

## The Neuropsychology of Written Language: A Framework for Effective Interventions



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### PRESENTATION OF GOALS

1. Discuss national trends in written language, and the need for educators and psychologists to explore writing from a brain-based educational perspective.
2. Discuss the neural architecture of language development in children and learn key frontal lobe brain processes responsible for the organization and production of written language.
3. Introduce a *brain-based* educational model of diagnosing written language disorders by classifying into distinct subtypes, with specific remediation strategies linked to each subtype.
4. Introduce the 90 minute dysgraphia evaluation as a more comprehensive means to assess eight core cognitive constructs associated with learning disorders in children.

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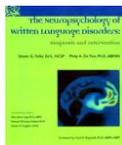
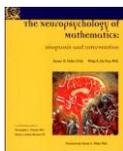
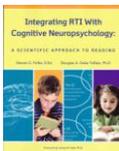
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### Further Reading Materials



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### Measuring Written Language

- ▶ The National Assessment for Educational Progress (NAEP) administered the first computer based assessment in writing in 2011.
- ▶ **8<sup>th</sup> grade:** 24,100 students.
- ▶ **12<sup>th</sup> grade:** 28,100 students.
- ▶ The assessment tasks reflected writing situations common to both academic and workplace settings and asked students to write for several purposes and communicate to different audiences. These included:
  1. **PERSUADE**
  2. **EXPLAIN**
  3. **CONVEY EXPERIENCE**
- ▶ Scored as Basic, Proficient, or Advanced.

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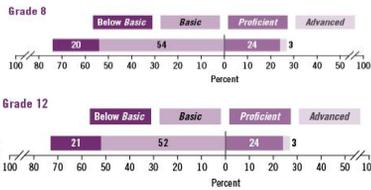
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### NAEP Writing Results for 8<sup>th</sup> & 12<sup>th</sup> grades (2011)



- ▶ 24% of students at both grades 8 and 12 performed at the Proficient level in writing in 2011.
- ▶ 74% of eighth-graders and 73% of twelfth-graders performed at the Basic level or below in writing in 2011.

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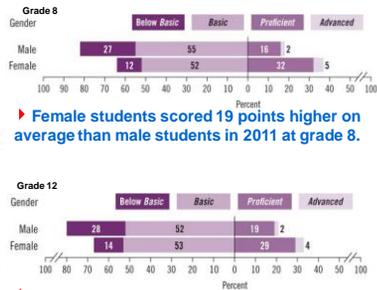
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### NAEP Writing Results for 8<sup>th</sup> & 12<sup>th</sup> grades (2011): Gender Differences



- ▶ Female students scored 19 points higher on average than male students in 2011 at grade 8.
- ▶ Female students scored 14 points higher on average than male students in 2011 at grade 12.

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### Why the disconcerting trend?

- ▶ Most students rely on writing, either e-mail, text messages, word processing, or other computerized technology to communicate.
- ▶ Downward extension of our curriculum whereby reading and written language are skills emphasized in kindergarten.
- ▶ Most state assessments require written language responses, short answers, and brief constructed responses even in subjects such as mathematics. Therefore, most school curriculums readjusted to emphasize state testing requirements.



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### My Response - Neuropsychology

- ▶ *A brain-based educational model of learning utilizing scientific research based upon brain-behavioral relationships to develop optimum learning opportunities for all children.*
- ▶ *Need for educators to better understand the neural underpinnings of written language to create a brain-based educational model of learning.*



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### Cognitive Constructs Involved with Written Language

- ▶ Attention
  - Poor planning
  - Uneven tempo
  - Erratic legibility
  - Inconsistent spelling
  - Poor self monitoring
  - Impersistence



**BRAIN REGION - Anterior Cingulate Cortex**  
 \*Selecting attention, response inhibition, and monitoring of errors. Receives projections from VTA (dopamine center of brain)

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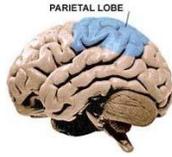
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### Cognitive Constructs Involved with Written Language

▶ Spatial Production

- Poor spatial production
- Poor visualization
- Poor margination
- Organization problems
- Uneven spacing
- Poor use of lines



BRAIN REGION - Right Parietal Lobe

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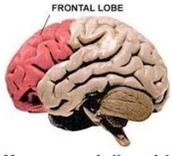
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### Cognitive Constructs Involved with Written Language

▶ Sequential Production

- Poor connected writing
- Letter reversals
- Organizational deficits
- Lack of cohesive ties
- Deficits in grapheme buffer, especially with ADHD kids, leads to graphomotor dysfunction



BRAIN REGION - Left Prefrontal Cortex

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### Cognitive Constructs Involved with Written Language

▶ Working Memory Skills

- Poor word retrieval skills
- Poor spelling
- Poor recall of grammar rules
- Loss of train of thought
- Poor elaboration of ideas
- Cortical mapping of language is distributed throughout brain (i.e. nouns vs. verbs)



BRAIN REGION - Semantic memories stored in Temporal Lobes. Retrieved by Frontal Lobes

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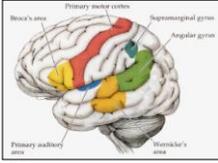
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### Cognitive Constructs Involved with Written Language

#### ▶ Language

- Poor vocabulary
- Poor expression
- Dysphonetic spelling
- Lack of cohesive ties
- Unconventional grammar
- Simplistic sentence structure
- Left hemisphere stores language by converging words into semantic baskets; right hemisphere excels in more divergent linguistic skills (simile and metaphor)



BRAIN REGION - Left Temporal Lobe



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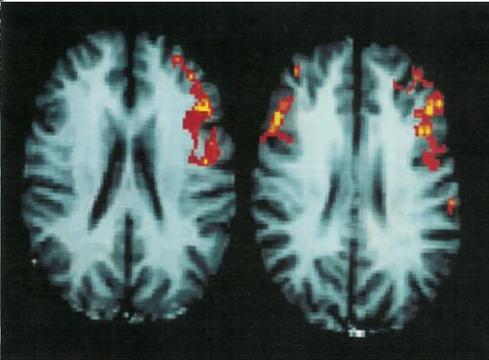
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### Male vs. Female Brain in Phonological Processing



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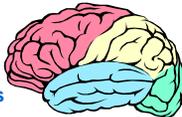
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### Cognitive Constructs Involved with Written Language

#### ▶ Intelligence

- Concrete ideation
- Poor development of ideas
- Poor audience awareness
- Weak opinion development
- Simplistic sentence structure



BRAIN REGION - Inferior Parietal Lobes



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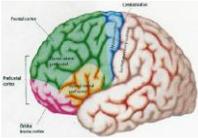
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### Cognitive Constructs Involved with Written Language

- ▶ **Executive Functioning**
  - Organize and plan ideas
  - Self monitor
  - Task initiation
  - Sustain attention to task
  - Difficulty making cognitive shifts from one topical area to another.



**BRAIN REGION – Dorsolateral Prefrontal Cortex**

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### Cognitive Constructs Involved with Written Language

- ▶ **Motor Output Speed**

Grade Levels	Handwriting Speed
Grade 1	15 -32 letters per minute
Grade 2	20 -35 letters per minute
Grade 3	25 -47 letters per minute
Grade 4	34 -70 letters per minute
Grade 5	38 -83 letters per minute
Grade 6	46 -91 letters per minute

**BRAIN REGION – Basal Ganglia** (Pollack et al., 2009)

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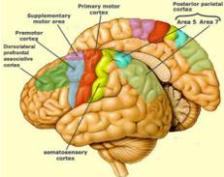
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### 3 Subtypes of Written Language Disorders

- I. **Graphomotor Dygraphias** - apraxia refers to a wide variety of motor skill deficits in which the voluntary execution of a skilled motor movement is impaired.
  - a) **Premotor cortex** plans the execution of a motor response.
  - b) **Supplementary motor area** – guides motor movement
  - c) **Cerebellum** - provides proprioceptive feedback.
  - d) **Basal Ganglia** – procedural memory and automaticity of handwriting.




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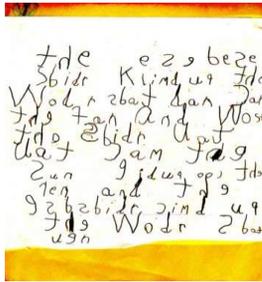
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**Example of Graphomotor Dysfunction**



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**3 Subtypes of Written Language Disorders**

**II. Dyslexic Dysgraphias:** deficits in spelling.

a) **Dysphonetic dysgraphia** - the hallmark feature of this disorder is an inability to spell by sound due to poor phonological skills. There is often an over-reliance on the visual features of words when spelling.

<u>Target Word</u>	<u>Misspelling</u>
point	pot
train	chan
old	od
climbing	cling
job	joib
video	veio
kitchen	tihn

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**3 Subtypes of Written Language Disorders**

b) **Surface dysgraphia** - a breakdown in the orthographic representation of words. Miscues made primarily on phonologically irregular words.

<u>Target Word</u>	<u>Misspelling</u>
knock	nok
build	bild
mighty	mite
juice	juse
onion	unnyun
said	sed
yacht	yot
laugh	laf

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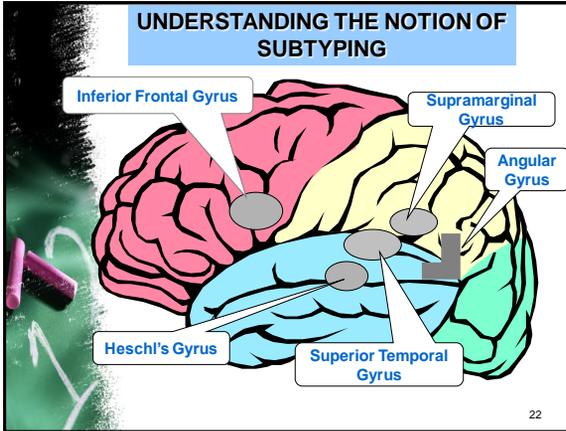
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**3 Subtypes of Written Language Disorders**

c) **Mixed Dysgraphia** - characterized by a combination of both phonological errors and orthographical errors depicting faulty arrangement of letters and words.

<u>Target Word</u>	<u>Misspelling</u>
advantage	advangate
cobweb	coweb
illusion	elushn
pocket	poet
work	wrok
kitchen	kinchen

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**3 Subtypes of Written Language Disorders**

III. **Executive Dysgraphias** - an inability to master the implicit rules for grammar which dictate how words and phrases can be combined. Deficits in working memory and executive functioning in frontal lobe hinder syntax!

- ▶ Characterized by:
  - Word omissions
  - Word ordering
  - Incorrect verb usage
  - Word ending errors
  - Poor punctuation
  - Lack of capitalization
  - Oral vs. written language discrepancy

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### Executive Functioning and Written Language

<u>Classification</u>	<u>Writing Dysfunction</u>
(1) Initiating	* Poor idea generation
(2) Sustaining Attn	* Lose track of thoughts
(3) Shifting	* Poor paragraph breaks
(4) Organization	* Disjoined content
(5) Planning	* Poor flow of ideas
(6) Self Monitor	* Careless miscues

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### 5 INTERVENTION KEYS: AUTOMATICITY

- (1) Motor Skills Automaticity: "Handwriting without tears"
- (2) Spelling Automaticity: "Alphabetic Phonics"
- (3) Language Automaticity: "Scaffolding to enhance verbal fluency"
- (4) Executive Functioning Automaticity: "Graphic Organizers"
- (5) Self Monitoring Automaticity: "Peer review with COPS strategy"

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### GRAPHIC ORGANIZERS

**Graphic Organizers** – this involves a pre-writing activity whereby the student simply lists a word or phrase pertaining to the topic. An example may include a brainstorming web:

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graph TD
    MARYLAND((MARYLAND)) --- BUSINESS((BUSINESS))
    MARYLAND --- CITIES((CITIES))
    MARYLAND --- SPORTS((SPORTS))
    MARYLAND --- POLITICS((POLITICS))
    MARYLAND --- CROPS((CROPS))
  
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### Self Monitoring Strategies

**COPS strategy** – a directional proof-reading strategy where the student re-reads their passage four times prior to completion.

- 1) **Capitalize** the first word of each sentence.
- 2) **Organize** the information by reviewing topic sentences and double check paragraph breaks. separations.
- 3) **Punctuation** miscues must be reviewed.
- 4) **Spelling** miscues must be reviewed.




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### Strategies for Secondary Students

**Inspirations** – teaches how to craft concept maps, idea maps, and other visual webbing techniques to assist in planning, organizing, and outlining his thoughts and ideas when writing. In addition, this software can assist with note-taking skills and help develop main and supporting ideas when writing. Very effective word predictive software.

**Keyboarding** - speed up output to reduce pressure from working memory skills to retain information over longer periods of time. Often leads to greater elaboration when writing.

**Livescribe** - a "smart" pen which would both record lecture information in the class, as well as transcribe notes to a computer screen. Smart pens allow students to better organize their notes, and also allows students to synchronize everything written with what was heard.

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### Strategies for Secondary Students

**Kurzweil Technology** - adaptive technology to further practice grammar, spelling, punctuation, and comprehension to assist with the writing process. Voice activated software also an option.

**KWS Charts** – a pre-writing activity for fact finding assignments whereby the student divides his paper into three columns. In the first column, he answers "What I **know**", in the second column "What I **want to learn**" and in the third column "Possible **sources**".

**Journal or Diary** – students need to practice any skill a minimum of 15-20 minutes per day to develop consistent improvement. Creating a journal or diary can be a fun and effortless way to practice writing on a daily basis.

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**Research Based Interventions (Graham & Perin, 2007)**

- (1) Writing Strategies (effect size .82)
- (2) Summarization (effect size .82)
- (3) Collaborative Writing (effect size .75)
- (4) Specific Product Goals (effect size .70)
- (5) Word Processing (effect size .55)
- (6) Sentence Combining (effect size .50)
- (7) Prewriting (effect size .32)
- (8) Inquiry activities (effect size .32)
- (9) Process Writing Approach (effect size .32)
- (10) Study of Models (effect size .25)
- (11) Writing for Content Learning (effect size .23)

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**5 Major Steps of Writing Process (Ray, 2001)**

- (1) **Prewriting** - use graphic organizers.
- (2) **Drafting** - use model to take notes and model how to organize in a text form using topic sentences.
- (3) **Revising** - second draft emphasizing content, and elaboration of ideas and making connections.
- (4) **Editing** - re-read for capitalization and punctuation errors.
- (5) **Publishing** - peer assisted strategies and teaching students to give and receive feedback.




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**90 Minute Dysgraphia Evaluation**

- ▶ Intelligence Measures
- ▶ Visual-Motor Integration
- ▶ Attention
- ▶ \*Working Memory\*
- ▶ \*Executive Functions\*
- ▶ Writing and Spelling Skills
- ▶ Phonological Awareness Skills
- ▶ Retrieval Fluency Skills

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### DYSGRAPHIA ASSESSMENT INSTRUMENTS

- ▶ **Visual-Motor Integration** - WIAT III Alphabet Writing Fluency (30 sec), NEPSY II Design Copying, PAL II Alphabet Writing, PAL II Handwriting Subtests
- ▶ **Attention** - NEPSY II Auditory Attn & Response Set, NEPSY II Inhibition, Connors 3, Tea-CH, CAS-Receptive Attention, WJIII- Auditory Attention.
- ▶ **Working Memory** - WISC IV Integrated Subtests, PAL II Verbal Working Memory Subtests, SB5, CAS, WRAML-2.
- ▶ **Executive Functions** - WIAT III Sentence Composition, PAL II Expository Note Taking, PAL II Narrative Compositional Fluency, BRIEF, DKEFS, NEPSY II.
- ▶ **Writing and Spelling Skills** - WIAT III Spelling (error analysis), PAL II Orthographic Spelling, WIAT III Essay Composition, PAL II Expository Writing
- ▶ **Retrieval Fluency Skills** - NEPSY II Word Generation, NEPSY II Speeded Naming, WJIII Retrieval Fluency.

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