both birth groups (p<.001).
- PT group did not significantly differ from FT group in overall reading scores (p=.108).
Results: Left ILF

- **Model 2A**: FA-change in the left ILF from age 6-8 years was added as a fixed factor.
- Variation in FA-change was associated with reading growth ($p=.006$).
- Relation between FA-change and reading growth was marginally stronger in the FT than PT group ($p=.090$).
**Results: Left OR**

- **Model 2B:** FA-change in the left OR from age 6-8 years was added as a fixed factor.
- Variation in FA-change was associated with reading growth ($p=.008$).
- FA decrease was associated with reading growth in the FT; FA increase was associated with reading growth in the PT group ($p=.070$).
Conclusions

- Children born FT and PT improve in reading from age 6 to 8 years.
- Associations of white matter change and growth in reading appeared to be different in the two groups; if this result is replicated in larger samples this would suggest that patterns of neurobiological prediction of reading development are different in children born FT and PT.
- Associations of FA decrease with reading growth may indicate changes in axonal diameter in FT children, while associations of FA increase with reading growth may indicate changes in myelination or fiber coherence in PT children.
THANK YOU

FOR YOUR ATTENTION.

THANK YOU TO MY
MENTORS & THE DBP
RESEARCH TEAM

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