Executive Functions and Written Expression: A Neuropsychological Perspective

Presented by
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Note: This presentation borrows heavily from Brain Literacy for Educators and Psychologists (Berninger & Richards, 2002) and Essential of Executive Functions Assessment (McCloskey & Perkins, 2012). These sources can be consulted for more information on the concepts presented in this overview.
Berninger refers to basic academic skills in terms of the neuropsychological systems or modes through which language is accessed and/or expressed:

- Language by ear (listening)
- Language by mouth (speaking)
- Language by eye (reading)
- Language by hand (writing)
Neuropsychology of Writing

• Language by hand develops over a longer developmental trajectory than the other language systems.
• Language by hand requires the greatest involvement of frontal lobe functions (executive functions and working memory) for success; as a result, relatively skilled writing does not develop typically until late adolescence.
Neuropsychology of Writing

Writing is not the mirror image of reading

– Writing is not just the output stage in relation to the input (reading) stage of written language.

– Writing is not merely a motor act.

– Handwriting, spelling, and composition are separable components of the developing writing system.
Basic Concepts

Processes

Abilities

Skills

Lexicons

Executive Functions

Strategies

Achievement

Memory
Skills

Processes

Lexicons

Abilities

Strategies

Achievement

Memory Time Frames
An Integrative Model Specifying Processes, Abilities, Lexicons, Skills, Memory and Achievement in Writing

- General & Specific Knowledge Lexicons
- Semantic Lexicon
- Executive Function processing at work
- Initial Registration (Immediate Memory)
- Working Memory
- Retrieval from Long Term Storage

- Language
- Idea Generation
- Reasoning
- Visuospatial

- Text Editing & Revising

- Text Generation
- Text Transcription & Spelling

- Text Production Automaticity

- Visuospatial Processing
- GraphoMotor Processing
- Orthographic Processing
- Phonological Processing
Knowledge Stores (Lexicons)

- Vocabulary (Pronunciation, Semantic Lexicons)
- Writing Conventions (Grammar, Punctuation, Capitalization)
- General Information
- Phonologic Awareness
- Morphologic Awareness
- Orthographic Awareness
Abilities (Taught as Skills?)

- Receptive Language
- Expressive Language
- Visuospatial Language
- Reasoning
- Idea Generation
Processing & Functioning (Taught as Skills?)

- Orthographic Processing
- Phonological Processing
- Morphological Processing
- Graphomotor Functioning
- Visuospatial Processing
Time Frames of Reference

- Initial Registration/Immediate Memory
- Working Memory
- Retrieval from Long-Term Storage
Written Expression Skills

- Handwriting (Letter Formation)
- Spelling
- Converting Ideas to Words
- Composition
  - Writing Sentences
  - Writing Paragraphs
  - Writing Essays
- Editing/Revising Words, Sentences, Paragraphs, Essays
Holarchical Organization

– Holarchical progression to the next stage can occur before completion of the previous stage.

– Holarchical development can continue at an earlier stage even after a later stage has begun.

– In a hierarchy, progression to the next stage cannot occur until after completion of the previous stage.
Writing as a Holarchically Organized Process

1. Idea Generation
2. Language Representation
3. Text Transcription
4. Text Generation
5. Reviewing/Revising
Writing as a Holarchically Organized Process

- Converting Ideas to Words
- Handwriting & Spelling
- Composition
- Editing/Revising

PLAN

ORGANIZE
– Naïve: First exposure to the task; responses required immediately; high demand for executive functions (EFs)
– Practiced: Time given to rehearse responses to the task; minimal demand for EFs
– Novel: Second exposure to the task, but responses required immediately to a set of all new items; moderate demand for EFs
Graphomotor Functioning

Orthographic Lexicon

Phonologic Lexicon

Graphomotor Sequencing & Motor Production

Attention to Orthography

Attention to Motor Production

Attention to Phonology
33 Self-Regulation EFs

- Perceive
- Focus
- Sustain
- Energize
- Initiate
- Inhibit
- Stop
- Interrupt
- Flexible
- Shift
- Modulate

- Balance
- Monitor
- Correct
- Gauge
- Anticipate
- Estimate Time
- Analyze
- Generate
- Associate
- Plan
- Organize

- Prioritize
- Compare/Eval
- Decide
- Sense Time
- Pace
- Sequence
- Execute
- Hold
- Manipulate
- Store
- Retrieve
Composition Instruction

Transition from Other- to Self- Regulation

– Developing writing must become increasingly self-initiated, self-sustained, self-monitored, and self-disciplined.

– The transition to self-regulation is more likely to occur if adults explicitly prepare developing writers for it through instructional cueing. Strategies can be taught as they are unlikely to emerge solely on the basis of myelination of the frontal lobes.
Composition Skill Development: Intermediate Writers

• Reviewing/revising is mostly at the word and sentence level.
• Executive control focus shifts to increasing self-regulation of higher level writing components.
• Revising/reviewing skills after transcription and text generation are developing more than idea generation skills.
Composition Skill Development: Advanced Writers

• Executive control focus is devoted to self-regulation of higher level writing components in a more integrated manner.

• Idea generation and preplanning continue to develop.

• The integration of reading and writing skills becomes more critical.
Finding the EF Demand Balance in Writing Assignments

Extensive List of Detailed Constraints On the Writing Product

A few guidelines and suggestions for specific writing strategies that can be used to complete the writing product

No guidelines for the writing product
Executive Function Writing Challenge 1:
Dealing with Physical Space Constraints:

Summer Time is Oil Change Time
EF Involvement in Writing

Essentials of Executive Functions Assessment Rapid Reference 6.3:
• Description of EF involvement in stages of writing
• Lists the EFs most likely to be involved in that stage
• Describes task behavior likely to be indicating a lack of EF use
EF Involvement in Writing

Idea Generation Stage

- Cueing/directing/coordinating the generation of a topic and/or ideas, or the acceptance of a topic and/or ideas provided by an outside source.
EF Involvement in Writing

EFs Likely to be involved in Idea Generation

• Energize, Focus, Initiate, Sustain, Gauge, Flexible, Generate, Associate, Choose/Decide, Monitor, Correct, Balance
EF Involvement in Writing

Behavior indicating EF difficulties:

• Resistance to topic.idea generation or resistance to accepting the topic/ideas of an outside source.
Progressive deterioration of performance is observed as executive function demands (+ EF) become greater.
Individually-administered Assessments of EF

• Identify a specific cognitive capacity baseline using a measure that minimizes EF involvement.

• Select and use a measure that adds executive function demands to the baseline capacity and observe the results.

• Continue to add additional EF demands and observe results.
Progressive deterioration of performance is observed as executive function demands (+ EF) become greater.
Cascading Production Decrement

PAL-II Alphabet Writing & PAL-II Copying A & B

Progressive deterioration of performance is observed as executive function demands (+ EF) become greater.

WIAT-III Sentence Composition and/or PAL-II Sentence Writing

WIAT-III Essay Composition
Progressive deterioration of performance is observed as executive function demands (+ EF) become greater.
EF Involvement in Writing

Essentials of Executive Functions Assessment Rapid Reference 6.6:

• Provides lists of Baseline EF-minimized Tasks and Related EF-saturated (EF+) Tasks for CPD Analyses for written expression assessment
EF Involvement in Writing

Essentials of Executive Functions Assessment Rapid Reference 6.8:

• The examples provided in this rapid reference illustrate how to identify written expression production decrements likely to be resulting from ineffective engagement of executive functions during task performance.
EF Involvement in Writing

Text Excerpt:

“When performed effectively, semantic fluency tasks can function as baseline measures that can be contrasted with other EF+ tasks to assess the effects of increased demands for executive function control of verbal fluency. Increased involvement of executive functions in verbal fluency tasks can be assessed by increasing the constraints on the type of words to be retrieved. This is typically achieved by switching from retrieval based on semantic category to retrieval based on initial letter (for example, words that start with the letter “f”). Tasks of this type greatly increase the demand for efficient coordination of the Retrieve and Pace cues to find and articulate only words that begin with a specific letter as well as the use of the Gauge, Inhibit, Shift, Monitor, Correct, and Sustain cues to maintain effective production. Decrement in performance between semantic fluency and initial letter fluency tasks strongly implicate executive functions difficulties as the source of the poorer performance. The D-KEFS further increases the executive functions demands of the standard fluency task by requiring the child to name an object from one category and then an object from another category and to keep switching back and forth between the two semantic categories for the duration of the task (D-KEFS Verbal Fluency Switching). Use of semantic category and initial letter fluency tasks in Cascading Decrement Analyses are shown below:”
# EF Involvement in Writing

## Essentials of Executive Functions Assessment Rapid Reference 6.13

### Table Excerpt:

<table>
<thead>
<tr>
<th>Writing Skill Direct Formal Measures</th>
<th>Most likely Process-oriented observations By Measure</th>
<th>Process-oriented observations of writing behavior likely to be indicative of a lack of use of EFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text Transcription / Graphomotor Production (Handwriting) • PAL-II Copying A • PAL-II Copying B • KTEA-II Written Expression • WIAT-III Sentence Composition • WIAT-III Essay Composition • WJ-III Writing Samples Writing Fluency • WJ-III Writing Fluency</td>
<td>1, 2*, 4, 5, 6, 7, 8, 10, 11*, 12, 13, 15</td>
<td>1. Resistance to topic/idea generation or resistance to accepting the topic/ideas of an outside source. 2. Generated ideas are quickly forgotten. 3. Ideas are poorly articulated; paucity of language production. 4. Written text is overly simplistic and minimal compared to good knowledge store and good oral expression of knowledge. 5. Use of pencil is resisted; pencil grasp is awkward and/or overly fatiguing, complaints are vocalized about the need to write. 6. Letters and words are poorly formed, overall legibility is poor. 7. Pace slows noticeably with passage of time. 8. Arguments lack coherence of reason or do not create a visual image despite adequately developed reasoning, language and/or visuospatial abilities. 9. Good initial use of reasoning or visuospatial abilities deteriorates as writing progresses. 10. Amount of written production is limited or writing is avoided despite adequate ideas and language representation.</td>
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<tr>
<td></td>
<td>5, 6, 7</td>
<td>5, 6, 7</td>
</tr>
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<td>• PAL-II Copying A</td>
<td>5, 6, 7</td>
<td>5, 6, 7</td>
</tr>
<tr>
<td>• PAL-II Copying B</td>
<td>1, 2*, 4, 5, 6, 7, 8, 9, 10, 11*, 12, 13, 15</td>
<td>1. Resistance to topic/idea generation or resistance to accepting the topic/ideas of an outside source. 2. Generated ideas are quickly forgotten. 3. Ideas are poorly articulated; paucity of language production. 4. Written text is overly simplistic and minimal compared to good knowledge store and good oral expression of knowledge. 5. Use of pencil is resisted; pencil grasp is awkward and/or overly fatiguing, complaints are vocalized about the need to write. 6. Letters and words are poorly formed, overall legibility is poor. 7. Pace slows noticeably with passage of time. 8. Arguments lack coherence of reason or do not create a visual image despite adequately developed reasoning, language and/or visuospatial abilities. 9. Good initial use of reasoning or visuospatial abilities deteriorates as writing progresses. 10. Amount of written production is limited or writing is avoided despite adequate ideas and language representation.</td>
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<td>• KTEA-II Written Expression</td>
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<td>1. Resistance to topic/idea generation or resistance to accepting the topic/ideas of an outside source. 2. Generated ideas are quickly forgotten. 3. Ideas are poorly articulated; paucity of language production. 4. Written text is overly simplistic and minimal compared to good knowledge store and good oral expression of knowledge. 5. Use of pencil is resisted; pencil grasp is awkward and/or overly fatiguing, complaints are vocalized about the need to write. 6. Letters and words are poorly formed, overall legibility is poor. 7. Pace slows noticeably with passage of time. 8. Arguments lack coherence of reason or do not create a visual image despite adequately developed reasoning, language and/or visuospatial abilities. 9. Good initial use of reasoning or visuospatial abilities deteriorates as writing progresses. 10. Amount of written production is limited or writing is avoided despite adequate ideas and language representation.</td>
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<td>• WIAT-III Sentence Composition</td>
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<td>• WJ-III Writing Samples</td>
<td>1, 2*, 3, 4, 5, 6, 7, 10, 11*, 12, 13, 15</td>
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<td>Writing Fluency</td>
<td>5, 6, 7, 12, 13, 15</td>
<td>5, 6, 7, 12, 13, 15</td>
</tr>
</tbody>
</table>
EF Involvement in Writing

Essentials of Executive Functions Assessment Rapid Reference 6.16:

• Case study report section describing a process-oriented assessment of executive functions difficulties affecting written expression
Assessing Executive Functions Directly Related to Writing

• A process-oriented observation approach can be effectively used to observe and document difficulties with the use of executive function processes during the performance of writing tasks.
• What Evan wrote for me:

My favorite game is … “mabul roling it is fun. I like making the box to role in to. Iam prety gode as well. It is rell inters ing. It is so fun
Executive Functions and Writing

• What Evan told me:

“My favorite game is rolling marbles. I think it is fun. I just learned it yesterday. It can be pretty hard at times. It can be fun and it’s interesting if you make it challenging. I like making the boxes to roll the marbles into. You probably need to be pretty skilled with eye hand coordination to do it. To get up the ramp you need to roll it really fast.”
Later Composition Instruction: General Rationale

“...it is unlikely that brain maturation alone without explicit instruction in self-regulation strategies will help middle school and high school students develop and apply executive functions productively to writing. The major pedagogical goal at this stage of development is to guide the Writing Brain in becoming more self-regulated. A major research-supported technique for accomplishing this goal is teaching explicit strategies for regulating the writing process, some of which are genre specific, and all of which should be coordinated with curriculum.”

Many executive functions difficulties related to writing are the result of a lack of adequate maturation of the neural networks involved in the use of these executive functions for writing.
Interventions for Executive Functions Difficulties Related to Writing

The most effective form of intervention for maturational difficulties with the use of executive functions is increased practice of all the stages of the writing process increasingly guided by the use of self-regulation strategies that can be taught to the student.
Early Composition Instruction

Modeling Strategies for Writing During Writing Sessions:

  – Teacher thinks out loud and discusses the ideas she plans to say.
  – Teacher models out loud different ways that she could state her ideas.

• “The sounds in what I say are related to letters in the words I write.”
  – Teacher models how she could say each word sound by sound, and change those sounds into letters using a sound-letter correspondence clue sheet.

• Teacher circulates and assists individual children as they apply the strategies to generate ideas, spoken text, phonologically segmented words, and written spellings with the aid of their clue sheets.
Five Stages of Strategy Instruction

1. Explain the purpose of self-regulation strategies in general and describe and discuss the specific steps of the strategy that will be taught.
5. Five Stages of Strategy Instruction

2. Model the use of the strategy using language and examples that connect with the students.
Five Stages of Strategy Instruction

3. Students memorize the steps in the strategy as well as any mnemonics that are used as part of the strategy.
Five Stages of Strategy Instruction

4. Teacher supports the implementation of the strategy by the students, scaffolding as necessary to help the students to master the use of the strategy.
5. Students independently apply the self-regulated strategy covertly (in their own minds). Students and teacher collaboratively evaluate the effectiveness of student self-directed strategy application.
## Kid Friendly Writing Rubric

<table>
<thead>
<tr>
<th>Domain</th>
<th><strong>FOCUS</strong></th>
<th><strong>Content</strong></th>
<th><strong>Organization</strong></th>
<th><strong>Style</strong></th>
<th><strong>Convention</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advanced</strong></td>
<td>Do my ideas stick to the main topic?</td>
<td>Do my ideas have details and descriptions?</td>
<td>Are my ideas in order?</td>
<td>Do my ideas and words paint a picture?</td>
<td>Did I check my work carefully?</td>
</tr>
<tr>
<td><strong>Proficient</strong></td>
<td>All Correct</td>
<td>Mostly Correct</td>
<td>Mostly Correct</td>
<td>Mostly Correct</td>
<td>Mostly Correct</td>
</tr>
<tr>
<td><strong>Basic</strong></td>
<td>Some Correct</td>
<td>Some Correct</td>
<td>Some Correct</td>
<td>Some Correct</td>
<td>Some Correct</td>
</tr>
<tr>
<td><strong>Below Basic</strong></td>
<td>Few Correct</td>
<td>Few Correct</td>
<td>Few Correct</td>
<td>Few Correct</td>
<td>Few Correct</td>
</tr>
</tbody>
</table>

### Details
- **Focus**
  - **ALL ideas relate to topic**
  - **The point or purpose is clear**

- **Content**
  - **Strongly developed topic sentence(s)**
  - **Includes ELABORATE and RELATED details, facts, or descriptions**

- **Organization**
  - **Well defined paragraph(s) with topic sentence(s)**
  - **Has a clear beginning, middle, and end**
  - **Ideas are in logical order with transition words**

- **Style**
  - **Uses a variety of simple and compound sentences**
  - **Uses a variety of colorful words and literary devices such as similes, alliteration, personification, onomatopoeia, and metaphors**
  - **Strong evidence of writer’s voice**

- **Convention**
  - **Complete Sentences**
  - **Grammar / Verb Tense**
  - **Capitals**
  - **Punctuation**
  - **Spelling**
  - **May also include Handwriting**