Assessment of Dyslexia and Executive Function in School-Age Children

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What is Dyslexia?

• An unexpected difficulty in reading in children and adults who otherwise possess the intelligence, motivation, and schooling considered necessary for accurate and fluent reading (Shaywitz 1998)

• Most Common of all of the known LD: affecting 1 in 5 children in the U.S. and accounting for 80% of those diagnosed with an LD

• While some professionals may define reading disability to include children whose primary deficit is in reading comprehension, focus is on dyslexia
Definition Adopted by Internal Dyslexia Association

• Characterizes dyslexia as difficulty with accurate and and/or fluent word recognition and by poor spelling and decoding abilities

• Dyslexia is a disorder within the language system, specifically the phonological processing system

• In order to read, child must learn the alphabetic principle: spoken words can be pulled apart into different units with the smallest unit being the phoneme – and that letters can represent these sounds

• Results of numerous studies have confirmed that a deficit in phonology is the most robust and specific correlate of dyslexia and forms the basis for the most successful, evidence-based interventions
Comorbidity Between ADHD and Dyslexia

• Co-occur more frequently than expected by chance, with 25-40% of children with one disorder meeting criteria for another (Willcutt & Pennington, 2000)

• Children with comorbid dyslexia and ADHD exhibit a more extensive and severe profile of neuropsychological weaknesses and stronger genetic loading (Willcutt, 2009)

• Multiple cognitive deficit hypothesis suggests that there is considerable overlap of neurocognitive deficits between these disorders (Moura et al. 2016)
Impairment in Groups with and Without RD and ADHD

Figure 1. Impairment (%) in groups with and without dyslexia and ADHD. Information from Willcutt et al. (2007).
Diagnosis & Treatment: Presenting Symptoms

• Problems learning to read and spell – not necessarily problems with reading comprehension or problems on weekly spelling tests
• “He’s having trouble in school”
• Slow reading or writing speed, letter and number reversals, problems memorizing math facts
Diagnosis & Treatment: Secondary Symptoms

• Resistance to schoolwork
• Disruptive in school
• “Lack of motivation” – particularly in bright, older students
• Emotional or physical complaints such as anxiety, depression, stomach aches, reluctance to go to school
History

- Family history of dyslexia or problems learning to read
- Problems learning the alphabet, letter names
- Trouble learning to read
- School assistance in reading
- Difficulty with spelling, written work
- Not working “up to potential”
Diagnosing Dyslexia: Assessing Intelligence

• Must assess intelligence, although somewhat controversial

• Recent study found that there was significant difference in General Ability Index (GAI) on the WISC between children with dyslexia and typically developing children (Moura et al. 2014)

• Most commonly used IQ tests:
  – Wechsler Intelligence Scale for Children (WISC-IV)
  – Wechsler Adult Intelligence Scale (WAIS-IV)
  – Differential Abilities Scale (DAS-II)
  – Stanford Binet
Assessment of Reading Ability:
Decoding Skills

• How accurately can the child decode (i.e., read aloud) single words?
• Visual errors are common on these tests (e.g., “car” for “cat”)
• These errors are reflective of a phonological coding or phonics problem because the child is using visual similarity rather than phonics to decode the word
### WIAT Word Reading

<table>
<thead>
<tr>
<th>in</th>
<th>to</th>
<th>my</th>
</tr>
</thead>
<tbody>
<tr>
<td>they</td>
<td>cow</td>
<td>when</td>
</tr>
<tr>
<td>bear</td>
<td>don’t</td>
<td>shop</td>
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<tr>
<td>other</td>
<td>stone</td>
<td>sky</td>
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<tr>
<td>breeze</td>
<td>fight</td>
<td>between</td>
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<td>goat</td>
<td>foot</td>
<td>wrong</td>
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<tr>
<td>seat</td>
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<td>depend</td>
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<td>frozen</td>
<td>knife</td>
<td>distance</td>
</tr>
<tr>
<td>equipment</td>
<td>manage</td>
<td>photograph</td>
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<td>playfully</td>
<td>rhyme</td>
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<tr>
<td>posed</td>
<td>budge</td>
<td>ruin</td>
</tr>
<tr>
<td>tough</td>
<td>garnish</td>
<td>ridiculous</td>
</tr>
<tr>
<td>interject</td>
<td>radiant</td>
<td>poise</td>
</tr>
</tbody>
</table>
Assessment of Reading Ability: Non-word Reading

- Is the child able to read non-words?
- Non-word reading is a benchmark for phonological decoding because in order to read a non-word (zoop, grep, untroikest), knowledge of phonological decoding alone must be relied upon as these letter strings have never been seen or heard before
<table>
<thead>
<tr>
<th>ak</th>
<th>mib</th>
<th>Pseudoword Card</th>
</tr>
</thead>
<tbody>
<tr>
<td>ik</td>
<td>ab</td>
<td>fip</td>
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<tr>
<td>rix</td>
<td>seb</td>
<td>zad</td>
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<tr>
<td>sluck</td>
<td>rith</td>
<td>dreep</td>
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<td>snay</td>
<td>droy</td>
<td>joom</td>
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<td>clurt</td>
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<td>glatch</td>
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<td>sorb</td>
<td>tuffle</td>
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<td>waim</td>
<td>stight</td>
<td>syle</td>
</tr>
<tr>
<td>floit</td>
<td>unfrodding</td>
<td>smaut</td>
</tr>
</tbody>
</table>
Assessment of Reading Ability: Reading Fluency

• Is the child’s reading fluent?
• Gray Oral Reading Test (GORT-5) most often used; performance is based on measures of rate and accuracy
• WIAT Oral Reading Fluency is another common measure of rate and accuracy
• Children with dyslexia are usually slow and halting in oral reading and will often make *function word errors* (interchanging “a” and “the”)
Assessment of Reading Ability: Reading Comprehension

- Can assess single-word comprehension as well as passages
- Children with dyslexia often perform better on tests of comprehension than on other measures of reading because:
  - They can rely on context to guess the meaning of a word they may not otherwise be able to decode
  - Reading comprehension is correlated with intelligence
- Comprehension has been shown to use different cognitive resources than the ones generally impaired by dyslexia (Kasirer and Mashal 2016)
Assessment of Reading Ability: Spelling

• Problems with spelling are extremely typical
• Proportion of errors that are not phonetically accurate
  (especially errors in which consonants have been added, omitted, or substituted) is important
• Dysphonetic Errors:
  – ‘bol’ for ‘boy’
  – ‘kerock’ for ‘cook’
  – ‘expilen’ for ‘explain’
Sammy: Spelling (2nd Grade)
Assessment of Reading: Writing

• Tests of writing include Test of Written Language (TOWL), where child has 15 minutes to generate a story about a picture.

• Other tests of writing fluency:
  – WIAT Essay/Sentence Composition
  – Woodcock Johnson Writing Samples
  – Oral and Written Language Scales (OWLS-II)
Sammy: TOWL (2nd Grade)

The men...
Sammy: TOWL (4th Grade)
Case: Tracy (Writing Sample)

1. My name is _______________________.

2. This is a ___________.

3. This is a ___________.

4. This is a little box. This is a ___________.

5. This is a white hat. This is a ___________.

6. He is running away.
Assessment of Phonological Processing: Lindamood Auditory Conceptualization Test (LAC-3)

- Measures an individual’s ability to perceive and conceptualize speech sounds using a visual medium (Lindamood and Lindamood, 2004), or Phonological Awareness (PA)
- Phonemes and syllables are represented using colored cubes and felt squares and the individual adds, takes away, or rearranges the cubes/squares to make new strings of phonemes or syllables
- Deficits in PA have been shown to differentiate dyslexic from typically developing children (World Health Organization, 2009)
Examples of Lindamood Subtests:

**Isolated Phoneme Patterns:**
If /t,t/ = □ □ Because I made two sounds that were the same

If I make two sounds that are not the same, you would pick two different colors /t,p/ = □ □

Now show me: /g,b,v/

**Tracking Phonemes**
If □ is /u/, and I want to show you /zu/, I have to put a different sound before the first: □ □

If □ □ is /zu/ and I want to show you /uz/ I would show you:

If □ □ □ □ is /pip/ show me /ip/
Neuropsychological Measures

• Full assessment not completely necessary but can provide important information regarding child’s cognitive strengths and weaknesses and role they may play in the child’s reading deficiency, as well as in the remediation process

• Problems can be seen in:
  – Difficulties with other aspects of language such as semantics and syntax (grammar)
• Children with dyslexia tend to:
  – Underperform on phonological tasks such as Digit Span
  – Show relative weaknesses on all verbal subtests
  – Obtain lower nonverbal IQ scores relative to peers (although effect size is smaller than for verbal IQ)
  – Show slower processing speed

Processing speed is the shared cognitive deficit that accounts for the comorbidity between dyslexia and ADHD (Willcutt et al, 2010)
PS is also shown to become more impaired when ADHD and dyslexia are comorbid as compared to individuals with only ADHD or dyslexia (Moura 2016)
Comorbidity between reading difficulties and ADHD is primarily attributable to common genetic influences that are shared with PS
Measures of Executive Function in Dyslexia

• Executive function is generally measured in multiple sub-categories

• Four commonly measured sub-categories:
  – Processing Speed
  – Shifting
  – Planning
  – Verbal Fluency
Processing Speed

• Measures how quickly an individual can process information and respond to simple intellectual tasks

• Has been shown to be impaired in children with dyslexia (Moura et al. 2014; Thomson et al. 2003)

• Common measures of processing speed:
  – WISC Coding and Symbol Search
  – WIAT Math Fluencies
  – Woodcock Johnson Reading/Math/Writing Fluencies
Shifting

• Measures the ability to move between different mental tasks or strategies
• Research has shown variation in the shifting ability of children with dyslexia, with some seeing no difference from typical developing children (Bental et al. 2007)
• Others found impairment in dyslexic children as compared to typically developing controls (Horowitz-Kraus 2012)
• Common measures of Shifting:
  – Wisconsin Card Sorting Test (WCST)
  – D-Kefs Trails Test Module 4
Planning

• Measures the ability to identify the procedure or steps necessary to complete a specific task

• Research has produced varying conclusions, with some suggesting that dyslexic individuals will be able to identify the appropriate steps but require longer to do so than TD individuals (Reiter et al. 2005)

• Common measures of Planning:
  – Tower of London
  – Tower of Hanoi
  – D-KEFS Tower Test
Verbal Fluency

• Measures memory and language ability, generally broken down into two sub-types: phonemic (generating words starting with a specific letter) and semantic (specific category)

• Dyslexic children have reduced ability to generate words from phonemic cues (Landrel et al. 2009)

• Semantic VF tasks have been shown to be useful to differentiate dysphonetic and dyseidetic dyslexia (Cohen et al. 1999)

• Common measures of Verbal Fluency:
  – D-KEFS Verbal Fluency
  – NEPSY Word Generation
Treatments for Dyslexia: Remediation

• Special education **services or private tutoring**
• **Highly structured, multi-sensory phonics-based approaches** are most successful
• **Programs make very concrete and clear the letter-sound correspondences:**
  – Orton Gillingham
  – Lindamood Bell
  – Wilson
• **Tutoring in**
  – Reading comprehension
  – Study skills
  – Writing
Treatments for Dyslexia: Compensation

- Extra time to complete tests and written assignments
- Giving feedback orally, permitting oral book reports
- Assistance with note taking
- Marking but not downgrading for spelling errors
- Use of laptop or handheld personal spellers
- Use of calculator when appropriate
- Providing access to lecture notes or tape-recording lectures
Unsubstantiated Treatments for Dyslexia

- Optometric training: eye exercises, colored lenses
- Medications or exercises to improve vestibular or cerebellar functioning
- Vitamins or dietary treatment
- Chiropractic manipulation
Assessment of Bright Young Adults with Dyslexia

- Diagnostic issues are more subtle and referral question is often depression, not “performing up to par,” inattention
- Typically these students have been performing at grade level, so no referral is made
- Tests measuring single-word accuracy may be inadequate
- Timed tests of reading are needed
- By high school, reading may be accurate but lack automaticity
- History is very important
Essential Facts about Dyslexia in Adults

• Phonological weakness persists; it never goes away
• In children, the phonological weakness primarily affect reading accuracy; over time, accomplished dyslexia adults learn to read a core of words accurately
• In bright young adults the phonological weakness affects the speed of reading
• Skilled adult readers read accurately and rapidly; while adult dyslexics read slowly and laboriously – they are not fluent
• Brain imaging studies indicate adult dyslexics never switch over to the automatic reading circuit necessary for fluency reading
• Reliance on secondary reading pathways results in accurate but slow reading
Outcome in Adolescence and Adulthood

- Well-designed follow-up studies repeatedly show that reading disabilities persist.
- General intelligence and initial severity of the reading disorder are best predictors of early adult reading levels.
- Most children can learn to read quite well, although they may remain slow readers and poor spellers.
- Cognitive linguistic weaknesses in verbal memory or phonological representations persist but need not be impairing.