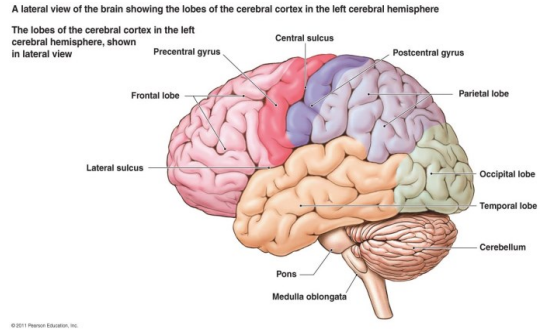
Brain-Based Strategies and Interventions to Help Children with Reading, Writing and Math



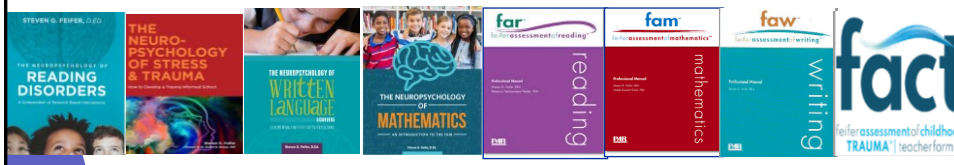
Steven G. Feifer, D.Ed, ABPdN
feifer@comcast.net
www.schoolneuropsychpress.com

1

1

Dr. Feifer's Journey

www.schoolneuropsychpress.com



- Nationally certified school psychologist **30+** years
- Diplomate in **pediatric** and **school** neuropsychology
- **Awards**: **Maryland School Psychologist of the Year*
  **National School Psychologist of the Year*
  **Legends in School Psychology Award*
  **Outstanding Educator in School Psychology*
- Author: **8 books** on learning and emotional disorders
- Test Author: **FAR-FAM-FAW-FACT**
- Currently in private practice at *Monocacy Neurodevelopmental Center* in Frederick, MD.

2

2

Reading Presentation Outline

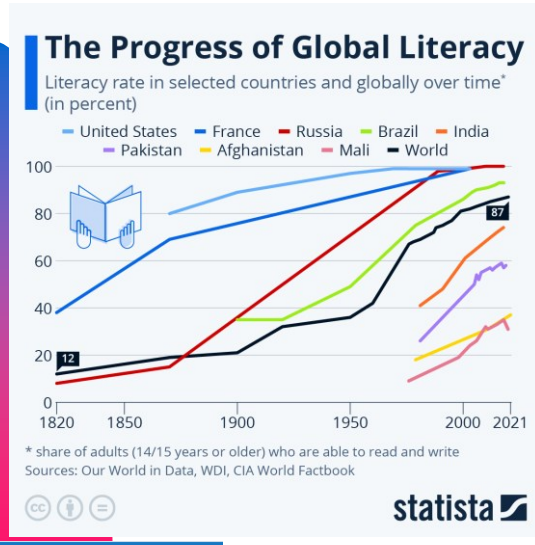
- **Why Literacy Matters**
- Defining Dyslexia
- Four Universal Truths of Reading
- Subtypes of Reading Disorders & Interventions
- Introducing the FAR

jack hirose

3

3

Global Literacy at a Glance
(Statista, 2022)



- 1820 - **12%** literacy rate
- 1900 - **20%** literacy rate
- 1960 - **42%** literacy rate
- 1983 – **70%** literacy rate
- Today – **87%** literacy rate
- Canada - **99%** literacy rate (10^{th} among OECD)
- 19% of adults had literacy rates at Level 1 on a scale between 1-5.

jack hirose

4

4

Global Literacy at a Glance

United Nations Education, Scientific, and Cultural Organization (UNESCO)

- ***'Literacy'*** *is the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts (UNESCO).*
- ***'Literacy'*** *is a* ***human right.*** *It reflects both the openness and economic stability of a culture to prioritize education for ALL its citizens.*

- **773 million** adults and children do not have basic literacy abilities with illiteracy highest in South Asia and sub-Saharan Africa.
- The COVID-19 epidemic affected the education of 62.3% of the world's **1.1 billion** students.

5

5

Literacy in Canada: Post Pandemic

Program for International Student Assessment (2022)

Table 3.16

Canadian and provincial average scores in reading over time, 2018–2022

	2018		2022	
	Average score	Standard error	Average score	Standard error
Newfoundland and Labrador	512	(4.3)	478*	(7.2)
Prince Edward Island	503	(8.3)	496	(10.4)
Nova Scotia	516	(3.9)	489*	(6.4)
New Brunswick	489	(3.5)	469*	(4.3)
Quebec	519	(3.5)	501*	(4.9)
Ontario	524	(3.5)	512*	(4.1)
Manitoba	494	(3.4)	486	(4.1)
Saskatchewan	499	(3.0)	484*	(4.3)
Alberta	532	(4.3)	525	(6.4)
British Columbia	519	(4.5)	511	(6.0)
Canada	**520**	**(1.8)**	507*	**(2.5)**

- Reading scores in Canada **(507)** declined **13** points.
- Average decline among 81 countries **10** points (**476** avg/**U.S. 504**).
- Newfoundland and Nova Scotia biggest decline.
- More than 23,000 15 yr old students in Canada from 850 schools.

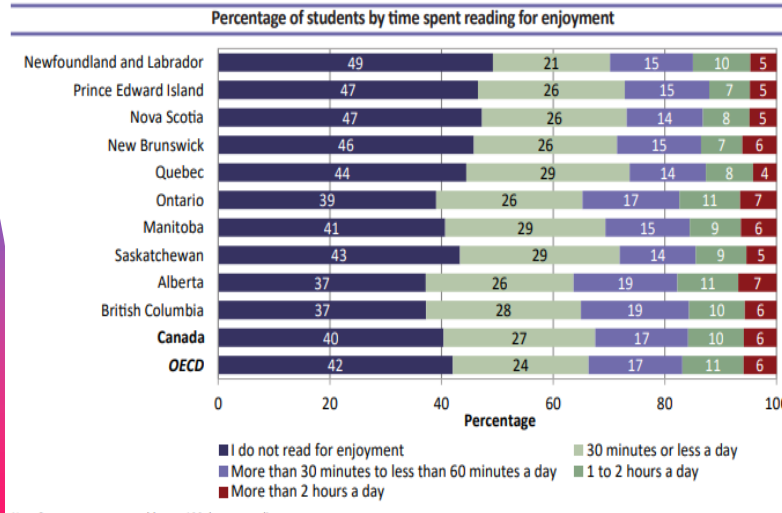
Organisation for Economic Cooperation and Development (OECD)

6

6

Literacy in Canada

Program for International Student Assessment (2018)



Note: Percentages may not add up to 100 due to rounding.

jack hirose

7

7

Literacy in Canada: Public Opinion Survey (2024)

NATIONAL PUBLIC OPINION ON LITERACY IN CANADA

EST. 1899 United for Literacy Littératie Ensemble formerly Frontier College

LITERACY IS CRITICAL TO QUALITY OF LIFE

94% of Canadians agree that **being able to read, write, and understand** printed and written materials has a **positive impact on Canadians' quality of life.**

LITERACY RATES NEED TO IMPROVE

93% of Canadians agree that **improving literacy rates** would **contribute to a more prosperous society**

nearly **8 in 10 Canadians support increased government action** to improve literacy rates

92% of Canadians agree that **improving literacy rates** would **improve Canadians' standard of living**

LITERACY IS A SOCIAL ISSUE

7 in 10 Canadians believe that **lower literacy leads to lower income and employment opportunities.**

6 in 10 Canadians believe low literacy has negative effects on **standard of living, financial stability, and quality of life.**

4 in 10 Canadians believe that **weaker literacy skills leads to homelessness and reduced engagement in civic life.**

"Literacy touches almost every aspect of our lives. I am encouraged that Canadians stand with us and make the literacy issue a priority; not just for others, but for society as a whole. **Bridging the literacy gap is something we can do. It's our most effective tool for equal access to opportunity.**"

Mélanie Valcin, President, United for Literacy

The nationwide survey of 1,552 respondents 18 years+ was conducted by Pollara Strategic Insights using an online methodology between February 20-21, 2024. Data has been weighted using the most current gender, age, and region Census data, to ensure the sample reflects the actual population of adult Canadians.

jack hirose

8

8

Reading Presentation Outline

Why Literacy Matters

➡ **Defining Dyslexia**

Four Universal Truths of Reading

Subtypes of Reading Disorders & Interventions

Introducing the FAR

9

9

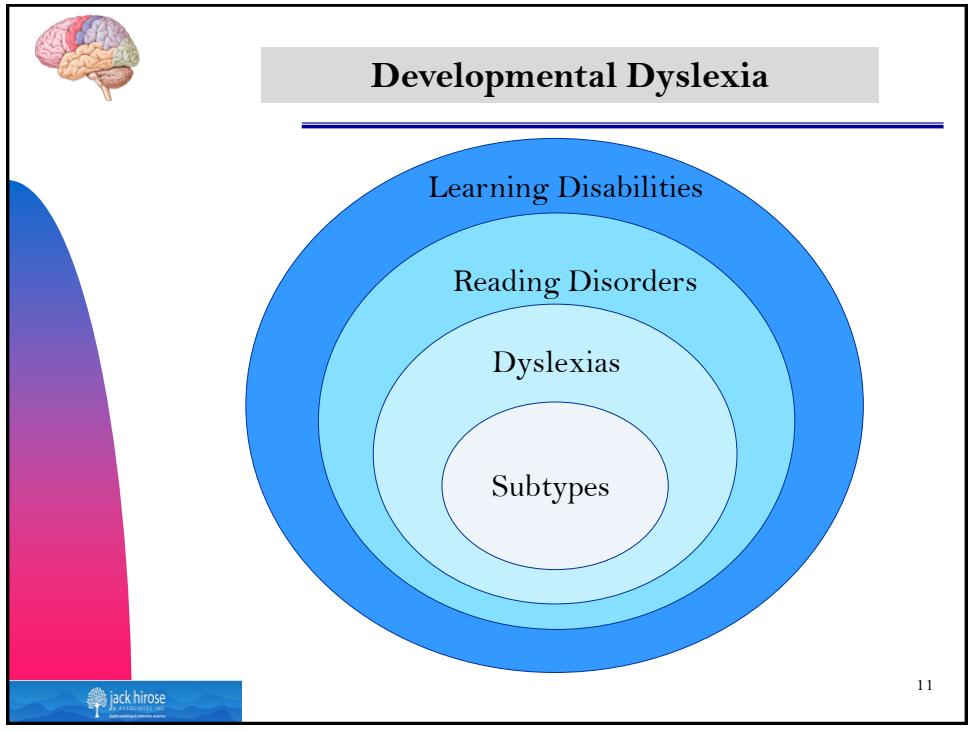
Defining Dyslexia

- *"Dyslexia is characterized by difficulties with **accurate** and / or **fluent** word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the p**honological component** of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. **Secondary consequences** may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge."*

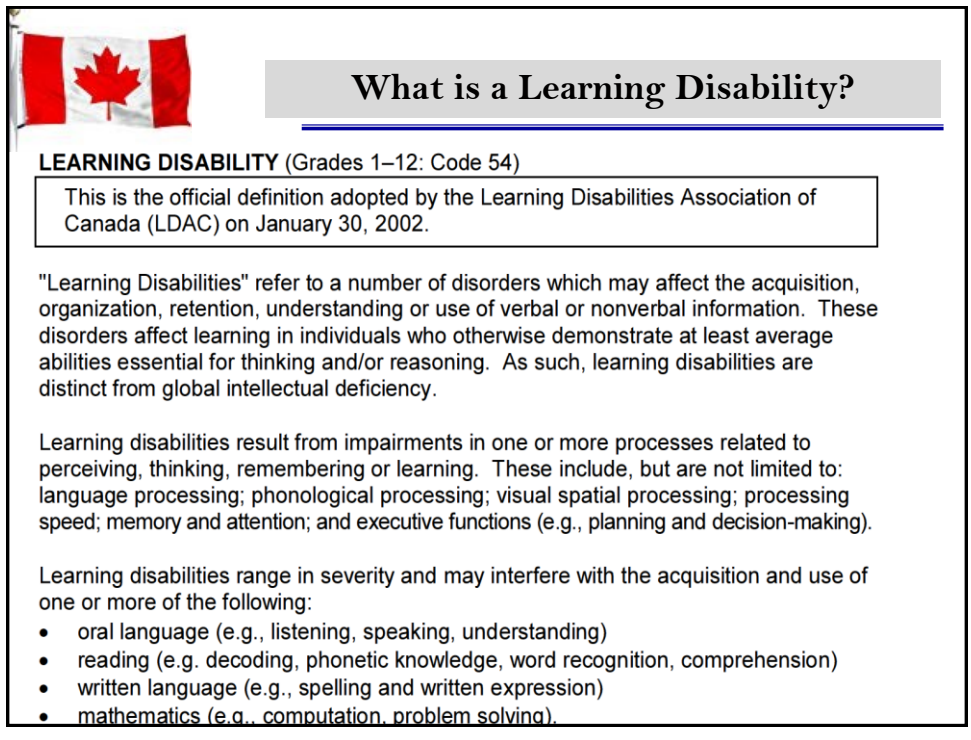
  - International Dyslexia Association (2002)

10

10

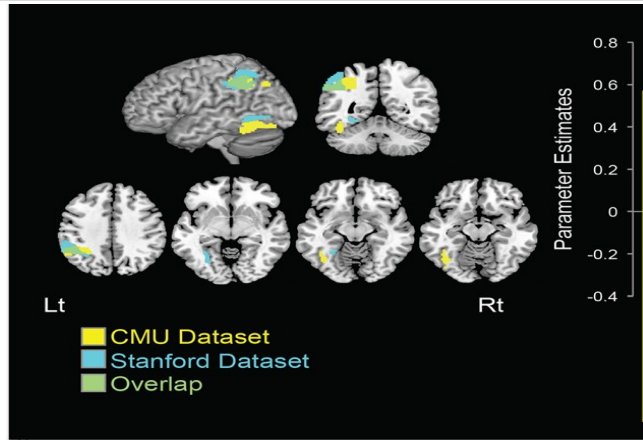

Developmental Dyslexia
Learning Disabilities
Reading Disorders
Dyslexias
Subtypes
jack hirose
11

11


What is a Learning Disability?
LEARNING DISABILITY (Grades 1–12: Code 54)
This is the official definition adopted by the Learning Disabilities Association of Canada (LDAC) on January 30, 2002.
"Learning Disabilities" refer to a number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. As such, learning disabilities are distinct from global intellectual deficiency.
Learning disabilities result from impairments in one or more processes related to perceiving, thinking, remembering or learning. These include, but are not limited to: language processing; phonological processing; visual spatial processing; processing speed; memory and attention; and executive functions (e.g., planning and decision-making).
Learning disabilities range in severity and may interfere with the acquisition and use of one or more of the following:
oral language (e.g., listening, speaking, understanding)
reading (e.g. decoding, phonetic knowledge, word recognition, comprehension)
written language (e.g., spelling and written expression)
mathematics (e.g., computation, problem solving).

12

What about the Role of IQ in Dyslexia?



Tanaka, H. et al. (2011). *The Brain Basis of the Phonological Deficit in Dyslexia is Independent of IQ.* Psychological Sciences, 22(11): 1442-1451

- Reduced activation seen among 57 (8-12yo) students from Carnegie Mellon and 74 students from Stanford (7-16yo) in discrepant AND non-discrepant readers in left parietal and visual word form area.
- IQ is not a factor in phonological processing!!
  (Siegal, 1991: Fletcher, et al. 1994; Stanovich, 2005: Shaywitz, 2010).

13

13

NASP Position Statement

- Specific learning disabilities are endogenous in nature and are characterized by **neurologically** based deficits in cognitive processes.
- These **cognitive processing** deficits are specific and interfere with the acquisition of one or more academic skills.
- Specific learning disabilities are **heterogeneous**—there are various **types** of learning disabilities, and there is no single defining academic or cognitive deficit or characteristic common to all types.
- SLD remains the largest category of educational disability. For students ages 6–21 receiving special education services, 37% had SLD's with 80% of SLD's involving reading (USDOE, 2021).
- Relying upon an **ability–achievement** discrepancy as the sole means of identifying children with specific learning disabilities is at odds with scientific research and with best practice.

14

14

Reading Presentation Outline

Why Literacy Matters

Defining Dyslexia

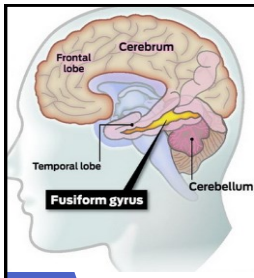
➡ **Four Universal Truths of Reading**

Subtypes of Reading Disorders & Interventions

Introducing the FAR

15

15



Is Reading a Form of Synesthesia?

Duke Ellington Billy Joel Pharrell Williams

- **Synesthesia** – cross wiring of senses. These musicians hear colors.
- **Exaptation** – the brain is evolving to learn modern tasks including reading (Stephen Jay Gould, 1982; DeHaene, 2013).

**Reading involves hearing symbols echo in the brain.
Is dyslexia is a failure to become a synesthete?

16

16

Four Universal Truths of Reading

1. In all word languages studied to date, children with developmental reading disorders (dyslexia) primarily have difficulties in identifying, recognizing, categorizing, and/or manipulating phonological units at all linguistic levels (Goswami, 2007).

Screening for Success (Hulme & Snowling, 2016)

1. Phonological awareness skills.
2. Ability to link sounds with letters.
*3. Rapid letter-naming skills?
   a) Rapid naming of letters better than objects (Kilpatrick, 2015)
   b) Rapid naming explains much of the reading variance independent of phonological awareness (Truong et al., 2019).

17

17

Developmental Risk Factors

Early/Pre-Academic Indicators (Preschool - Kindergarten)

- Family history of dyslexia
- Delayed language developmental milestones
- Poor receptive vocabulary (in comparison to child's environment)
- Few books in the child's home environment
- Articulation delays
- Difficulty learning and remembering nursery rhymes
- Difficulty learning letter names-sounds-numbers

Initial Academic Indicators (Kindergarten - 1st grade)

- Poor ability to link sounds with letters
- Slower rapid naming of objects and letters
- Difficulty retelling a story
- Difficulty breaking words into smaller parts
- Aversion/avoidance of reading

18

18

Four Universal Truths of Reading

2. The English language *is not* a purely phonological!

- 1 letter grapheme: c a t. The sounds **/k/** is represented by the letter **'c'.**
- 2 letter grapheme: l ea f. The sound **/ee/** is represented by by the letters **'e a'.**
- 3 letter grapheme: n igh t. The sound **/ie/** is represented by the letters **'i g h'.**
- 4 letter grapheme: th r ough. The sound **/oo/** is represented by the letters **'o u g h'.**

- The English language includes over **300** ways of representing **44** sounds using a series of different letter combinations (Uhry & Clark, 2005). In Italian there is no such ambiguity as just **33** graphemes are sufficient to represent the **25** phonemes.
- Therefore, **25%** of words are phonologically irregular (i.e. "*debt*", "*yacht*", "*onion*", etc..) or have one spelling but multiple meanings –*homonyms*- (i.e. "*tear*", "*bass*", "*wind*", etc.)

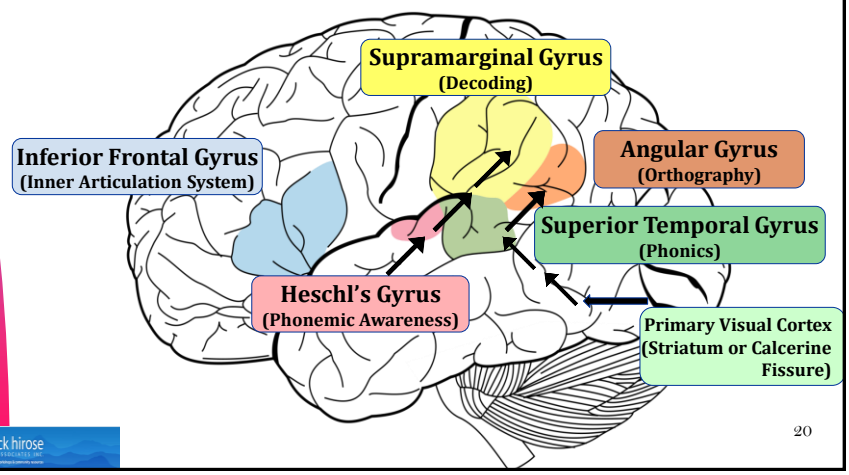
19

Summary: We need to develop **orthography!!**

19

The Reading Brain: How Words are Assembled

3. Neuroimaging techniques have demonstrated that **phonological** processing and **orthographic** processing are a by-product of the *temporal-parietal* junctures in the left hemisphere of the brain (Paz-Alonso et al., 2018; Glezer et al., 2016;Sandak et al., 2004; McCandliss & Noble, 2003).

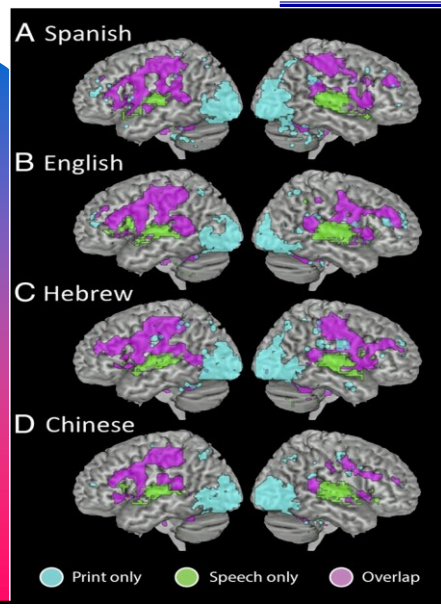


20

20

A Universal Reading Brain

Rueckl et al., (2015). Universal brain signature of proficient reading: Evidence from four contrasting languages. **Proceedings of the National Academy of Sciences**; 112(50): 15510–15515

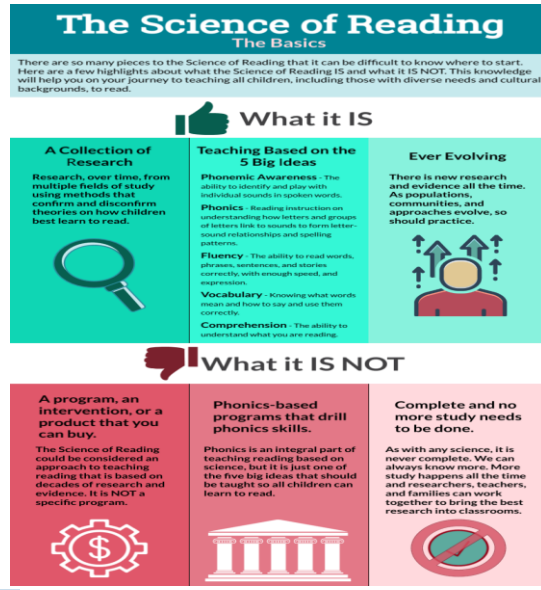


- Proficient reading entails the convergence of phonological and orthographic processing systems onto a common network of neural structures dominated by the left perisylvian regions of the brain.
- Dyslexics in transparent orthographic systems, such as Spanish, German, Italian, Greek have difficulty in acquiring reading speed as a hallmark deficit of dyslexia (Ziegler et al., 2003; Davies et al., 2007; Constantinidou & Stainthorp, 2009; Wimmer et al., 2010).

21

21

4. Embrace the Science of Reading

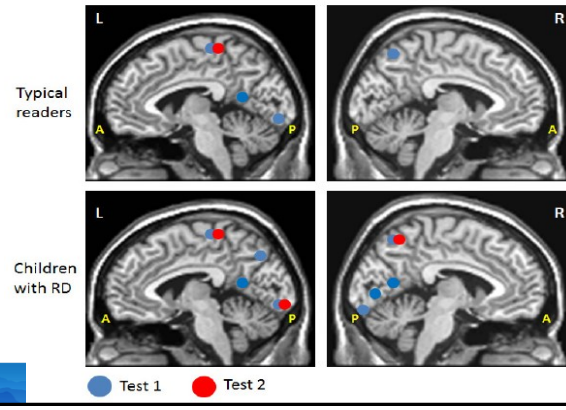


22

22

Do Interventions Change the Brain?

- Horowitz-Kraus, T., Vannest, J.J., Kadis, D., Cicchino, N., Wang, Y.Y. & Holland, S. K.(2014). Reading acceleration training changes brain children with reading disorders. *Brain and Behavior*, 886-902.
- 33 children with reading disorders 8-12 years-old.
- RAP training…4 weeks…20 min daily….fluency and comprehension
- Computer presentation of sentences…which dissipate based on response accuracy…and students select correct answer.



23

jack hirose

23

Reading Presentation Outline

Why Literacy Matters

Defining Dyslexia

Four Universal Truths of Reading

➡ **Subtypes of Reading Disorders & Interventions**

Introducing the FAR

24

jack hirose

24

Subtypes of Dyslexia

1. **Dysphonetic Subtype** - great difficulty using phonological route in reading, so visual route to lexicon is used. These readers do not rely in letter to sound conversions, but rather over-rely on visual cues to determine meaning from print.

Neuropsychological Significance: Left temporal-parietal gradient *(supramarginal gyrus)*.

Target Word:	Read As:
cat	*couch*
balloon	*ball*
jump	*gym*
ghost	*goat*

25

25

1. Remediation Strategies for Dysphonetic Dyslexia

Over Age 12:	Wilson Reading System
	SRA Corrective Reading & REACH System
(Top- Down)	Read 180
	HOSTS
	Kaplan Spell/Read
	LEXIA Strategies for Older Students
Ages 7 - 12:	ASDEC Language Foundations (Orton-Gillingham)
	SRA Corrective Reading
	Earobics II
	LiPS
	LEXIA Primary Reading
(Bottom-Up)	Horizons
Under Age 7:	Fast Forword II(Tallal)
	Earobics I
	Phono-Graphix
	Saxon Phonics Program
	Readwell
	Ladders to Literacy
	Fundations
	Road to the Code
	SIPPS
	Scott Foresman Early Intervention Reading

26

26

Subtypes of Dyslexia

2. Surface dyslexia - an over-reliance on sound symbol relationships as the process of reading never becomes automatic. These children break every word down to its phonological base, and read slowly due to poor **orthographic** perception and processing.

WORD		READ AS
island	→	izland
grind	→	grinned
listen	→	liston
begin	→	beggin
lace	→	lake

- Extreme difficulty reading words where phonemes and graphemes are not in 1 to 1 correspondence: **yacht**
  debt

jack hirose

27

27

Remediation Strategies for Surface Dyslexia

Over Age 12:
Academy of Reading
Wilson Reading System
Laubauch Reading Series
Read 180

Ages 7 - 12:
Read Naturally
Great Leaps Reading
Quick Read
RAVE-O
Fast Track Reading

Under Age 7:
Destination Reading
Reading Recovery
Early Success
Fluency Formula

jack hirose

28

28

Subtypes of Dyslexia

3. **Mixed Dyslexia** - severely impaired readers with characteristics of both **phonological** deficits, as well as **orthographical** deficits. These readers have no usable key to unlocking the reading and spelling code. Very bizarre error patterns observed.

WORD	READ AS:
Advice	Exvices
Correct	Corex
Violin	Vilen
Museum	Musune
Possession	Persessive
Material	Mitear

* Multiple breakdowns along many reading pathways. 29

29

4 Remediation Strategies for Mixed Dyslexia

(1) **Multiple Programs** - An eclectic and approach capitalizing on the particular strengths of the child. Consider using a multi-sensory type of **Orton-Gillingham** program, coupled with a fluency model such as **Read Naturally,** and the computerized models of **Read 180**.

(2) **Top Down Strategies** – Often atypical development mapping individual sounds to the visual word form association areas.

(3) **Socioeconomic Status** - is a very strong predictor of reading skills due primarily to the home literacy environment. Therefore, schools need to provide more reading opportunities.

(4) **Motivation and Confidence** –Great Leaps, Read Naturally, etc. tend to give immediate feedback.

30

30

4 Components of Reading Comprehension

1. **Content Affinity** - attitude and interest toward specific material.

2. **Working Memory** - the ability to temporarily suspend information while simultaneously learning new information. The amount of memory needed to execute a cognitive task.

3. **Executive Functioning** - the ability to self-organize verbal information to facilitate recall.

4. **Language Foundation** – vocabulary knowledge is vital for passage comprehension.

jack hirose

31

31

Reading Comprehension Interventions

1. **Stop & Start Technique** – student reads a passage out loud and every 30 seconds "stop" to ask questions.
2. **Directional Questions** – ask questions at the beginning of the text instead of the end.

3. **Read Aloud** – reading out loud allows student to hear their own voices and facilitates working memory.

4. **Story Maps** – pre-reading activity where graphic organizers are used to outline and organize the information.

5. **Active Engagement** – encourage **active,** not passive reading, by having children take notes or putting an asterisk next to important information. Also, multiple colors for highlighting.

jack hirose

32

32

Reading Presentation Outline

Why Literacy Matters

Defining Dyslexia

Four Universal Truths of Reading

Subtypes of Reading Disorders & Interventions

➡ **Introducing the FAR**

jack hirose

33

33

far™ feiferassessmentofreading™

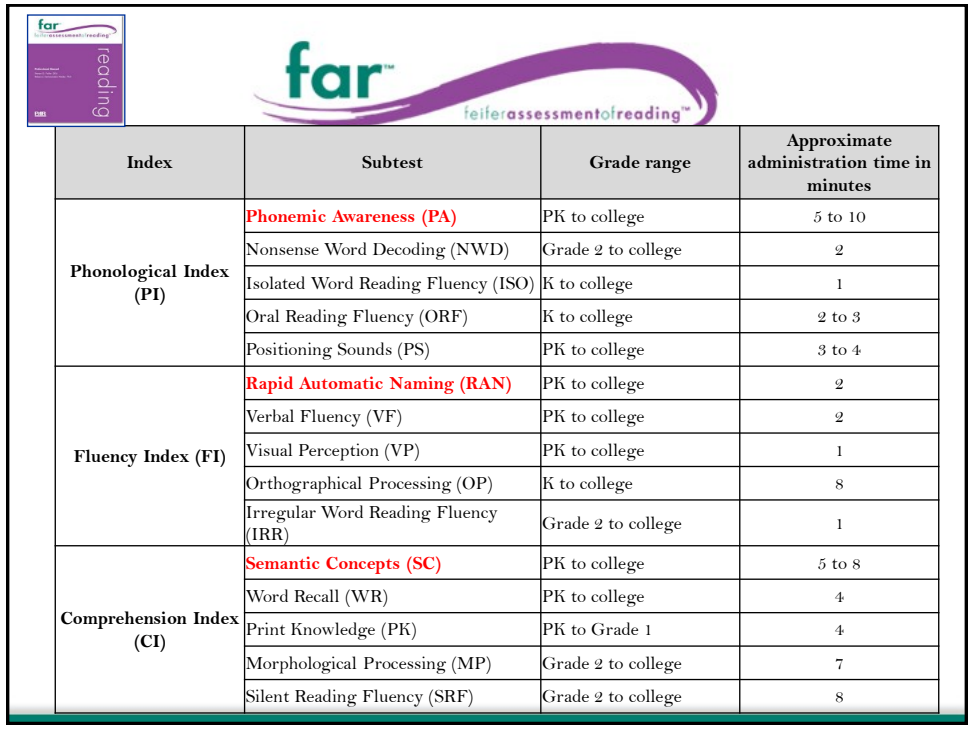
Steven G. Feifer, D.Ed., ABPdN

- A **neurodevelopmental** assessment of reading
- Pre-K to College (Ages 4-21)
- Normative sample included 1,074 students
- 15 subtests in complete battery
- Diagnoses **4 subtypes** of reading disorders
- Includes the FAR-S dyslexia **screening** battery
- Total Far index score and 4 Reading index scores

jack hirose

34

34



Index	Subtest	Grade range	Approximate administration time in minutes
Phonological Index (PI)	Phonemic Awareness (PA)	PK to college	5 to 10
	Nonsense Word Decoding (NWD)	Grade 2 to college	2
	Isolated Word Reading Fluency (ISO)	K to college	1
	Oral Reading Fluency (ORF)	K to college	2 to 3
	Positioning Sounds (PS)	PK to college	3 to 4
Fluency Index (FI)	Rapid Automatic Naming (RAN)	PK to college	2
	Verbal Fluency (VF)	PK to college	2
	Visual Perception (VP)	PK to college	1
	Orthographical Processing (OP)	K to college	8
	Irregular Word Reading Fluency (IRR)	Grade 2 to college	1
Comprehension Index (CI)	Semantic Concepts (SC)	PK to college	5 to 8
	Word Recall (WR)	PK to college	4
	Print Knowledge (PK)	PK to Grade 1	4
	Morphological Processing (MP)	Grade 2 to college	7
	Silent Reading Fluency (SRF)	Grade 2 to college	8

35

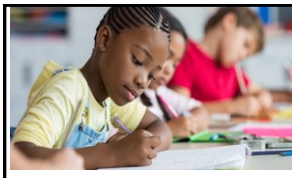
Writing Presentation Outline

- **Defining Dysgraphia**
- Cognitive Constructs and Writing
- 3 Subtypes of Written Language Disorders
- Strategies for Success
- Introducing the FAW

jack hirose

36

36



What is Dysgraphia?

Dysgraphia is a broad-based term that refers to a specific learning disability in written expression. The term can include problems with letter formation, legibility, letter spacing, spelling, fine motor coordination, rate of writing, grammar and overall sentence production (Chung et al., 2020).

Developmental Dysgraphia refers to difficulty acquiring writing skills despite adequate learning opportunities and cognitive skills.

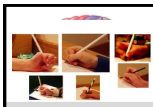
- Younger children tend to have deficits with the motoric aspects of the written stroke, whereas older children struggle with more cognitive-linguistic elements of writing (Biotteau et al., 2019).

Acquired Dysgraphia refers to a learned skill (writing) being disrupted by a specific injury or degenerative condition.

jack hirose

37

37



Warning Signs of Developmental Dysgraphia

Age Group	Signs of Dysgraphia
Preschool aged children	• Awkward pencil grasp • Lack of hand dominance • Fatigues quickly when writing • Letters poorly formed or inversed • Difficulty writing within margins • Overflow motor movements • Does not anchor paper with opposite hand.
Elementary aged students	• Illegible or messy handwriting • Letter transpositions • Mirror writing • Switching between cursive and print • Slower paced writing • Poor spelling impacts legibility. • Frequent erasures
Secondary school students	• Poor planning and organizational skills. • Discrepancy between verbal output and • written output. • Difficulty keeping pace when note-taking. • Does not separate ideas by paragraph. • Paragraphs do not flow from general to • specific. • Grammar impacts legibility.

38

Types of Writing Genres

- **Persuasive** - change the reader's point of view in order to affect the reader's action.
- **Expository**- explaining objective information to enhance the reader's overall understanding.
- **Experiential** - to describe a personal experience or narrative to others.
- **Prosaic** – to convey a particular sentiment or emotion from a personal experience. Often written in a metaphoric style inclusive of poem, lyric, or sonnet.
- **Analytical** – heavily structured style of writing where scientific scrutiny involved.

39

39

Writing Presentation Outline

Defining Dysgraphia

➡ **Cognitive Constructs and Writing**

3 Subtypes of Written Language Disorders

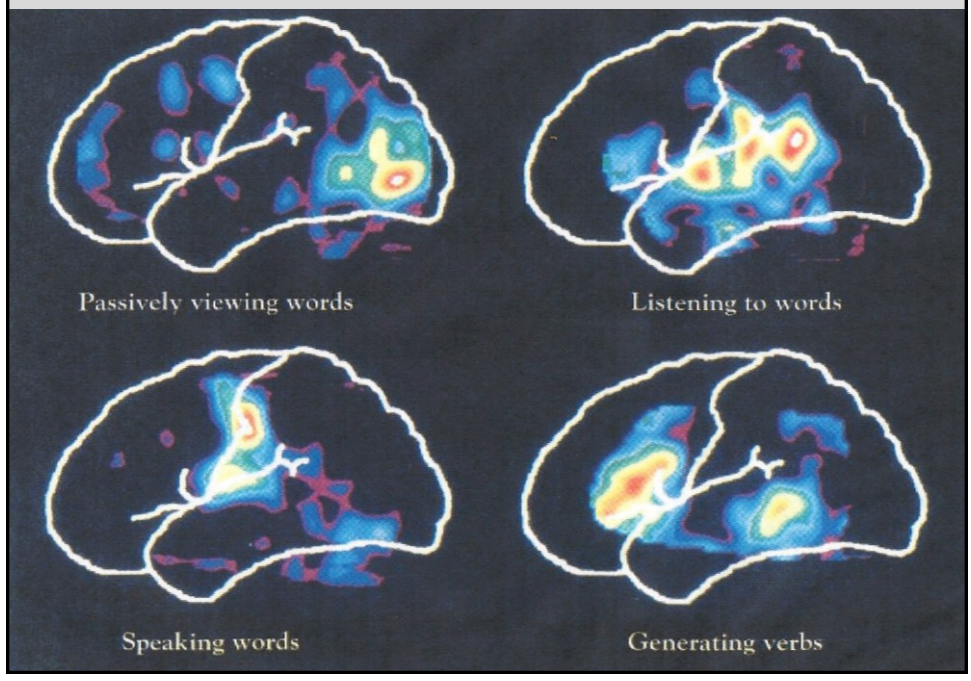
Strategies for Success

Introducing the FAW

40

40

THE WRITING BRAIN (Posner & Raichle, 1994)

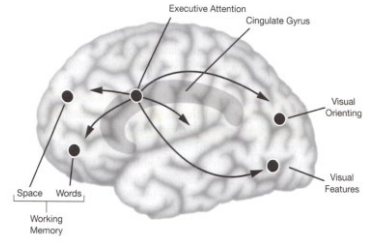


41

Cognitive Constructs and Written Language

Attention: (Selective & Sustained)

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



BRAIN REGION **- Anterior Cingulate Gyrus**
****Effort control and top-down attention***

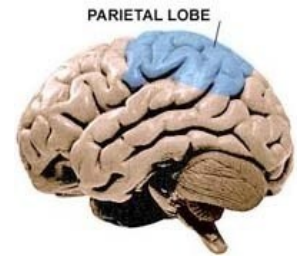
42

42

Cognitive Constructs and Written Language

Spatial Production

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



BRAIN REGION –Right Parietal Lobe

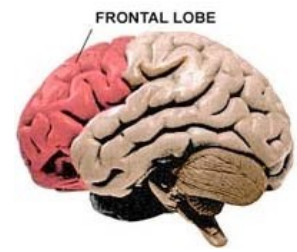
jack hirose

43

Cognitive Constructs and Written Language

Sequential Production

- Poor connected writing
- Letter reversals
- Organizational deficits
- Lack of cohesive ties
- Deficits in working memory, especially with ADHD kids, leads to sequential dysfunction.



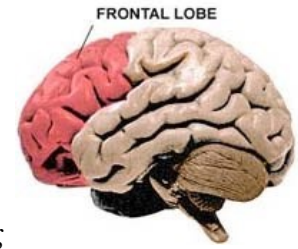
BRAIN REGION – Left Prefrontal Cortex

jack hirose

44

Cognitive Constructs and Written Language

Working Memory Skills



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

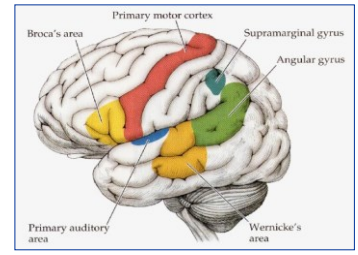
BRAIN REGION – Semantic memories stored in temporal lobes. Retrieved by frontal lobes

45

45

Cognitive Constructs and Written Language

Language:



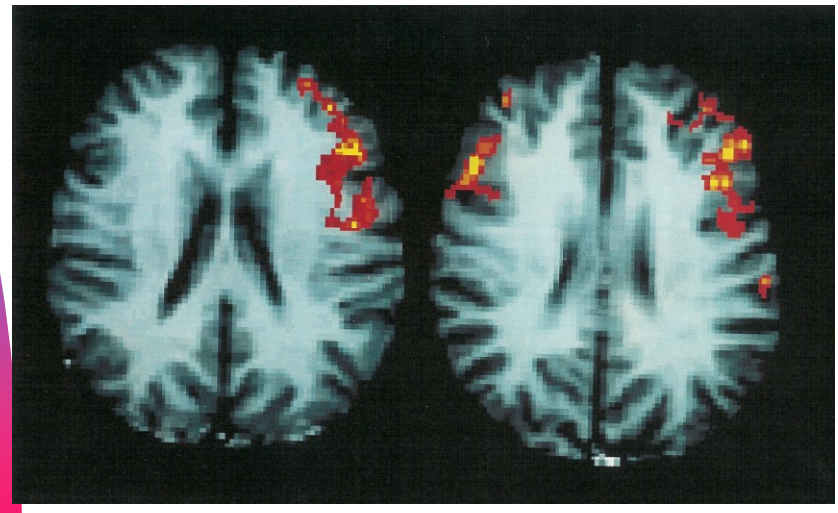
- Poor vocabulary
- Lack of cohesive ties
- Poor grammar
- Simplistic sentence structure
- Left hemisphere stores language by converging words into semantic baskets; right hemisphere excels in more divergent linguistic skills (simile and metaphor).
- Writing genre impacts retrieval!

BRAIN REGION – Temporal Lobes

46

46

Gender Differences in Phonological Processing



47

47

Gender Differences: What the research says….

Krafnick, A.J. & Evans, T. M. (2019). Neurobiological Sex Differences in Developmental Dyslexia. Frontiers in Psychology, Vol.9,1-14.

- A **language-based learning disability** impacts 5-13% of the population due to poor decoding & spelling skills.
- **Language-based learning disabilities** have higher ratios for boys than girls.
- Lower levels of **testosterone** *(measured in utero)* correlate with less gray matter in language (temporal-parietal) regions for males.
- **Conclusion:** Deficits with **testosterone** impacts reading brain for males. Deficits with **estrogen** does not necessarily impact reading brain for females, but has been linked to deficits in sensorimotor areas.

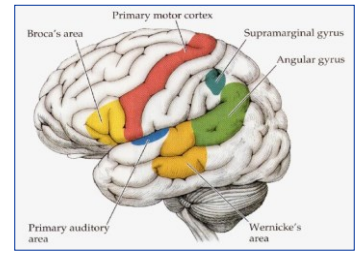
48

48

Cognitive Constructs and Written Language

Intelligence

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



BRAIN REGION – Inferior Parietal Lobes

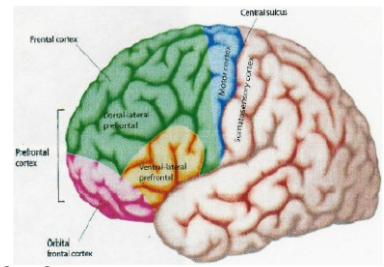
49

49

Cognitive Constructs and 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

50

50

Cognitive Constructs and Written Language: Motor Output Speed (Pollock et al, 2009)

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

51

51

Writing Presentation Outline

Defining Dysgraphia

Cognitive Constructs and Writing

➡ ***3* Subtypes of Written Language Disorders**

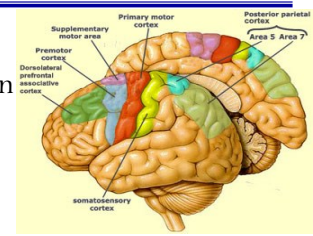
Strategies for Success

Introducing the FAW

52

52

3 Subtypes of Written Language Disorders



(1) **Graphomotor Dysgraphia** - 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.

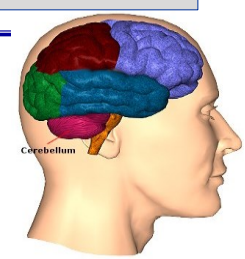
c) **Cerebellum** - physical act of sequencing fine motor movements becomes less effortful and more reflexive.

d) **Basal Ganglia** – procedural memory and automaticity of handwriting and gross motor movements.

53

53

The Role of the Cerebellum in Writing



- The cerebellum contains **50%** of the neurons in the brain.
- Guides and corrects motor movements based upon proprioceptive feedback.
- Made up of purkinje cells and granule cells which are primarily excitatory, and help fine tune the writing process.
- Over time, the physical act of sequencing subtle motor movements becomes less effortful and more reflexive.
- Deficits mainly lead to motor coordination issues….ataxia….*("3971" ATM Code spatial/sequential)*

54

54

Key Observations

1. Does the student have enough space on their desk?
2. Are both feet on the floor?
3. Does the student complain their hand is tired?
4. Does the student use excessive force?
5. Does the student use an immature grip?
6. Does the student constantly rub their eyes when writing or put their head down on the desk?
7. Does the student appear distracted?
8. Does the student use their opposite hand to anchor the page?

❖Side note: Handwriting shown to improve memory and spelling over keyboarding by activating more regions of sensorimotor and parietal lobes (Askvik et al., 2020).

jack hirose

55

55

3 Subtypes of Written Language Disorders

(2) Dyslexic Dysgraphias: (Spelling Miscues)

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 *(i.e "sommr" for "summer")*.

b) Surface dysgraphia - a breakdown in the *orthographic* representation of words. Miscues made primarily on phonologically irregular words *(i.e. "laf" for "laugh"; "juse" for "juice"; "mite" for "mighty")*.

c) Mixed Dysgraphia - characterized by a combination of both *phonological* errors and *orthographical* errors depicting faulty arrangement of letters and words *(i.e "ceshinte" for "kitchen")*.

jack hirose

56

56

3 Subtypes of Written Language Disorders

(3) **Executive Dysgraphia** – poor production and difficulty with the implicit rules for grammar which dictate how words and phrases can be combined. Deficits in *working memory* and *executive* functioning in frontal lobes hinders output.

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

57

57

Features of Executive Dysgraphia

a) **Verbal Retrieval Skills** – the frontal lobes are critical in retrieving words stored throughout the cortex, often stored by semantic categories.

b) **Working Memory Skills** – helps to recall spelling rules and boundaries, grammar rules, punctuation, and maintaining information in mind long enough for motoric output.

c) **Organization & Planning** – syntactical arrangement of thought needed to sequence mental representations.

58

58

Executive Functioning and Written Language

Classification	Writing Dysfunction
(1) Initiating	* Poor idea generation * Poor independence
(2) Sustaining	* Lose track of thoughts * Difficulty finishing * Sentences disjointed
(3) Inhibiting	* Impulsive/Distractible
(4) Shifting	* Perseverations * "Stuck" on topic

59

59

Executive Functioning and Written Language

Classification	Writing Dysfunction
(5) Poor Organization	* Frequent erasers * Forget main idea * Disjointed content
(6) Poor Planning	* Poor flow of ideas * Lack of cohesive ties
(7) Poor Word Retrieval	*Limited word choice * Simplistic sentences
(8) Poor Self Monitor	* Careless miscues * Sloppy work

60

60

Writing Presentation Outline

Defining Dysgraphia

Cognitive Constructs and Writing

3 Subtypes of Written Language Disorders

➡ **Strategies for Success**

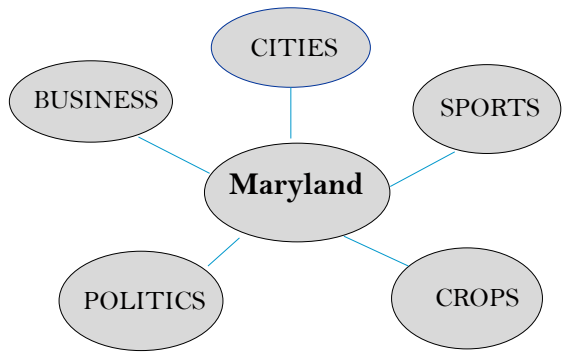
Introducing the FAW

61

61

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 a web:



62

62

Self Monitoring Strategies

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

1) **C**apitalize the first word of each sentence.

2) **O**rganize the information by reviewing topic sentences and double check paragraph breaks.

3) **P**unctuation miscues must be reviewed.

4) **S**pelling miscues must be reviewed.

jack hirose

63

63

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. Very effective word predictive software.
- **Kurzweil Technology** - adaptive technology to further practice grammar, spelling, and punctuation. Voice activated software also an option.
- **Journal or Diary** – can be a fun and effortless way to practice writing on a daily basis.
- **Keyboarding** - speed up output to reduce pressure from working memory skills to retain information over longer periods of time.
- **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.

64

64

10 Research Based Strategies (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)*

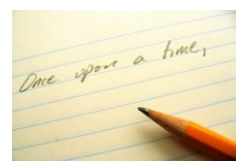
jack hirose

65

65

5 Steps for Executive Dysgraphia (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 base upon a writing rubric.



jack hirose

66

66

Writing Programs

1. **EmPOWER** – developed by Dr. Bonnie Singer through Architects for Learning. Can use in any class in any grade. Six steps include:
   - **E**valuate –break down the task to determine what I have to do.
   - **P**lan – identify my purpose for writing and select strategies.
   - **O**rganize – show my thinking and organize my ideas.
   - **W**ork – work my ideas into a well structured text.
   - **E**valuate – assess my work.
   - **R**e-Work – make necessary changes.

2. **Paragraphology** – developed by **Jemicy School** using a color coded approach to teach expository writing for Middle School. (Uses a different color for Topic Sentence, Supporting Sentence, Details, Conclusions, and Transitions)

3. **SRSD** – **S**elf-**R**egulated **S**trategy **D**evelopment. Research based to improve planning, editing and written product (De la Paz, 2007; De la Paz & Graham, 2002; Englert, 2009; Graham, 2006; Graham & Perin, 2007; Perin, 2007).

jack hirose

67

67

Writing Presentation Outline

Defining Dysgraphia

Cognitive Constructs and Writing

3 Subtypes of Written Language Disorders

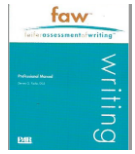
Strategies for Success

➡ **Introducing the FAW**

jack hirose

68

68



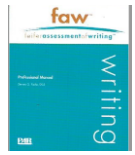
Feifer Assessment of Writing (FAW)

- A neurodevelopmental assessment of written language disorders.
- Pre-K to College (Ages 4-21)
- 12 subtests in complete battery/10 subtests core
- Diagnoses 3 subtypes of writing disorders:
  - **1) Graphomotor Dysgraphia**
  - **2) Dysexic-Dysgraphia**
  - **3) Executive Dysgraphia**
- Includes the FAW-S dysgraphia screening battery
- Yields a Compositional Writing Index (CWI)

jack hirose

69

69



Feifer Assessment of Writing (FAW)

Structure of the FAW

Index	Subtest	Grade range	Approximate administration time in minutes
Graphomotor Index (GI)	Alphabet Tracing Fluency (ATF)	PK to college	1 - 2
	Motor Sequencing (MS)	PK to college	3 - 4
	Copying Speed (CS)	K to college	3 - 4
	Motor Planning (MP)	PK to college	2 - 3
Dyslexic Index (DI)	Homophone Spelling (HS)	K to college	3 - 4
	Isolated Spelling (IS)	PK to college	4 - 6
Executive Index (EI)	Executive Working Memory (EWM)	Grade 2 to college	10 - 12
	Sentence Scaffolding (SS)	Grade 2 to college	13 - 16
	Retrieval Fluency (RF)	PK to college	7 - 8
	Expository Writing (EW)	Grade 2 to college	6
Compositional Writing Index (CWI) ***(optional)***	Expository Writing (EW)	Grade 2 to college	6
	Copy Editing (CE) ***(optional)***	Grade 2 to college	4
	Story Mapping (SM) ***(optional)***	Grade 2 to college	6

jack hirose

70

70

Math Presentation Outline

➡ **Math by the Numbers**

Math Anxiety and Learning

The Neural Machinery of Mathematics

Building a Math Brain

3 Subtypes of Dyscalculia

Introducing the FAM

71

71

PISA DATA (2022): 15 yr. olds

Program for International Student Assessment
700,000 students from **81** countries

- A test of **mathematical literacy** for ***15*** year old students which focuses upon the direct application of mathematical principles administered every ***3* years.**
- **Math Literacy** is a students' capacity to reason mathematically and to utilize mathematics to solve problems in a variety of real-world contexts.

Cross Country Comparisons:

- The **PISA Technical Advisory Group** established to ensure strong comparability of PISA scores across countries and economies.

Results:

- Compared to 2018, mean performance fell by **10** score points in reading and by almost **15** score points in mathematics, primarily as a result of the pandemic.

72

72

PISA DATA (2022): 15 yr. olds

Country	Average Score
International Average	**472**
1. Singapore	575
2. Macao-China	552
3. Chinese Taipei	547
4. Hong Kong (China)	540
5. Japan	536
6. Korea	527
7. Estonia	510
8. Switzerland	508
9. Poland	498
10. Canada	**497**
11. Netherlands	493
12. Ireland	492
13. Belgium	489
14. Denmark	489
15. United Kingdom	489
16. Australia	487
17. Austria	487
18. Czech Republic	487
19. Slovenia	485
20. Finland	484

PISA DATA (2022): 15 yr. olds

Country	Average Score
International Average	**472**
21. Latvia	483
22. Sweden	482
23. New Zealand	479
24. Germany	475
25. Lithuania	475
26. France	474
27. Hungary	473
28. Spain	473
29. Portugal	472
30. Italy	471
31. Viet Nam	469
32. Norway	468
33. Malta	466
34. **United States**	**465** (37th place in 2018)
35. Slovak Republic	464
36. Croatia	463

PISA Data 2018: Canadian Decline

Canadian results in mathematics over time, 2012–2018

	2012		2015		2018	
	Average score	Standard error	Average score	Standard error	Average score	Standard error
Canada	518	(1.8)	516	(4.2)	512	(4.1)
Newfoundland and Labrador	490	(3.7)	486	(4.8)	488	(7.3)
Prince Edward Island	479	(2.5)	499*	(7.3)	487	(11.6)
Nova Scotia	497	(4.1)	497	(5.8)	494	(7.2)
New Brunswick	502	(2.6)	493	(6.2)	491	(6.6)
Quebec	536	(3.4)	544	(5.9)	532	(4.9)
Ontario	514	(4.1)	509	(5.5)	513	(5.6)
Manitoba	492	(2.9)	489	(5.5)	482	(5.0)
Saskatchewan	506	(3.0)	484*	(4.6)	485*	(6.0)
Alberta	517	(4.6)	511	(5.9)	511	(6.1)
British Columbia	522	(4.4)	522	(6.1)	504*	(6.2)

* Significant difference compared with baseline (2012)
Note: The linkage error is incorporated into the standard error for 2015 and 2018.

jack hirose

75

75

Anna Stoke (May, 2015)

Associate Professor of Mathematics and Statistics at University of Winnipeg

1. Employ the 80/20 rule for direct instruction to discovery-based learning.
2. Reduce multiple strategy approaches that are inefficient and place too much burden on working memory.
3. Important concepts are introduced too late, especially Algebra.
4. Teacher training in mathematics needs to improve.

jack hirose

76

76

4 Reasons for U.S Decline

1. **Time on task.** Most elementary math instruction occurs in the afternoon, average is **54** instructional minutes per day (89 min language arts).
2. **Pandemic.** Math skills suffered more than any other academic skill in the U.S. as a result of educational disruptions to the pandemic.

*3. **Too much focus on procedural knowledge.** In order to develop conceptual understanding, students should practice multiple methods of problem solving from both a visual-spatial and verbal approach.

*4. **Math Confidence.** There are inherent cultural differences in math. When U.S. students struggle in math…the response is often *"I'm bad in math"*. When students from many Asian countries struggle in math …the response is *"I didn't try hard enough"* (Sun et al., 2021).

77

77

Math Presentation Outline

Math by the Numbers

➡ **Math Anxiety and Learning**

The Neural Machinery of Mathematics

Building a Math Brain

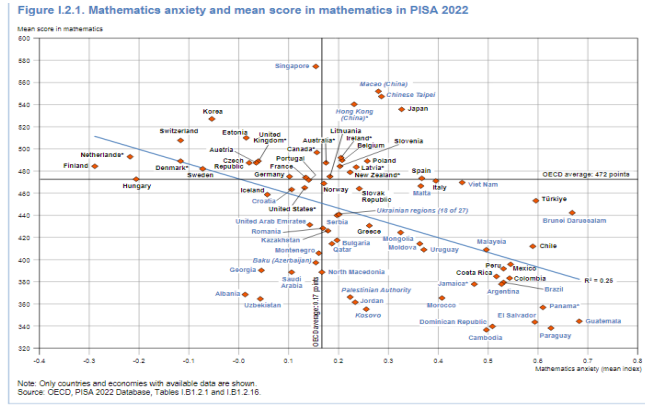
3 Subtypes of Dyscalculia

Introducing the FAM

78

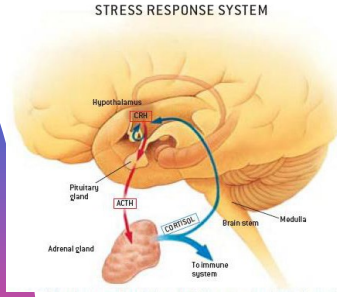
78

Math Anxiety and PISA Score Performance



- Negative correlation with anxiety (6 questions) and math performance.
  - 2023: **39%** of students felt nervous when doing math.
  - 2012: **31%** of students felt nervous when doing math.

Math Anxiety



Cortisol – a glucocorticoid (glucose-cortex-steroid) that regulates the metabolism of glucose in the brain. A balance or homeostasis of cortisol is needed for optimal brain functioning. Too much *(Cushing's Syndrome)*…too little *(Addison's Disease)*.

- Anxiety and stress alters amygdala to PFC connections leading to poor executive functioning (Berens et al., 2017). EF is imperative in solving word problems.
- Anxiety impacts cognition and learning by way of working memory (Dowker et al., 2015), hindering number manipulation.
- Anxiety impacts **procedural knowledge** with respect to mathematics.

The Truth About Math Anxiety: Do We Have a Math Phobia?

Implicit Messages:

"Oh not to worry Billy, I was never that good in math either."
"Wow, are you taking Algebra II….that is sooooo hard!"
"Hey Ritchie…it doesn't matter if you do not understand your math homework, you will never use this stuff in real life."

Causes of Math Anxiety:

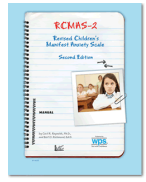
- Timed tests
- Pop quizzes
- Being called upon to write a math problem on the board
- Speeded skill drills and classroom competitions
- Teaching too quickly before concepts are consolidated
- Unit tests that cover too much information
- No visual cues
- Poor instruction
- Classroom climates that prevent students from asking questions
- Stressing teacher's own algorithm

81

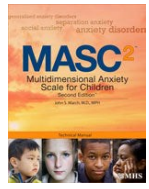
jack hirose

81

Anxiety Measures



- **Revised Children's Manifest Anxiety Scale-2nd Edition** – examines 5 areas of anxiety including physiological, defensiveness, worry, inconsistent responding, and social anxiety.



- **Multidimensional Anxiety Scale for Children – 2nd Edition** – includes both a self-report and parent report scale. There are 50 items in total.

- **Behavior Assessment Scale for Children-3rd Edition** – includes teacher, parent, and self-report scales to measure behavior and social emotional functioning.

82

82

Math Presentation Outline

Math by the Numbers

Math Anxiety and Learning

➡ **The Neural Machinery of Mathematics**

Building a Math Brain

3 Subtypes of Dyscalculia

Introducing the FAM

83

83

What is a Math Disability?

Math Learning Disability (MLD) - a generic term referring to children whose math performance in the classroom is substantially below age- and grade-level expectations. Often used when there is unexpected underachievement.

***Dyscalculia** – children with specific math-related deficits, including:

a) Learning and retrieving mathematical facts
(Language Retrieval)

b) Executing math calculation procedures
(Symbolic Working Memory)

c) Basic number sense and concept development
(Executive Functioning)

d) Visualizing magnitude representations.
(Visual-Spatial Memory)

* Up to **20%** of school age children have MLD or persistent difficulty with math (Iuculano et al., 2015)

84

84

The Neural Machinery of Mathematics

Language Skills: (temporal lobes)

- Most Asian languages have linguistic counting systems past *ten* (*ten-one, ten-two, etc)* whereas English deviates from **base-10** system (Campbell & Xue, 2001).
- Chinese numbers are brief *(i.e. 4=si, 7=qi)* allowing for more efficient working memory. The language is tonal which enhances auditory discrimination and memory precision.
- Calculator usage directly proportional to poorer math performance.
- U.S. kids spend **180** days in school
  South Korea children spend **220** days in school
  Japan kids spends **243** days in school

85

85

Working Memory and Math

Working Memory System

- Phonological Loop
- *Visual-Spatial Sketchpad
- Central Executive System

Mathematical Skill

- Listening to math lecture
- Self-talk through procedures (Long division: Divide-Multiply-Subtract-Bring Down)
- Manipulate symbols (symbolic)
- Magnitude comparisons(nonsymbolic)
- Geometry
- Inhibiting distracting thoughts
- Modulating anxiety
- Regulating emotional distress

86

86

Horizontal Vs. Vertical

(Trbovich & LeFevre, 2003)

- Solving problems in a vertical format required the use of more visual resources, particularly the visual-spatial sketchpad of working memory.
- Solving problems in a horizontal format required more phonological resources resulting in *slower* performance.

A	B
32 + 6	6 + 32
C	D
32 + 6	6 + 32

jack hirose

87

87

Executive Functioning and Mathematics

EXECUTIVE DYSFUNCTION	BRAIN REGION	MATH SKILL
• *Selective Attention*	• *Anterior Cingulate/* • *Subcortical structures*	• Poor attention to math operational signs • Place value mis-aligned
• *Planning Skills*	• *Dorsal-lateral PFC*	• Selection of math process impaired • Difficulty determining salient information in word problems

jack hirose

88

88

Executive Functioning and Mathematics

EXECUTIVE DYSFUNCTION	BRAIN REGION	MATH SKILL
• *Organization Skills*	• *Dorsal-lateral PFC*	• Inconsistent lining up math equations • Frequent erasers • Difficulty setting up problems
• *Self-Monitoring*	• *Dorsal-lateral PFC*	• Limited double-checking of work • Unaware of plausibility to a response.
• *Cues Pattern Recognition*	• *Dorsal-lateral PFC*	• Symbolic reasoning

89

89

Math Presentation Outline

Math by the Numbers

Math Anxiety and Learning

The Neural Machinery of Mathematics

➡ **Building a Math Brain**

3 Subtypes of Dyscalculia

Introducing the FAM

90

90

Building a Math Brain: 4 Neurocognitive Factors

1. **Approximate Number System** - non-symbolic representation of math represented by space and time.
2. **Connectivity** - linking non-symbolic representations with symbolic representations (numerals) to form our own internal number line.
3. **Automaticity** - facts and procedures.
4. **Quantitative knowledge** - mathematical reasoning emerges from the development of *number-sense* as students learn to apply mathematics to real world problems.

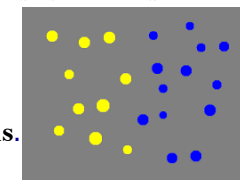
92

91

1. Approximate Number System

(Mazzocco, Feigenson & Halberda, 2011)

- A mental representational system of visual-spatial approximations that may underscore "number sense".
- Emerges independent of instruction (innate) and in non-humans as well. A preverbal skill.
- Intuitively judging which line at the grocery store is shortest, or whether there is enough milk left in the carton to make breakfast are everyday examples.

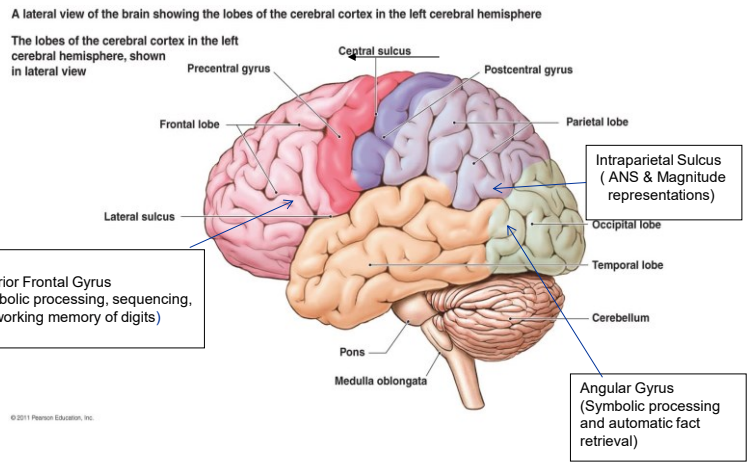


- Nonsymbolic representation of magnitudes and amounts activates **inferior parietal sulcus**.
- Distinguishes math LD from students from typical peers.

92

92

2. Making the Connection



Symbolic vs. Non-symbolic Brain Regions

93

93

2. Connectivity (non-symbolic to symbolic connection)

Distance Effect: when students are presented with two numerals and asked which one is larger: a) Students respond *fastest* when the numbers are small and quantitatively far apart (Butterworth & Varma, 2014).
b) Students respond *slowest* when numbers are relatively large and closer together (*Weber's Law*).

Fast Response		Slow Response	
12	94	1,211	1,221
3	44	38,004	38,409
47	1	987	978
87	15	10,242	10,202
17	71	261,789	261,689
8	39	8,111	8,101

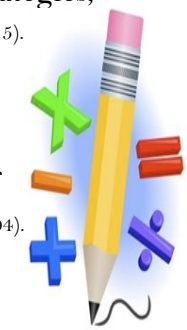
- Children with **developmental dyscalculia** respond more slowly than typical peers, even when controlling for IQ and reading ability (Skagerlund & Traff, 2014).

94

94

3. Math Facts and Automaticity

- As number processing becomes more automatic, there is a shift ofeffortful control toward the back of the brain (Ashkenazi et al., 2014; Cho et al., 2012).
- Children with dyscalculia use more inefficient strategies, especially with subtraction (Rosenberg-Lee et al., 2015).
- Typically developing children show a rapid shift from using slower, effortful counting strategies toward using more direct forms of automated fact retrieval by 3rd grade (Geary, 2004).



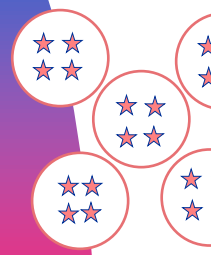
jack hirose

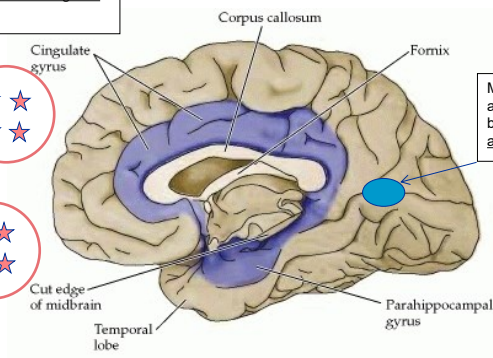
95

95

Math Fact Automaticity: 5 x 4 = ?

Math fact retrieval is very effortful, slower, and requires more sustained attention when the anterior cingulate gyrus is involved.





Math fact retrieval is more automatic when posterior brain regions such as the angular gyrus are involved.

5x4=20

Math fact retrieval and the brain
(Cho et al, 2012)

jack hirose

96

96

4. Quantitative Knowledge:
The Key for Higher Level Math Skills

- The development of **quantitative knowledge** is critical to comprehend more complex mathematics, as well as to establish cognitive flexibility when problem solving.
- Often dependent upon a variety of frontal lobe constructs including **symbolic reasoning** and **executive functioning** skills.
- For example, the ability to develop a base-10 understanding of numerals and transcode challenging equations into more palatable forms of operations requires good executive functioning skills. Take the equation 9 X 16 = ____.
- **The "24" Game**: http://www.4nums.com/

97

97

Let's Play a Game!

The 24 Game: *"Four numbers will be presented at random. The goal is to use all four numbers by adding, subtracting, multiplying, or dividing them to reach 24."*

https://www.4nums.com/

98

98

Singapore Math

Singapore Math – based upon a visualization philosophy taught in Singapore…gained popularity after PISA study.

- Emphasis is on **visualizing math** concepts before representing them with an equation. Goes at student pace to build upon each concept so re-teaching is not needed.
- Flow of information is from Concrete to Pictorial to Abstract.
- The use of **Bar-Models**, which represent arithmetic quantities by line segments, facilitate understanding eliminate the need of rote memorization of facts.
- Word problems build **semantic** understanding of concepts.

jack hirose

99

99

Keys to Math Interventions

- Teach students to think in *"pictures"* as well as *"words"*.
- Construct incorrect answers to equations and have students discriminate correct vs. incorrect responses by drawing a picture.
- Use dice, dominoes, unifix cubes, abacus, Rekenrek, playing cards, apps, and games to keep math FUN!!
- Have students write a math sentence from a verbal sentence.
- Reinforce the language of math by re-teaching quantitative words such as *more*, *less*, *equal*, *sum*, *altogether*, *difference*, *etc...*
- Incorporate money, sports, baking recipes, etc.. to add context and relevance to math.
- Teach more base-10 strategies and FNWS and BNWS.
- Use mnemonics to remember long sequences (Dead Monkeys Smell Bad)
- Reduce classroom anxiety to maximize working memory!!!

jack hirose

100

100

Math Presentation Outline

Math by the Numbers

Math Anxiety and Learning

The Neural Machinery of Mathematics

Building a Math Brain

➡ **3 Subtypes of Dyscalculia**

Introducing the FAM

101

101

3 Subtypes of Math Disabilities

(1) Verbal Dyscalculia Subtype:

Main deficit is the automatic retrieval of number facts which have been stored in a linguistic code.

- Over-reliance on manipulatives when problem solving.
- Multiplication and addition often impaired.
- Poor at math fluency tests.
- Math algorithms often preserved.
- Often have learning disabilities in language arts as well.

Key Constructs: Language & Verbal Retrieval Skills

102

102

3 Subtypes of Math Disabilities

(2) Procedural Dyscalculia Subtype:

- A deficit in the ability to count, order, or sequence numbers.
- Difficulty recalling the algorithm or sequence of steps when performing longer math operations.
- Confusion with long division and place value.
- Retrieval of math facts such as single digit addition, subtraction, and multiplication, as well as magnitude comparisons often preserved.

Key Constructs: Working Memory and Anxiety

103

103

3 Subtypes of Math Disabilities

(3) Semantic Subtype (Visual-Spatial)

- A deficit with non-symbolic representations of math including estimation skills, aligning numbers in columns, magnitude representations, and pattern recognition skills among objects (right hemisphere).
- Poor number sense and understanding of math.
- In the *left hemisphere*, impacts visual inferencing of verbal information. For example:

"A laboratory used 120 fence posts in an experiment comparing two types of paint. Six fewer than twice as many fence posts were painted with paint A as were painted with paint B. How many fence posts were painted with paint A? Paint B?"

Key Constructs: Visual-Spatial processing

104

104

Math Presentation Outline

Math by the Numbers

Math Anxiety and Learning

The Neural Machinery of Mathematics

Building a Math Brain

3 Subtypes of Dyscalculia

➡ **Introducing the FAM**

105

105

Traditional Assessments for Math

Woodcock Johnson
Tests of Achievement

- Applied Problems
- Calculation
- Math Facts Fluency
- Number Matrices

WIAT®4
Wechsler Individual Achievement Test
Fourth Edition

- Math Problem Solving
- Numeric Operations
- Math Fluency

KTEA-3™

- Math Concepts & Applications
- Math Computation
- Math Fluency

106

106

fam™
feiferassessmentofmathematics™
Steven G. Feifer, DEd

- A **neurodevelopmental** assessment of mathematics
- Pre-K to College (**Ages 4-21**)
- Normative sample included 1,061 students
- 19 subtests in complete battery
- Diagnoses 3 subtypes of math disorders
- Includes the FAM-S dyscalculia screening battery
- Total Fam index score and 3 math index scores:
  - a) **Procedural** subtype
  - b) **Verbal** subtype
  - c) **Semantic** subtype
- Qualification Level: **S or B**

jack hirose

107

107

fam™
feiferassessmentofmathematics™
Steven G. Feifer, DEd

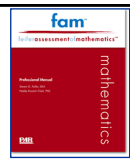
Structure of the FAM

Index	Subtest	Grade range	Approximate administration time
Procedural Index (PI)	Forward Number Count (FNC)	PK to college	5 minutes
	Backward Number Count (BNC)	K to college	5 minutes
	Numeric Capacity (NCA)	PK to college	3 minutes
	Sequences (SEQ)	PK to college	5 minutes
	Object Counting (OC)	PK to Grade 2	5 minutes
Verbal Index (VI)	Rapid Number Naming (RNN)	PK to college	1 minute
	Addition Fluency (AF)	K to college	1 minute
	Subtraction Fluency (SF)	K to college	1 minute
	Multiplication Fluency (MF)	Grade 3 to college	1 minute
	Division Fluency (DF)	Grade 3 to college	1 minute
	Linguistic Math Concepts (LMC)	PK to college	6 minutes
Semantic Index (SI)	Spatial Memory (SM)	PK to college	5 minutes
	Equation Building (EB)	Grade 3 to college	4 to 6 minutes
	Perceptual Estimation (PE)	PK to college	5 minutes
	Number Comparison (NCO)	PK to college	2 minutes
	Addition Knowledge (AK)	K to college	2 minutes
	Subtraction Knowledge (SK)	K to college	2 minutes
	Multiplication Knowledge (MK)	Grade 3 to college	2 minutes
	Division Knowledge (DK)	Grade 3 to college	2 minutes

jack hirose

108

108



fam™
feiferassessmentofmathematics™
Steven G. Feifer, DEd

- Based upon a neurocognitive theory of brain functioning.
- Use in conjunction with an academic achievement test.
- Saves time because the processing is built into the test.
- Explains WHY a student is having math difficulty, not just WHERE the student is achieving.
- Directly informs intervention decision making.
- Can diagnose, screen, or use for progress monitoring.
- Can help determine curriculum casualties following the pandemic.
- Puts the "I" back in IEP's!!!

jack hirose

Let's Stay Connected

Steven G. Feifer, D.Ed., ABPdN
Licensed Psychologist
Workshops: feifer@comcast.net
Books: www.schoolneuropsychpress.com

far™
feiferassessmentofreading™

fam™
feiferassessmentofmathematics™

faw™
feiferassessmentofwriting

LEARN MORE

WATCH NOW

BUY NOW

jack hirose