Specific Developmental Dyslexia: Core Problems and Effective Treatments

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Issues to be covered

1. What percentage of school children in the United States experience difficulties learning to read?

2. Where do children with “specific developmental dyslexia” fit within the broader spectrum of all students with reading difficulties?

3. What are the core neurological/psychological problems in students with dyslexia?

4. What do we know about effective interventions for students with dyslexia?
The size of the problem

The Nation’s Report Card—Reading 2013

Go to Google and type in "The Nation’s Report Card"
2013 results from National Assessment of Educational Progress at 4th Grade

Percentage of students performing **below the Basic Level** of Proficiency - 179,000 students tested

- White: 21%
- Black: 50%
- Hispanic: 47%
- Poor: 48%
- Non-poor: 17%

**Socio-cultural diversity**

**Socio-economic diversity**
Prior to recent discoveries about dyslexia, students like Alexis were diagnosed by exclusion.

Alexis has a reading difficulty not caused by:

- Low intelligence, or general ability
- Lack of support, or learning opportunities, at home
- Poor instruction
- Other disabilities like vision or hearing

Made the assumption, that these disabilities were intrinsic to the child, but didn’t know what the intrinsic disability was.
A modern definition of Dyslexia

“Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction.” (Lyon & Shaywitz, 2003)
Dyslexia is a specific learning disability that is **neurobiological in origin**: categories of evidence

1. Heritability studies using large twin samples have shown that core reading problems in children with dyslexia are highly heritable.

2. Studies using FMRI have found consistent differences in brain functioning in samples of dyslexic and non-dyslexic students and adults.
Recent Functional Neuroimaging findings on Adults
Neural Response to Intervention

Does the pattern of brain activation change in response to intervention?

8 children with severe dyslexia (7 to 17)
8 week intense phonologically-based intervention (2 hours a day = up to 80 hours of instruction)

Very large improvements in reading ability

Simos et al., Neurology, 2002
Strong activation pattern

Weak activation pattern
Decreased activity in right hemisphere

Increased activity in left hemisphere
Decreased activity in right hemisphere

Increased activity in left hemisphere
Dyslexia is a specific learning disability that is neurobiological in origin

1. Heritability studies using large twin samples have shown that core reading problems in children with dyslexia are highly heritable

2. Studies using FMRI have found consistent differences in the brain functioning in samples of dyslexic and non-dyslexic students

3. Examinations of the brains of deceased individuals with dyslexia have found subtle differences in brain architecture consistent with behaviorally observed differences
1. Students with dyslexia show early difficulties learning letter sound correspondences.

2. They also have difficulties learning to “sound out” unfamiliar words (phonemic decoding skills).

3. Their difficulties learning to decode unfamiliar words makes them inaccurate readers, and makes their reading slow and labored and unrewarding.

4. They do not become fluent readers because their inaccurate and labored decoding makes it difficult to learn to recognize thousands of words by sight.

It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities.
Once reading instruction begins, fluency based word reading tasks are highly diagnostic of the kinds of reading difficulties experienced by students with dyslexia.

<table>
<thead>
<tr>
<th>Pronounceable nonwords</th>
<th>High frequency read words</th>
</tr>
</thead>
<tbody>
<tr>
<td>pim</td>
<td>cat</td>
</tr>
<tr>
<td>baf</td>
<td>book</td>
</tr>
<tr>
<td>pate</td>
<td>help</td>
</tr>
<tr>
<td>skree</td>
<td>paper</td>
</tr>
<tr>
<td>dreker</td>
<td>money</td>
</tr>
<tr>
<td>brinbert</td>
<td>space</td>
</tr>
</tbody>
</table>
These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction."

Before reading instruction begins, students with dyslexia have difficulties becoming aware of the phonological structure of language
Words are composed of strings of phonemes. A phoneme is the smallest unit of sound in a word that makes a difference to its identity.
Phoneme awareness is the understanding that speech is composed of a sequence of sounds (phonemes) that are combined, and recombined to form words. It is also the ability to identify and manipulate these sounds.

It is important for learning to read because it helps children understand the way that letters are used to represent words in our language.
In Kindergarten, the two **most diagnostic** tests for dyslexia are:

**Knowledge of letter names or letter sounds**

**Tests of phonemic awareness**

“What is the last sound you hear in the word *man*?”

“What are the sounds in the word *fit*?”

“If the word *man* began with an /f/ sound, what word would it be?”
Specific reading disabilities, or developmental dyslexia, is caused by a weakness, or lack of talent, in the *phonological domain of language*. A weakness makes it difficult to acquire phonemic awareness and alphabetic reading skills—which interferes with the growth of accurate reading skills and reading fluency. These problems, in turn, interfere with reading comprehension.
What we know about the factors that affect reading comprehension

Proficient comprehension of text is influenced by:

- Accurate and fluent word reading skills
- Oral language skills (vocabulary, linguistic comprehension)
- Extent of conceptual and factual knowledge
- Knowledge and skill in use of cognitive strategies to improve comprehension or repair it when it breaks down.
- Reasoning and inferential skills
- Motivation to understand and interest in task and materials
Important facts about talent in the phonological language domain:

It is like most other talents in that it is distributed normally in the population.
“Phonological talent” is normally distributed in the population.

Children can be strong in this talent-like my grandson Andrew.
“Phonological ability” is normally distributed in the population.

Children can be moderately weak in this talent-like David.
Each of these kinds of weakness is normally distributed in the population.

Serious difficulties—probably require special interventions and a lot of extra support—like Alexis.
Another important fact about talent in the phonological language domain:

It is only weakly correlated with broad verbal ability or general intelligence.
Phonological Language Ability is not highly Correlated with General Verbal Ability as measured by IQ tests.
Phonological Language Ability is not highly Correlated with General Verbal Ability as measured by IQ tests.
One more important fact about talent in the phonological language domain:

Children’s ability in this area when they come to school is influenced both by biologically based talent, and by opportunities to learn from their pre-school environment.
Development of Phonological Sensitivity

Cross-sectional study comparing the performance of 250 children from higher income families to 170 children from lower income families.

Children were between two- and five-years of age.
Elision Task

Adjusted Average Score

- Middle-Income
- At-Risk

Age Group: 2-Yr-Old, 3-Yr-Old, 4-Yr-Old, 5-Yr-Old
To summarize:

Children can come to school weak in phonological ability either because of their biology or their language experience.

Regardless of whether they also have broader weaknesses in verbal ability, both types of children need similar intensive early reading support in order to prevent reading failure.
Do we know how to prevent the phonological problems in students with dyslexia from developing into a serious reading disability?

Yes, in all but a very small percentage of students (perhaps around one to two percent)
An Example of an Effective Intervention
Design of Study in which intervention occurred

1. Most “at risk” first graders from five elementary school - PPVT above 70

2. Instruction provided in 45 min. sessions every day from October through May in groups of 3 or 5 by experienced teachers or well-trained paraprofessionals

3. Used a structured (scripted) reading program that contained instruction and practice in phonemic awareness, phonics, fluency, and comprehension
Growth in Word Reading Ability

National Percentile

October  January  May

30  70  75th  50th  25th
Growth in Correct Words Per Minute on First Grade Level
Passages for four lowest performers
What about remediation for older students who did not get effective preventive interventions?
A study of intensive, highly skilled intervention with 60 children who had severe reading disabilities

Children were between 8 and 10 years of age

Had been receiving special education services for an average of 16 months

Nominated as worst readers: at least 1.5 S.D’s below grade level

Average Word Attack=69, Word Identification=69, Verbal IQ=93

Randomly assigned to two instructional conditions that both taught “phonics” explicitly, but used different procedures with different emphasis

Children in both conditions received 67.5 hours of one-on-one instruction, 2 hours a day for 8 weeks

Children were followed for two years after the intervention was completed
Growth in Total Reading Skill Before, During, and Following Intensive Intervention

Standard Score

Interval in Months Between Measurements
Growth in Total Reading Skill Before, During, and Following Intensive Intervention

Standard Score

Interval in Months Between Measurements

P-Pretest  Pre  Post  1 year  2 year

LIPS  EP

80  85  90  95
Growth in phonemic decoding during intervention & follow-up

- LIPS
- EP

Pretest | posttest | 1 year | 2 years

Standard Score: 100, 90, 80, 70, 60
Growth in text reading accuracy during intervention & follow-up

- Pretest
- Posttest
- 1 year
- 2 years

LIPS
EP
Growth in comprehension during intervention & follow-up

Standard Score

Pretest  posttest  1 year  2 years

EP  LIPS
Growth in fluency during intervention & follow-up

![Graph showing growth in fluency during intervention & follow-up](image)
Oral Reading Fluency was much improved on passages for which level of difficulty remained constant.

Absolute change in rate from pretest to 2-year follow-up.

**Most difficult passage**

<table>
<thead>
<tr>
<th>P</th>
<th>WPM</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>38</td>
<td>10</td>
</tr>
<tr>
<td>P</td>
<td>101</td>
<td>2</td>
</tr>
</tbody>
</table>

**Next most difficult passage**

<table>
<thead>
<tr>
<th>P</th>
<th>WPM</th>
<th>Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>42</td>
<td>6</td>
</tr>
<tr>
<td>P</td>
<td>104</td>
<td>1</td>
</tr>
</tbody>
</table>
Disparity in outcomes for rate vs. accuracy in five remediation studies

Beginning level of Word Identification Skill
Five principles of effective intervention for older students with dyslexia who continue to struggle in reading
**PRINCIPLE # 1**

**Effective interventions teach academic skills directly**

Training in motor, visual, neural, or cognitive processes *without academic content* does *not* reliably lead to better academic outcomes for children with learning disabilities (Fletcher et al., 2007).

Intensive and skillful phonologically based interventions have an impact on brain functioning. They facilitate the development of neural systems that support skilled reading.
PRINCIPLE # 2

Address learning deficits directly. Teach the skills and knowledge required for proficient reading.

Children with auditory processing difficulties need to learn how to decode; students who lack fluency need to become more fluent; students with weak comprehension/reading strategies need to become more strategic.
PRINCIPLE # 3

Broad methods of effective teaching for any struggling learner are helpful for students with dyslexia.

In contrast to instruction for students who learn easily, interventions for students with dyslexia must:

- Be more precisely targeted at the right level
- Provide clearer and more detailed explanations
- Contain more systematic instructional sequences
- Provide more extensive opportunities for guided practice
- Contain more opportunities for error correction and feedback
- Allow cumulative review of previously taught content
PRINCIPLE # 4

Provide more intensive instruction

The most direct way to increase learning rate is to increase the intensity of instruction. Intensity can be increased both by providing additional time and reducing the size of instructional group.

Torgesen, 2005a
PRINCIPLE # 5

Teach students to be strategic for word analysis, vocabulary building, and comprehension

Dyslexic students need to acquire effective strategies for decoding complex, unfamiliar words, for learning new word meanings, and for creating meaning from text

Instruction should also explicitly address generalization to real literacy/learning tasks in classroom and home

Maureen Lovett (2008)
Questions/Discussion