Working Memory & Processing Speed in the Classroom

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Not all gifted students are built alike!
Slow Processing Speed

• Not always a bad thing?
What’s important about Working Memory and Processing Speed?

Problems in WM and/or PS:

…are often part of the reason children struggle in school

…are often seen in *Twice Exceptional* students

…cause troubles at home

…impact children’s relationships.

…often define children’s feelings about themselves.
Goals

• To demonstrate how Working Memory (WM) and Processing Speed (PS) impact students.

• To demonstrate that WM and PS can be related to the Executive Functions associated with ADHD and with LD.

• To develop more thorough and accurate definitions of WM and PS.

• To plan interventions to address WM and PS problems in the classroom.
What’s important about Working Memory and Processing Speed?

• In school, WM and PS impact alertness, learning, expression, social adjustment, academic identity, emotional comfort, etc.

• At home, WM and PS impact homework, chores, relationships, recreation (sports and games), self concept, etc.
WM and/or PS may accompany giftedness (2e)

At this point these are informal labels, but refer to two essential parts:

1. Giftedness
2. Learning interference(s)

...which combine to cause the student to underperform.
Three subgroups of 2e

1. Students identified as gifted, who develop difficulties in school. Their learning problems remain unrecognized until they fall so far behind their peers that someone finally suspects a disability.

2. Students whose learning disabilities have been identified, but whose exceptional abilities have never been recognized.

3. Students those whose abilities and disabilities mask each other (pressing the gas but the brakes are engaged).
WM and PS in context

ADHD

LD

Emotional Problems
WM & PS can be related to ADHD and/or Learning Differences

Learning Differences

ADHD/Executive Functions
WM as related to Learning
Ways to measure WM and PS

These factors are included in many standardized tests:

- Psychological
- Educational
- Neuropsychological
WM & PS as related to Structures of Intelligence

- Wechsler Scales (WPPSI, WISC, WAIS)
- Verbal Comprehension Index
- Perceptual Organization Index
- Working Memory Index
- Processing Speed Index
- Full Scale IQ
Basic Definitions (WISC-IV)

Working Memory Index

• The WMI assesses the ability to hold new information in short-term memory, concentrate, and manipulate that information to produce some result or reasoning processes. It is important in higher-order thinking, learning, and achievement. It can tap concentration, planning ability, cognitive flexibility, and sequencing skill, but is sensitive to anxiety too. It is an important component of learning and achievement, and ability to self-monitor.
WISC-IV Working Memory Subtests

- Digit Span
  - Repeating series of digits
  - Reversing series of digits

- Letter Number Sequencing
  - Repeating sequences of numbers and letters in proper order

- Arithmetic
  - Using mental math to perform basic calculations
Basic Definitions (WISC-IV)

Processing Speed Index

- The PSI assesses the abilities to focus attention and quickly scan, discriminate between, and sequentially order visual information. It requires persistence and planning ability, but is sensitive to motivation, difficulty working under a time pressure, and motor coordination.

It is related to reading performance and development. It is related to Working Memory, in that increased processing speed can decrease the load placed on working memory, while decreased processing speed can impair the effectiveness of Working Memory.
WISC-IV Processing Speed Subtests

- Coding: Transcribe symbols using a code
- Symbol Search: Mark whether a target symbol occurs in a search group
- Cancellation: Mark target members of a category mixed in arrays of targets and non-targets
Working Memory and Processing Speed as basic elements of the WISC-IV’s structures of intelligence
### Working Memory as a WISC-IV Component

#### Calculation of Child's Age

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Day</th>
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<tbody>
<tr>
<td>2006</td>
<td>08</td>
<td>15</td>
</tr>
<tr>
<td>1947</td>
<td>02</td>
<td>09</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
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</tbody>
</table>

#### Total Raw Score to Scaled Score Conversions

<table>
<thead>
<tr>
<th>Subtest</th>
<th>Raw Score</th>
<th>Scaled Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block Design</td>
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<td>13</td>
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<tr>
<td>Similarities</td>
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<tr>
<td>Digit Span</td>
<td>13</td>
<td>11</td>
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<tr>
<td>Picture Concepts</td>
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<td>Coding</td>
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<td>Letter-Number Seq</td>
<td>16</td>
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<tr>
<td>Matrix Reasoning</td>
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<td>11</td>
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<tr>
<td>Comprehension</td>
<td>31</td>
<td>11</td>
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<tr>
<td>Symbol Search</td>
<td>30</td>
<td>11</td>
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<td>11</td>
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<tr>
<td>(Information)</td>
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<td>11</td>
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<tr>
<td>Arithmetic</td>
<td>24</td>
<td>11</td>
</tr>
<tr>
<td>(Word Reasoning)</td>
<td>27</td>
<td>11</td>
</tr>
</tbody>
</table>

#### Sum of Scaled Scores

- Total Scaled Score: 33
- Verbal Comprehension: 13
- Perceptual Reasoning: 11
- Working Memory: 12
- Processing Speed: 7
- Total Scaled Score: 13

#### Composite Score Profile

- Verbal Comprehension: 13
- Perceptual Reasoning: 11
- Working Memory: 12
- Processing Speed: 7
- Total Scaled Score: 13

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Processing Speed as a WISC-IV Component
Woodcock-Johnson assesses fluency:

- **Reading Fluency:** speed of reading sentences and answering "yes" or "no" to each.
- **Writing Fluency:** writing simple sentences, using three given words for each item and describing a picture, as quickly as possible for seven minutes.
- **Math Fluency:** speed of performing simple calculations for 3 minutes.
Reading and Processing Speed

• A subset of children with reading disorders display marked difficulties with **verbal and visual processing speed** and that may indicate a subtype of reading disorder.

• Individuals with impairments in both RAN (rapid automatic naming) and phonemic awareness had the most severe reading problems when matched on phonological skills. Individuals with worse RAN scores had poorer performance on timed word recognition and comprehension tests.
Learning Differences can occur in ...
Processing Speed may be hampered due to trouble activating
Steven M. Butnik, ph. D. received his Ph.D. in clinical psychology from the University of Vermont in 1980. He was appointed the director of the Children's Psychology Clinic at the University of Vermont in 1980. He is licensed as a clinical psychologist in Virginia.

Butnik has provided a wide range of psychological services to children and their families since 1982. He has a particular interest in the assessment and management of children with attention deficit hyperactivity disorder (ADHD). In order to provide additional medical alternatives to children with ADHD, Dr. Butnik followed additional training in neurofeedback. He received this training in 1998 from Dr. Joel Lubar, who pioneered the use of neurofeedback for ADHD.
Quickly read the following:

• It has come to the attention of this office that many unsolicited onterators have been tramming on permis of the deriait. Further emications will result in the immediate contority of every sarmensant involved.
Processing Speed impacted by trouble remembering material

“Quickly name all of your elementary teachers from kindergarten through grade six.”
Processing Speed impacted by trouble with output
Oral expression, motor expression

"This computer has a fast modem, the latest Pentium, increased RAM, a huge hard drive and broadband net connections. Only one problem...slow pointer fingers."
ADHD - Inattentive Type
SCT May Be A New Disorder

- Common Presenting Symptoms:
  - Daydreaming, Spacey, Stares
  - Hypoactive, Slow moving, Lethargic, Sluggish
  - Easily Confused, Mentally “Foggy”
- Slow, Error Prone Information Processing
- Poor Focused or Selective Attention
- Erratic Retrieval - Long-Term Memory (?)
- Socially Reticent or Withdrawn
- Not Impulsive (By Definition)
WM & PS as related to Executive Functions

Executive Functions Impaired in ADD Syndrome

PS as related to EF

Regulating Alertness, Sustaining Effort & Processing Speed

3. Effort
WM as related to EF

Utilizing Working Memory & Accessing Recall

5. Memory
Alan Baddeley's model of working memory
Other variables to consider…

- Ambient noise
- Classroom distracters
- Emotional interference (general anxiety, perfectionism, performance anxiety, OCD)
Putting it together – some classroom tasks are especially daunting

Copy the following:

HOMEWORK DUE WEDNESDAY

Math – complete today’s worksheet.
English – Wordly Wise: pages 14-19, even problems only.
Science – continue taking notes on bean plant project
Social Studies – color map with colored pencils: green for your birth state, blue for states you have visited.
WM & PS contribute to academic success

Interventions –

• Services provided by teachers

• Services provided under Section 504

• Services provided under IDEA IEP
Addressing Processing Speed Problems

Built for speed.

Goes fast, but does not have great strength or power. Good for some jobs and not others.
Addressing Processing Speed Problems

Built for power.

Does not do its work quickly, but has great strength and power. Good for some jobs and not others.
Addressing Processing Speed Problems

Determine source of problems to tailor interventions to the individual student’s needs.

If it’s an Activation problem, is it due to…?

• **emotional factors** (It’s too much…”): provide encouragement, support, help getting started, etc

• **cognitive factors** (“I don’t even know where to begin.”): develop a plan, break it down, use graphic organizers, etc
Addressing Processing Speed Problems

If there are focus/attention problems:
• Reduce distractions, provide white noise, recognize on task behavior, prompt student when she drifts, provide incentives for completion of work, etc

If there are working memory problems:
• Provide templates, word banks, encourage questions, provide gentle reminders
Addressing Processing Speed Problems

If there are activity interferences:

- Provide opportunities for movement, fidget objects, gum chewing/candy sucking, etc
Addressing Processing Speed Problems

Increase time to complete tests
Eliminate unnecessary, clerical task elements (e.g., make use of brief responses)
Mad Math Minute makes some students “mad”
Reduce number of tasks necessary to evidence competence
Monitor time spent on homework – adjust as necessary
Overcoming Obstacles Related to Memory

• Assistive Technology for students
• Instructional Materials
• Teaching /Assessment Methods
• Instruction
Assistive Technology for students

• Teachers use software programs as an alternative or additional way of presenting information
• Students tape record directions or information
• Students use software programs for organization of key points
• Teachers add notes about directions or key points as part of assignment that is given on the computer
Instructional Materials

• Multiple modalities, including art and simulations when presenting directions, explanations, and instructional content
• Multiple intelligences approach
• Materials that are meaningful to students
• Copies of the information that highlight key facts
Teaching /Assessment Methods

- Students repeat directions or information back to teacher
- Students repeat information to selves
- Teacher repeats information or directions
- Teacher reinforces students for remembering details
- Students recall important details at the end of a lesson or period of time
Teaching /Assessment Methods (continued)

• Students sequence activities after a lesson or event
• Students teach information to other students
• Students deliver the schedule of events to other students
• Teacher delivers directions, explanations, and instructional content in a clear manner and at an appropriate pace
• Teacher provides students with environmental cues and prompts such as posted rules and steps for performing tasks
Teaching /Assessment Methods (continued)

• Teacher provides students with written list of materials and directions
• Students use resources in the environment to recall information (notes, textbooks, pictures, etc.)
• Teacher gives auditory and visual cues to help students recall information
• Teacher relates information presented to students’ previous experiences
• Teacher emphasizes key concepts
Teaching /Assessment Methods (continued)

• Teacher reviews prior lesson’s key concepts and vocabulary before moving on
• Students outline, highlight, underline, or summarize information that should be remembered
• Teacher provides adequate opportunities for repetition of information through different experiences and modalities
• Teacher provides students with information from a variety of sources
• Teacher tells students what to listen for when being given directions or receiving information
• Students use advanced organizers
• Teacher uses visual imagery
Instruction

- Teach students to use associative cues or mnemonic devices (ROY G BIV)
- Teach students to transform information from one modality to another (e.g., From verbal to a diagram or from visual to verbal)
- Teach students to question any directions, explanations, and instructions they do not understand
- Teach students to deliver increasingly long verbal messages
- Teach students how to organize information into smaller units
- Teach note taking and outlining
Instruction (continued)

• Teach students how to highlight and summarize information
• Teach students a routine for beginning a task
• Teach students how to recognize key words
• Teach students to use resources in the environment to recall information (notes, textbooks, pictures, etc.)
• Teach students study and test-taking skills
• Teach students to practice memory skills by engaging in activities that are purposeful such as delivering messages or being in charge of a classroom task
Instruction (continued)

• Teach students to practice repetition of information
• Teach students to engage in memory games and activities
• Teach students categories
• Teach listening skills
• Teach students how to use organizers such as lists, tables, and graphics
• Teach visual imagery
• Teach students systematic ways to store and retrieve information
New developments in research and practice

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New developments in research and practice
Cogmed

Working Memory Training program is:

- Specifically designed for sustainably improved attention
- Evidence-based
- Clinically proven
- Five weeks long
- Coach-supported
- Conducted at home with phone-based assistance
- Proven to be 80% effective
Cogmed’s research...

• Results from [this} study provide strong evidence that approximately 20 hours of computerized WM training over a 5-week period produced gains in this important executive function and in other executive functions that were not the specific focus of training. These benefits were evident immediately following training and remained evident 3 months later, even though no further training had occurred. In addition, there were significant reductions in children's ADHD symptoms according to parents, although no comparable benefits were evident in teachers' ratings. The gains in WM and the reductions in attention difficulties reported by parents were large, and comparable in magnitude to effects obtained by medication.
Conclusion

• Students with WM and/or PS problems who are “missed,” mis-diagnosed or mis-taught may become discouraged, depressed, underemployed or worse.

• Students with WM and/or PS problems who are well-addressed educationally, can be the treasures who shine in unique ways.