Auditory Resolution Deficits in Children with Reading Difficulties

Presented by:
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Dual Route Model of Reading e.g. Coltheart et al. (2001)

Lexical Route
- Orthographic Lexicon
- Semantics
- Phonological Lexicon
- Letter Identification and Position Coding

Sublexical Route
- Letter-Sound Rules
- Blending
- Phoneme Output
- Phoneme Output
Broad Categories of Dyslexia

- Phonological
  - "gop"
- Mixed
- Surface
  - "yacht"
Broad Categories of Dyslexia

- **Surface**
  - “yacht”

- **Phonological**
  - “gop”

- **Mixed**

- **Auditory deficit**

**Our hypothesized subgroup**
Two main types of auditory deficits for dyslexia

Trouble processing **phonemes**
Rate-processing constraint hypothesis (Tallal, 1980)
- Phoneme Identification Test (PIT)
  - Assesses categorical perception

Trouble processing **syllables**
Temporal sampling framework hypothesis (Goswami, 2011)
- Parsing Syllable Envelopes Test (ParSE)
  - Assesses syllable boundary detection
PIT – Fast-rate processing of formant frequency changes

Conditions: Quiet; 0 dB SNR Broadband Noise
ParSE – Temporal sampling of slower syllabic amplitude modulations

0% modulation

50% modulation

100% modulation
Hypotheses

• A proportion of children with **phonological** or **mixed** reading difficulties will **fail** PIT and/or ParSE
• Children with **surface** reading difficulties will **pass** PIT and ParSE
• Children’s performance on the PIT and ParSE would be:
  • Positively correlated with **non-word** reading (and stronger for PITN)
  • But **not** correlated **irregular word** reading
Participants

• 16 children: males = 10; females = 6
• Age range = 8 yrs 2 mths – 11 yrs 4 mths; Mean age = 9 yrs 7 mths
• All monolingual English speakers
Test Procedure

Day 1
- Hearing Screen
- Reading (CC2)
- Auditory Resolution (PIT & ParSE)
- Phonology (CTOPP-2 BNW & SNW)

Day 2
- Attention (NEPSY-II)
- Speech-in-Noise (LiSN-S HC)
- Memory (TAPS-3 NMF & NMR)
- Intelligence (WASI-II Voc & MR)
Results

Child with reported reading difficulties

Phonological dyslexia  
\( n = 4 \)

Mixed dyslexia  
\( n = 7 \)

Surface dyslexia  
\( n = 5 \)

Fail: Auditory deficit  
\( n = 4 \)

PITQ&N:  
\( n = 2 \)

ParSE:  
\( n = 2 \)

Pass: Non-auditory deficit  
\( n = 0 \)

RCC2

PIT & ParSE
Results

Child with reported reading difficulties

- Phonological dyslexia
  - Fail: Auditory deficit
    - n = 4
  - Pass: Non-auditory deficit
    - n = 0

- Mixed dyslexia
  - n = 7

- Surface dyslexia
  - n = 5

PIT & ParSE

- Fail: Auditory deficit
  - n = 4
- PITQ&N: n = 2
  - PITN: n = 1
  - ParSE: n = 1
- Pass: Non-auditory deficit
  - n = 0

CC2
Results

Child with reported reading difficulties

- Phonological dyslexia
  - Fail: Auditory deficit
    - n = 4
  - Pass: Non-auditory deficit
    - n = 0
- Mixed dyslexia
  - Fail: Auditory deficit
    - n = 4
  - Pass: Non-auditory deficit
    - n = 3
- Surface dyslexia
  - Fail: Auditory deficit
    - n = 1
  - ParSE
    - n = 1
- PITQ&N
  - n = 2
  - PITN
    - n = 1
  - ParSE
    - n = 1
- PITQ&N
  - n = 2
  - PITN
    - n = 1
  - ParSE
    - n = 2
Results

Child with reported reading difficulties

Phonological dyslexia
\( n = 4 \)

- Fail: Auditory deficit
  \( n = 4 \)
- Pass: Non-auditory deficit
  \( n = 0 \)

Mixed dyslexia
\( n = 7 \)

- Fail: Auditory deficit
  \( n = 4 \)
- Pass: Non-auditory deficit
  \( n = 3 \)

Surface dyslexia
\( n = 5 \)

- Fail: Auditory deficit
  \( n = 1 \)
- Pass: Non-auditory deficit
  \( n = 4 \)

PIT & ParSE

- PITQ&N: \( n = 2 \)
- PITN: \( n = 1 \)
- ParSE: \( n = 1 \)

- PITQ&N: \( n = 2 \)
- ParSE: \( n = 2 \)

- ParSE: \( n = 1 \)
## Significant Correlations

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>r</th>
<th>r²</th>
<th>p</th>
<th>Correlation Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-words vs. PITN</td>
<td>16</td>
<td>0.58</td>
<td>0.34</td>
<td>0.019</td>
<td>Strong</td>
</tr>
<tr>
<td>Non-words vs. Blending</td>
<td>16</td>
<td>0.72</td>
<td>0.52</td>
<td>0.002</td>
<td>Strong</td>
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<tr>
<td>Non-words vs. Segmenting</td>
<td>16</td>
<td>0.61</td>
<td>0.37</td>
<td>0.013</td>
<td>Strong</td>
</tr>
<tr>
<td>PITQ vs. PITN</td>
<td>16</td>
<td>0.74</td>
<td>0.54</td>
<td>0.001</td>
<td>Strong</td>
</tr>
<tr>
<td>Blending vs. Segmenting</td>
<td>16</td>
<td>0.74</td>
<td>0.55</td>
<td>0.001</td>
<td>Strong</td>
</tr>
<tr>
<td>Attention Switching vs. NMF</td>
<td>16</td>
<td>0.57</td>
<td>0.33</td>
<td>0.020</td>
<td>Strong</td>
</tr>
<tr>
<td>NMF vs. NMR</td>
<td>16</td>
<td>0.61</td>
<td>0.37</td>
<td>0.012</td>
<td>Strong</td>
</tr>
</tbody>
</table>
Non-Word vs. PIT Correlations

Graph 1: PITQ z score vs. Non-word z score
- $r = 0.36, r^2 = 0.36, p = 0.17$

Graph 2: PITN z score vs. Non-word z score
- $r = 0.58, r^2 = 0.34, p = 0.02$
Non-Word vs. ParSE Correlation

\[ r = -0.09, r^2 = 0.01, p = 0.75 \]
Irregular Word vs. PIT Correlations

Irregular word z score vs. PITQ z score:
- \( r = -0.15, r^2 = 0.02, p = 0.58 \)

Irregular word z score vs. PITN z score:
- \( r = -0.16, r^2 = 0.03, p = 0.55 \)
Irregular Word vs. ParSE Correlation

\[ r = -0.22, r^2 = 0.05, p = 0.45 \]
Conclusions

• A proportion of children with phonological or mixed reading difficulties failed PIT or ParSE
  • But not both
    • Different mechanisms at work for rate-processing & temporal sampling
    • These hypotheses may describe different reading difficulties
• 4 out of 5 children with surface reading difficulties did not have an auditory resolution deficit
• Non-word reading correlated to PITN only
  • Need to do a larger study, subgroup children, and then correlate
Thanks for listening! Any questions?

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