Slide 1

Written expression and cognitive functions: What does the research indicate?

Amy Dilworth Gabel, Ph.D., NCSP
Director, Training and Professional Development
Pearson Clinical Assessment

Slide 2

Objectives

• Describe research-based cognitive factors that related to written expression.
• Introduce assessment batteries to identify disorders of written expression.
• Describe interventions for writing.

Slide 3

Definitions - Quick Guide

• Orthography - visual patterns of the written word
• Syntax - grammatical rules that permits meaningful combinations of words and phrases
• Semantics - meanings that correspond to words
• Lexicon - collection of words in language
Definitions - Quick Guide

• Dysgraphia is a learning disability that affects writing, which requires a complex set of motor and information processing skills. It can lead to problems with spelling, poor handwriting and putting thoughts on paper. People with dysgraphia might have trouble organizing letters, numbers and words on a line or page.

Definitions - Quick Guide

• Dyslexia - a language-based processing disorder can hinder reading, writing, spelling and sometimes even speaking.
• Dyspraxia is a disorder that affects motor skill development. People with dyspraxia have trouble planning and completing fine motor tasks.

The Process of Learning

• Learning is the process of acquiring information.
• What are the cognitive factors that enable students to show what they know and can do?
  – How do they collect, sort, store, and retrieve information? (Miller, 2007)
  – How do they receive, perceive, process, and remember information? (Ellis, 2007)
Building Blocks of Learning

- **SYMBOLIC**
  - Phonology
  - Orthography
  - Motor

- **CONCEPTUAL**
  - Language
  - Reasoning

- **FOUNDATIONAL**
  - Behavior
  - Emotions
  - Attention
  - Self-Esteem

(Mather, N. & Goldstein, S. 2008. Learning disabilities and challenging behaviors)

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Developmental Stages - Writing

1. Imitation (PS – Gr 1)
2. Graphic Presentation (Gr 1 & 2)
3. Syntactic Incorporation (Gr 2 – 4)
4. Automatization (Gr 4 – 7)
5. Elaboration (Gr 7 – 9)
6. Abstraction and Personalizations (Gr 9 and up)

See Levine & Reed (1999) and Feifer & DeFina (2002)

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Basic Motor Skill Development

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Writing Achievement Shown to be Related to:
- Graphomotor System
- Language / Auditory Processing / Phonological Awareness
- Working Memory / Short-term Memory
- Executive Functions
- Crystallized Intelligence
- Visual Processing (Orthographic)
- Long-term retrieval
- Processing Speed / Automaticity / RAN
- Fluid Intelligence
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What do you know about the connection of writing to:

- Listening?
- Speaking?
- Reading?

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It's about language, but

Language is not a unitary construct


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Integration of Processes

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**Coding Word Forms in Verbal Working Memory** (Berninger, 2007)

- Morphological (e.g., past, past participle)
- Phonological (e.g., /s; /ed; /ing)
- Orthographic (e.g., /ill)

**Example:**
- **parn** (/s; /ed; /ing)
- **pill**
- **bread**/**beard**

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**Written Language Problems Based on a Working Memory Architecture** (Berninger, 2007)

- Supports oral reading
- Supports writing language and writing math

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**Moment of reflection –**

Learned?
Confirmed?
Prompted a question?
Application?

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Shifting Gears to Working Memory And Executive Functioning

Classroom Learning Demands on WM
- Common classroom activities that impose simultaneous demands on storage and processing:
  - Listening to a speaker while trying to take notes
  - Following complex instructions
  - Decoding unfamiliar words
  - Writing sentences from memory
  - Mental arithmetic
  - Impact of weakness may show up later with greater demands for cohesive writing and comprehension

WM and Oral Language
- Strong relationship between verbal memory subsystems and both language development and oral language comprehension (Crain et al., 1990)
  - Phonological STM & Verbal WM
- Developmental delays and disorders in language have often been attributed to a dysfunction in verbal WM
Individual Differences and Written Expression
Presented by Amy Dilworth Gabel, Ph.D., NCSP

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**WM and Language**

- **Oral Language Comprehension**
  - WM plays critical role in constructing and integrating ideas from a stream of successive words
  - Primary function of Verbal WM is to extract meaning from phonological input
- **Spoken Language**
  - WM less involved unless syntactic structure or meaning of sentence is confusing

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**WM and Oral Language Impairments**

- The weak phonological memory performance of individuals with Oral Language Impairments may originate from their slow recognition and discrimination of speech sounds (phonemic awareness)
- Articulation rate may be a cause of memory span deficits, impacting language processing
- Slow processing speed may allow auditory traces to fade before meaning can be extracted
- Difficulties with word retrieval

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**Working Memory & Written Language**

- Written expression is a complex activity that requires the integration of several cognitive processes and memory components.
- Heavy emphasis on Working Memory especially executive WM, verbal WM, and visual WM.
- Emphasis on phonological STM
EF and Writing

• Can’t generate ideas
  – Independent journal writing a problem
• Perseverates on topics
• Difficulties organizing written output
  – Begins but can’t conclude in cohesive manner
  – Including format of arguments, and grammatical
    and spelling errors
  – Dysfluent writing, doesn’t transition well within text
• Unaware of mistakes, poor editing

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Lower-level Skills like
Transcription – AUTOMATICITY

Research Classroom
Learning Disorders

- Processes associated with Learning
  - Reading and Writing processes—not actual reading or writing but cognitive components related to the efficient acquisition of or support of reading and writing
    - Phonological processing/awareness
    - Orthography—connecting visual form to sound
    - Morphology—connecting visual form to meaning through rule application

Learning Disorder

- Language functioning is one of the most critical cognitive domains for learning
  - Word knowledge and naming
  - Syntax/language structure
  - Repetition
  - Working memory
    - Encoding
    - Manipulation
    - Auditory versus visual (spatial and details)
  - Each component is necessary for verbal expression and comprehension
Learning Disorder

- Cognitive functions associated with learning problems
  - Executive Functioning
    - Mild inhibitory control problems, particularly with Math DX
  - Sensorimotor
    - May have some fine motor issues with writing dx.
  - Automaticity
    - Ability to process basic cognitive processes with minimal use of working memory or strategic processes

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Written Language Problems Based on a Working Memory Architecture (Berninger, 2007)

- Supports oral reading
- Supports writing language and writing math

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Executive Functions—Switching Set (Berninger, 2007)

- Switching/Slower Switching
- Work—High—Word
- Work—High—Rich
- Work—High—Word

Figure 1: Slowing attention in mental set
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**Executive Functions—Inhibition**
(Berninger, 2007)

Inhibition in Working Memory

Name ink color.

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**Executive Functions—Monitoring**
(Berninger, 2007)

Monitoring and Working

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**Written Language Problems**
and the Three Word Forms
(Berninger, 2007)

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Other terms – Subtypes of Language-Based Dysgraphia
1. Phonological Dysgraphia
2. Surface Dysgraphia
3. Mixed Dysgraphia
4. Semantic/Syntactic Dysgraphia
   - Deep Dysgraphia (subtype)

Other terms – Subtypes of Non-Language Based Dysgraphia
1. Ideomotor Apraxia
2. Ideational Apraxia
3. Constructional Dyspraxia

Consider Assessing (Neuropsych)
- Sensory
- Attention
- Coding of Words/Linguistic Awareness
- Levels of Language
- Memory
- Executive Functions
- Speed and Efficiency of Processing
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Consider Assessing (Neuropsych)

- Cognitive Abilities
  - Verbal Comprehension
  - Nonverbal Reasoning
- Academics
  - Spelling
  - Handwriting
  - Composition
  - Word Decoding
  - Word Reading
  - Reading Comprehension
  - Paper and pencil calculation

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Consider Assessing (CHC)

- Strongest
  - Gc: Language Development, Lexical Knowledge, General Information
  - Gsm: Memory Span, Working Memory Capacity
  - Ga: Phonetic Coding
  - Gs: Perceptual Speed
- Less Robust
  - Gf: Inductive, General Sequential Reasoning
  - Gv: Generally not strong, but place orthographies here – strong relationship in neuropsych research
  - Glr: Naming Facility (RAN), Associative Memory

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Some “Myths”

- If the child is referred for writing difficulties, I don’t need to worry about math.
- One of my middle school students won’t write; he’s just lazy.
- Auditory discrimination is an important area to assess for writing.
- Finger succession tasks are unimportant.
### Terminology Turmoil

- Orthography
- Fluency
- Automaticity
- Writing Speed

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### Consider Assessing

- Intelligence
- Constructional skills (Copying tasks)
- Working Memory
- Executive Functions
- Writing and Spelling
- Phonological Skills
- Orthographic Skills
- Retrieval Fluency
- Family and Developmental History

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### Written Expression

#### Competitive Analysis of Coverage

<table>
<thead>
<tr>
<th>Subtest(s) that Cover the Process</th>
<th>WISC5</th>
<th>DAS2</th>
<th>KTEA3</th>
<th>PAL-III</th>
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</thead>
<tbody>
<tr>
<td>Comprehension - Knowledge</td>
<td>Gc: Crystallized Knowledge; Language Development; General Knowledge; General Knowledge: Awareness; Memory; Language Ability; Reading Ability; Vocabulary</td>
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<td>Oral Ability: Early Number Concepts, Naming, Sensory Memory, Language Processing, Rapid Naming, Rapid Naming</td>
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<thead>
<tr>
<th>Individual Differences and Written Expression</th>
<th>Presentated by Amy Dilworth Gabel, Ph.D., NCSP</th>
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</thead>
</table>

| Morphologic Awareness | Inductive-Inductive Reasoning; General Sequential Reasoning; Planning, Reasoning, and Problem Solving | Are they Related, Does it Fit, Sentence Structure |

| Matrix Reasoning Picture Concepts | Figure Weights | Nonverbal Reasoning Cluster Matrices, Picture Similarities, Sequential & Quantitative Reasoning | Math Concepts and Applications |

### Slide 47

<table>
<thead>
<tr>
<th>Orthographic Processing</th>
<th>Orthographic Processing included in Gv</th>
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### Slide 48

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<thead>
<tr>
<th>Working Memory / Short-term Memory</th>
<th>Working Memory Capacity; Working Memory; Verbal Working Memory</th>
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<th>Retrieval Fluency, Naming Facility; Associative Memory; Sound to Letter Correspondence; Lexical Access</th>
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### Individual Differences and Written Expression
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#### Slide 49

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Remedial vs. Compensatory Interventions

- Remedial Interventions
  - Have the expressed goal of correcting a deficit by directly addressing the area of weakness.
- Compensatory Interventions
  - Emphasize using the individual’s cognitive or memory strengths and assets, in an effort to bypass the deficit, thereby reducing its impact on learning and performance.
  - Strategy Training
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Plan a Timeline Piece

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Planning & Writing

- Story Plans
  - Diagram of the important parts of a story
- Plans for Writing
  - Teach outline for writing sentences & supporting sentences
- Teach Sentence Openers
  - Idea generating questions
  - For example, Who, What, When, Where...

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Metacognition Training

- The conscious use of executive control processes
- Two aspects of Metacognition:
  - Self-awareness
    - The knowledge of one's skills and cognitive abilities, understanding how one's skills and abilities match up with task requirements, and knowing which processes and strategies will lead to successful goal attainment.
  - Self-control
    - The ability to consciously monitor, manage, control, and evaluate one's cognitive activities and select strategies for use.
Metacognitive Training

- Key aspects of metacognitive interventions include teaching the individual:
  - To become aware of his/her processing deficits and strengths;
  - To select an appropriate strategy for the task at hand;
  - To self-monitor progress toward an objectives;
  - To revise or change the strategies when necessary;
  - To self-evaluate.

Memory Interventions

- Rote Strategies
- Relational Strategies
- Phonological STM Interventions
- Verbal WM Interventions
- Visuospatial Working Memory
- Executive Working Memory
- Mnemonics
- Long-term Memory
- Phonological Processing

Rote vs. Relational Strategies

- Rote Strategies:
  - Basic rehearsal strategies (e.g., simple repetition)
  - Minimal demands on WM resources
  - Primary purpose of maintaining items in phonological short-term memory
  - Simple to teach and learn
- Relational Strategies
  - Involves higher level WM processing
  - Increased retention of information
  - Mnemonics; visual imagery
  - Attaching meaning to information
Phonological STM Interventions
- Most STM Interventions involve rehearsal training.
- Rehearsal Strategies
  - Simply saying the material over and over to oneself
  - Serial repetition process; allows information to be maintained in WM for longer periods of time, thus enhancing short-term recall and facilitating long-term storage encoding
  - Most basic memory strategy
  - Increases verbal WM

Additional Phonological STM Interventions
- Naming letters and objects
- Repeating spoken sentences
- Reciting nursery rhymes
  - Highlights the phonological structure of language
- Rhyming games
  - Enhance phonemic awareness and the ability to store phonological information

Verbal Working Memory Interventions
- Elaborative Rehearsal
  - Associate meaning with stimuli
  - Keeps information active in WM without repetition and also facilitates moving information to LTM.
- Semantic Rehearsal
  - Brief sentences using the word to be remembered
**Verbal Working Memory Interventions**

- **Chunking**
  - Pairing, clustering, grouping, or association of different items into units that are processed and remembered as a whole; thereby facilitating short-term retention and encoding into long-term storage.

- **Paraphrasing**
  - A strategy that builds off of both rehearsal and chunking. Students restate information in their own words; requiring that they reorganize and condense a large amount of linguistic information into smaller, well-integrated, and more personally meaningful units.

**Visuospatial Working Memory Interventions**

- Should be used with individuals with severe limitations in verbal working memory, such as language and literacy disabilities.

- Primarily consist of visual mnemonics
  - Recode verbal information into visuospatial information

**Mnemonics**

- **Visual Imagery**
  - Involves transforming verbal content into visual information
  - Beneficial when used with students who have language deficits or deficits in verbal WM

- **Pegwords**
  - Numbers from one to ten are associated with pictured rhyming words (e.g., "one-bun, two-shoe")
  - Good strategy for remembering numbers & sequences

- **Loci**
  - Memorize order of rooms; associate items to be remembered with each room
An Evidence-based intervention for working memory training.

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