An examination of subtypes of developmental dyslexia and intervention effects

Beth A. O'Brien, Maryanne Wolf and Maureen Lovett

Joint NIE, MOE and KKH Symposium on “Beyond the Mainstream: Exploring the Cognitive Development of Children with Special Needs and Children At-Risk of Academic Failure”, Singapore, 4 April 2013
An examination of subtypes of developmental dyslexia and intervention effects

Beth A. O’Brien  CRPP, NIE

collaborators Maryanne Wolf & Maureen Lovett
(Tufts University; Toronto University)
Developmental Dyslexia

- a specific learning disability
- biological in origin
- characterized by difficulties with accurate and/or fluent word recognition
- and by poor spelling and decoding abilities.
Double-Deficit Hypothesis

No Deficits
- Intact Phonological Decoding
- Intact Naming
- Average Reading

Phonological Deficit
- Impaired Phonological Decoding
- Intact Naming
- Impaired Naming Speed
- Impaired Comprehension

Naming Speed Deficit
- Intact Phonological Decoding
- Impaired Rate of Naming
- Impaired Comprehension

Double-Deficit
- Impaired Phonological Decoding
- Impaired Rate of Naming
- Severe Comprehension Deficit

(Wolf & Bowers, 1999)
Evidence for Independent Deficits

**Naming Speed:**

I differs between children with dyslexia versus average peers and garden variety poor readers (Wolf & Obregon, 1999)

II statistically independent contribution to reading fluency and comprehension (Bowers, 1995; Pennington et al., 2001; Schatschneider et al., 2004)

III better predictor of reading in transparent languages with shallow orthographies or non-alphabetic orthographies (e.g., Dutch-Yap & van der Leij, 1993; German - Wimmer, Mayringer, & Landerl, 2000; Chinese - Ho, Chan, Tsang, & Lee, 2002; Japanese - Kobayashi, et al., 2005)

IV involves activation of different brain structures than phonemic tasks (Misra, et al., 2004; Eckert et al., 2003; Deutsch et al., 2005)
RMSEA value of .083, CFI > .95
Powell, Stainthorp, Stuart, Garwood & Quinlan (2007)
Do Double Deficit Hypothesis subtypes of dyslexia represent different classes of individuals?

Are phonological-deficit and naming-speed-deficit deficit subtypes different in kind or degree?

% of Taxon and Complement groups in range

# CASES

INDICATOR VARIABLE

“Hitmax Point”

Total Sample

Latent Complement Group

Latent Taxon Group

Taxon

Complement
Taxometric Analysis Procedures

**MAXCOV**

**MAMBAC**

**INDICATOR VARIABLE**

- Covariance (Y, Z indicators)
- 1st cut
- 2nd cut
- Last cut
- Hitmax Point

**Covariance (Y, Z indicators)**

- MY BELOW
- MEAN (Y) ABOVE
- MEAN (Y) BELOW
- MY ABOVE

**Cuts along X Indicator**

**Mean Above - Mean Below**
Covariance

INDICATOR VARIABLE

Covariance

Mean Above - Mean Below

Mean Above - Mean Below

Taxonomic

Nontaxonomic
Sample Participants

671 Grade 1-3 Children identified with reading disability:

- Low Achievement Criterion (below 15th percentile)
- Discrepancy Criterion (1SD difference from predicted)

English speaking (monolingual)
No primary sensory or neurological conditions

(Morris, Lovett & Wolf, NICHD #HD30970)
Hypotheses Tested:

I. Taxon with phonological deficits
   
   * Indicator variables:
     - CTOPP Elision (Wagner, Torgesen, Rashotte, 1999)
     - CTOPP nonword repetition
     - Sound Symbol conversion (Lovett, et al., 1994)
     - Decoding (TOWRE, Torgesen et al., 1999)

II. Taxon with naming speed deficits
   
   * Indicator variables:
     - RAN Letters
     - RAN Objects (Denkla & Rudel, 1976)
     - WISC-III Coding (Wechsler, 1991)
Hypothesis 2
NSD TAXON
• Both Taxometric procedures indicate the presence of a phonological-deficit taxon and a taxon without phonological deficits

• Children with and without phonological processing deficits are different in kind (e.g., in neurobiological, or genetic constitution)

• Results imply multiple neurobiological pathways for reading failure
# Implications for Diagnosis and Intervention

<table>
<thead>
<tr>
<th>Phonological Core Deficit</th>
<th>Double-Deficit Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on phonological processing</td>
<td>Explicitly address automaticity and fluency as well as phonology</td>
</tr>
</tbody>
</table>
direct instruction program
training letter-sound correspondences, sound segmentation and blending
practice with rhyming, decoding, and word analysis

integrated fluency program training quality representation and rapid rate of retrieval in:
phonological, orthographic, semantic, syntactic, and morphological component processes, and their interconnections
Practice at sublexical, lexical, and connected text levels

PHAB (Phonological awareness & Blending)
PHAB+ RAVEO
Reading Measures

across Taxometric Subtypes

**PD taxon** scored below Elision HITMAX point from MAXEIG analysis

**nonPD taxon** scored above Elision HITMAX point from MAXEIG analysis
Word Reading Accuracy
(WRAT-3)

<table>
<thead>
<tr>
<th>Taxometric Subtype</th>
<th>MATH+CSS</th>
<th>PHAB/DI+CSS</th>
<th>PHAB/DI+RAVEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td>30</td>
<td>44</td>
<td>51</td>
</tr>
<tr>
<td>nonPD</td>
<td>33</td>
<td>24</td>
<td>35</td>
</tr>
</tbody>
</table>
Passage Reading Fluency (GORT)

Z Score Change

Taxometric Subtype

- MATH+CSS
- PHAB/DI+CSS
- PHAB/DI+RAVEO

PD

nonPD
CONCLUSIONS

1. Overall, children with dyslexia benefited more from RAVE-O fluency training in subword processing, word identification and reading fluency.

2. For Word Reading, children in the non-phonological taxon were aided the most with RAVE-O fluency training compared to phonological training alone.

3. For decoding and text fluency, children in the phonological-deficit taxon showed additional gains from RAVE-O training.
CONCLUSIONS

**Diagnosis** - Needs to take into account measures such as naming speed in addition to phonological processing tasks

**Treatment** - Should explicitly address issues of automaticity and fluency as well as phonology