Unraveling the Relationship Between ADHD and Executive Functioning: What Every Clinician and Educator Needs to Know

www.samgoldstein.com
info@samgoldstein.com
@drsamgoldstein
@doctorsamgoldstein

Sam Goldstein, Ph.D.
Assistant Clinical Professor
University of Utah School of Medicine

Disleksi ve Hiperaktivite Derneği

1

1

Relevant Disclosure

- Co-Author of Managing Attention Disorders in Children (1990, 1998) .
- Author of Managing Attention and Learning Disorders in Late Adolescence and Adulthood (1997).
- Co-author of Clinician's Guide to Adult ADHD: Assessment and Intervention (2002).
- Co-author of the Autism Spectrum Rating Scales (MHS, 2009).
- Author of Understanding and Managing Children's Classroom Behavior (1997,2007)
- Co-author of Assessment of Autism Spectrum Disorders First and Second Editions (Guilford, 2009, 2019).
- Co-author/presenter Assessment of Autism Spectrum Disorders CEU (APA, 2009).
- Co-author of Raising a Resilient Child With Autism Spectrum Disorders (2011, McGraw Hill).
- Co-author of Treatment of Autism Spectrum Disorders (2012, Springer).
- Co-author of the Autism Spectrum Evaluation Scales (in development, MHS).
- Compensated speaker financially supported by Multi-Health Systems.

2

My Unitary Goal for This Session!

Understand and be able to apply the science, clinical practice and educational ramifications of Executive Functioning (EF) and Attention Deficit Hyperactivity Disorder (ADHD)

3

What is the Relationship?

- ADHD is a Diagnosis/EF is a set of Processes.
- ADHD is defined by behavior/EF is defined by Process.
- ADHD is a summary term for a group of Symptoms/EF is a summary term for a group of Processes.
- ADHD may include some EF Processes/EF may include some ADHD Symptoms.
- Tests for ADHD and/or EF do not correlate very well with behavioral measures of ADHD and/or EF.
- ADHD is defined by consensus/EF has no such consensus thus far.
- ADHD is not EFDD.

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How Do We Enhance Compliance and Fidelity?

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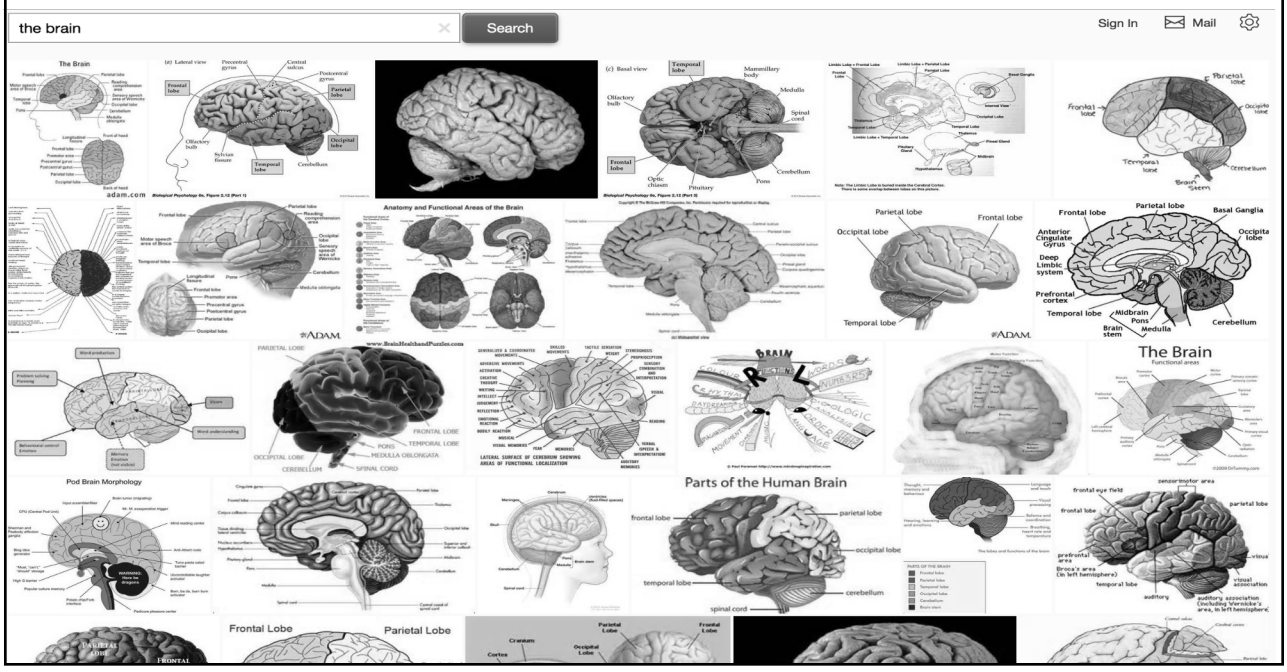
The Brain



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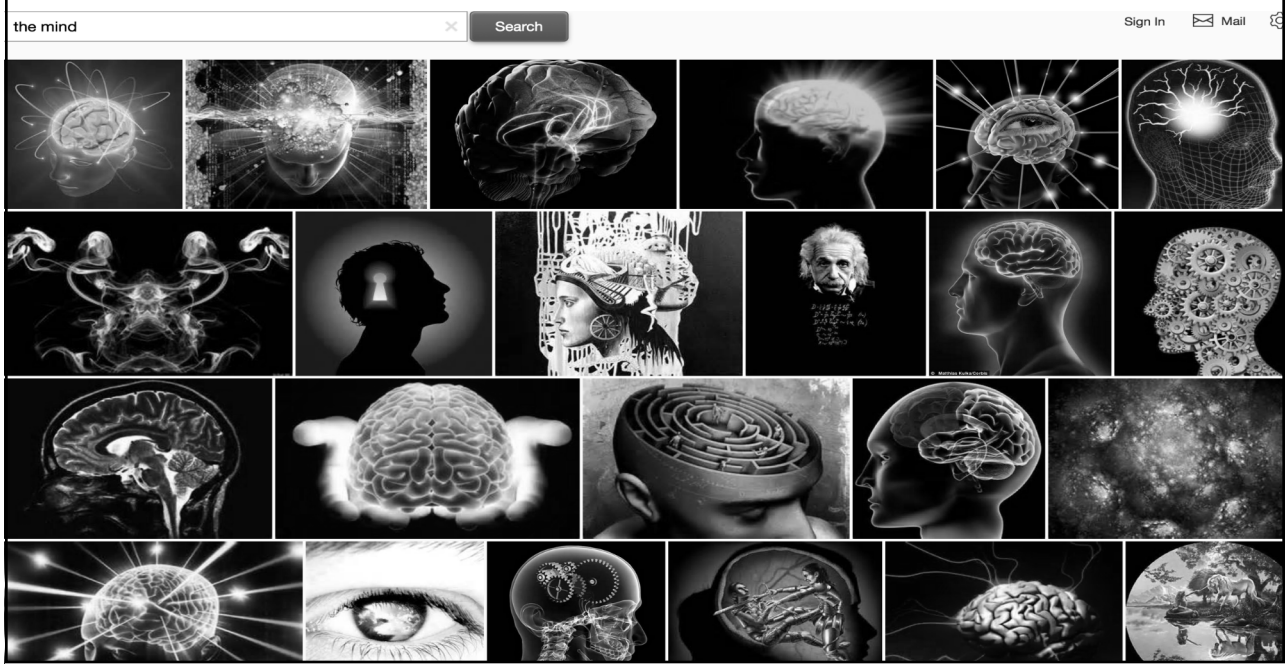
The Mind



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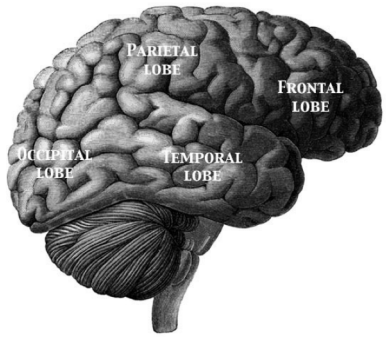
We Are About the Mind!



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The Five Child Challenge

What variables predict the capacity to learn and the quality of performance?

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What is/are Executive Function(s)

There is no formal excepted definition of EF

- We typically find a vague general statement of EF (e.g., goal-directed action, cognitive control, top-down inhibition, effortful processing, etc.).
- Or a listing of the constructs such as
  - Inhibition,
  - Working Memory,
  - Planning,
  - Problem-Solving,
  - Goal-Directed Activity,
  - Strategy Development and Execution,
  - Emotional Self-Regulation,
  - Self-Motivation

10

What Neural Activities Require EF?

- Those that involve planning or decision making.
- Those that involve error correction or troubleshooting.
- Situations when responses are not well-rehearsed or contain novel sequences of actions.
- Dangerous or technically difficult situations.
- Situations that require the overcoming of a strong habitual response or resisting temptation.

11

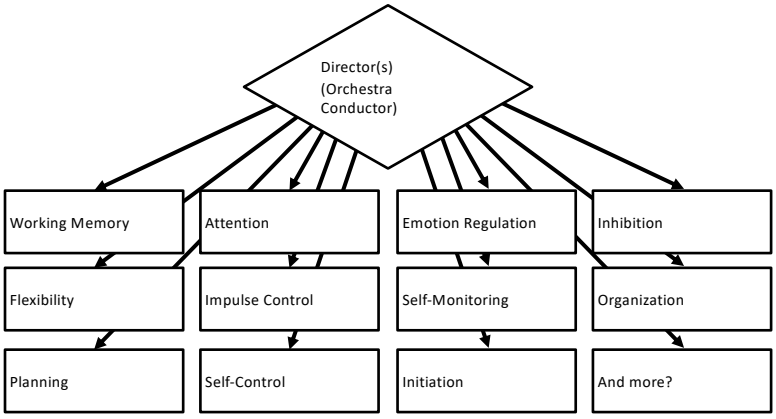
What Neuronal Structures are Implicated in EF?

- Prefrontal
- Rich cortical, sub-cortical and brain stem connections.
- The dorsolateral prefrontal cortex (DLPFC) is involved with integrating different dimensions of cognition and behavior.
- The anterior cingulate cortex (ACC) is involved in emotional drives, experience and integration, inhibition of inappropriate responses, decision making and motivation.
- The orbitofrontal cortex (OFC) plays a key role in impulse control, maintenance of set, monitoring ongoing behavior and socially appropriate behaviors.

12

Three Categories of EF Theories

- Regulators that control
- Abilities (cognitive processes)
- Behaviors



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13

EF & Achievement

	WJ-III Achievement Tests				
CEFI Scales	Total	Broad Reading	Broad Math	Broad Written Language	Median
Full Scale	.51	.48	.49	.47	.49
Attention	.59	.52	.46	.55	.54
Emotion Regulation	.18	.27	.15	.17	.18
Flexibility	.61	.50	.55	.54	.55
Inhibitory Control	.23	.32	.15	.26	.25
Initiation	.32	.26	.38	.28	.30
Organization	.32	.31	.33	.33	.33
Planning	.58	.54	.57	.50	.56
Self-Monitoring	.53	.51	.51	.49	.51
Working Memory	.57	.48	.60	.47	.53
	p < .05	p < .01			

14

14

EF & Intelligence

	WISC-IV						
	FS	VC	PR	WM	PS	CEFI	
						Mn	SD
CEFI							
Full Scale	.39	.44	.27	.30	.34	93.0	11.9
Attention	.39	.33	.32	.40	.35	91.8	11.2
Emotion Regulation	.14	.25	.08	-.06	.11	97.2	14.7
Flexibility	.57	.68	.45	.46	.37	93.8	11.0
Inhibitory Control	.21	.20	.13	.08	.27	97.7	13.5
Initiation	.25	.31	.14	.21	.25	91.2	15.1
Organization	.15	.17	.06	.14	.17	92.2	13.6
Planning	.46	.54	.31	.38	.39	93.6	11.1
Self-Monitoring	.39	.45	.31	.33	.27	92.0	11.3
Working Memory	.38	.43	.31	.36	.23	92.5	13.6
WISC-IV M	95.5	96.8	101.5	92.6	90.7	92.6	
WISC-IV SD	18.1	14.7	17.5	17.5	19.4	17.5	
Note: All correlations were corrected for range instability.							

15

15

EF & Neuropsychological Abilities

	CAS						
	FS	Plan	Sim	Att	Suc	CEFI	
CEFI						Mn	SD
Full Scale	.45	.49	.43	.37	.32	91.4	13.2
Attention	.40	.42	.39	.30	.35	90.3	12.8
Emotion Regulation	.26	.22	.23	.24	.13	96.9	14.7
Flexibility	.52	.54	.51	.40	.42	92.2	13.0
Inhibitory Control	.27	.29	.22	.18	.21	96.0	13.9
Initiation	.40	.37	.31	.30	.20	89.0	16.3
Organization	.29	.36	.21	.20	.23	90.5	14.3
Planning	.47	.54	.46	.37	.38	92.5	12.4
Self-Monitoring	.48	.50	.49	.43	.35	91.2	12.4
Working Memory	.48	.46	.45	.38	.30	91.0	14.0
CAS Mn	95.8	92.4	101.6	96.5	98.0		
CAS SD	17.1	14.5	17.0	15.1	14.6		
Note: All correlations were corrected for range instability.							

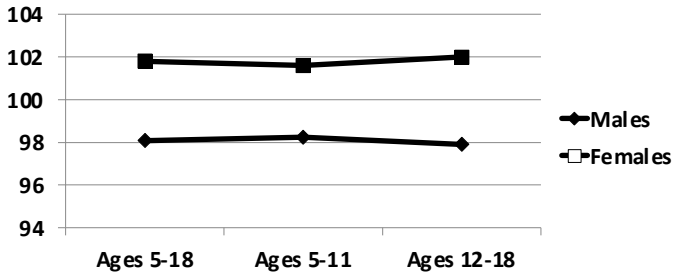
16

16

Gender Differences: Parent Raters

Girls have better EF than Boys

Parents	N	**Mn**	SD	N	**Mn**	SD	**ES**
Ages 5-18	700	**98.1**	14.9	699	**101.8**	15.0	**-0.25**
Ages 5-11	350	**98.2**	14.3	349	**101.6**	15.6	**-0.22**
Ages 12-18	350	**97.9**	15.4	350	**102.0**	14.4	**-0.28**



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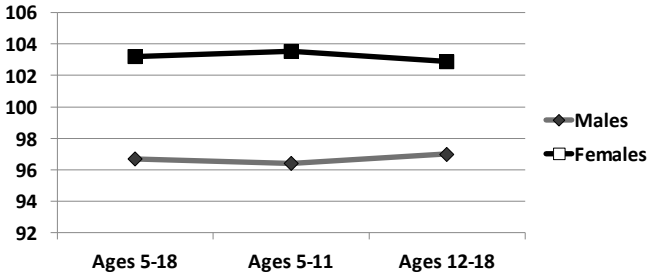
Gender Differences: Teacher Raters

Girls have better EF than Boys

Teachers	N	**Mn**	SD	N	**Mn**	SD	**ES**
Ages 5-18	700	**96.7**	14.4	700	**103.2**	15.0	**-0.44**
Ages 5-11	350	**96.4**	14.5	350	**103.5**	14.9	**-0.49**
Ages 12-18	350	**97.0**	14.4	350	**102.9**	15.0	**-0.40**



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Goldstein, Naglieri, Princiotta, & Otero (2013)

- We found more than 30 definitions of EF(s).
- Executive function(s) has come to be an umbrella term used for many different abilities, including planning, working memory, attention, inhibition, self-monitoring, self-regulation and initiation carried out by pre-frontal areas of the frontal lobes.

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What is Executive Function(s)

1. Barkley (2011): "EF is thus a **self-directed set of actions**)" (p. 11).
2. Dawson & Guare (2010): "Executive skills allow us **to organize our behavior over time**" (p. 1).
3. Delis (2012): "Executive functions reflect the **ability to manage and regulate one's behavior** (p. 14).

21

21

What is Executive Function(s)

4. Denckla (1996): "EF (is) a set of **domain-general control processes**…" (p. 263).
5. Gioia, Isquith, Guy, & Kenworthy (2000): "a **collection of processes that are responsible for guiding, directing, and managing cognitive, emotional, and behavioral functions**" (p. 1).

22

22

What is Executive Function(s)

6. Pribram (1973): "**executive programmes …to maintain brain organization** " (p. 301).
7. Roberts & Pennington (1996): EF "**a collection of related but somewhat distinct abilities such as planning, set maintenance, impulse control, working memory, and attentional contro**l" (p. 105).

23

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What is Executive Function(s)

6. Stuss & Benson (1986): "**a variety of different capacities that enable purposeful, goal-directed behavior, including behavioral regulation, working memory, planning and organizational skills, and self-monitoring**" (p. 272).
7. Welsh and Pennington (1988): "the **ability to maintain an appropriate problem-solving set for attainment of a future goal**" (p. 201).

24

24

What is Executive Function(s)

10. McCloskey (2006): "a **diverse group of highly specific cognitive processes collected together to direct cognition, emotion, and motor activity,** including …the **ability to engage in purposeful, organized, strategic, self-regulated, goal directed behavior**" (p. 1)

"think of executive functions as a set of independent but coordinated processes rather than a single trait" (p. 2).

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What is Executive Function(s)

10. Lezak (1995): "**a collection of interrelated cognitive and behavioral skills that are responsible for purposeful, goal-directed activity**," …
11. "**how and whether a person goes about doing something**" (p. 42).
12. Luria (1966): "… **ability to correctly evaluate their own behavior and the adequacy of their actions**" (p. 227).

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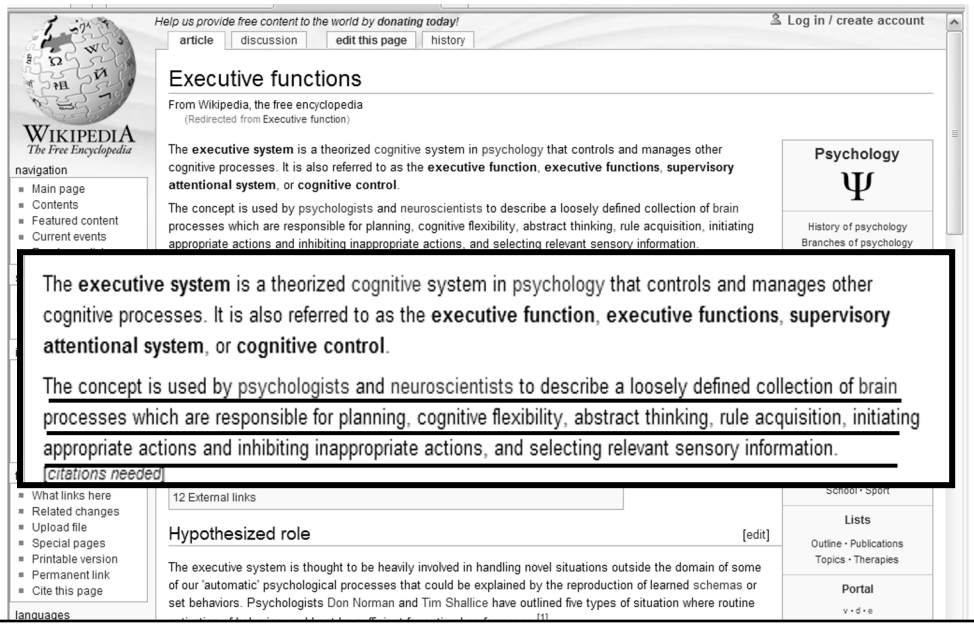
Executive Functions



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And Finally. . . .

A panel of researchers in 1994 identified 33 EFs by consensus!

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The Top Six Were:

- Self-regulation
- Sequencing of behavior
- Flexibility
- Response inhibition
- Planning
- Organization of behavior

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What is the relationship of EF to attention?

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Conditions and Disorders That Have Demonstrated EF Impairments

- Depression – sense of helplessness and hopelessness.
- Anxiety – lack of confidence in predicting outcome.
- ADHD – Immaturity in developing effective self-discipline.
- Oppositional and Conduct Disorders – noncompliance and rule violation.
- Autism – social learning impairment.
- Learning Disability – delayed acquisition of academic knowledge despite good instruction.

31

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Executive Function(s)

- One way to examine the issue addressing the nature of EF is to research the factor structure of behaviors related to EF(s)
- To do so, we examined the factor structure of a nationally representative sample of children.
- We conducted a series of research studies to answer the following question:
  - What is the underlying structure of EF behaviors?
  - Is there is just one underlying factor called Executive Function), or do the behaviors group together into different constructs suggesting a multidimensional structure?

32

32

EXPLORATORY FACTOR ANALYSES

- Both item-level and scale-level exploratory factor analyses (EFA) were conducted.
- The normative samples for parents, teacher, and self ratings were randomly split into two samples and EFA conducted using
  - the item raw scores
  - nine scales' raw scores
- We used a standardization sample from our instrument the Comprehensive Executive Functioning Inventory (CEFI).

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Sample Characteristics

- Sample was stratified by
  - Sex, age, race/ethnicity, parental education level (PEL; for cases rated by parents), geographic region
  - Race/ethnicity of the child (Asian/Pacific Islander, Black/African American/African Canadian, Hispanic, White/Caucasian, Multi-racial by the rater
  - Parents provided PEL of both parents
    - The higher of the two levels was used to classify the parental education level of the child.
  - All raters completed the questionnaire via paper-and-pencil or online methods.

34

34

EXPLORATORY FACTOR ANALYSES

- For the *first half* of the normative sample using item scores: EFA of the 90 items was conducted
- The scree plot test and the very simple solution criterion both indicated that only **one factor** should be retained.
- The ratio of the first and second eigenvalues was greater than four for all three forms, which is a common rule to support a **one factor solution.**

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EXPLORATORY FACTOR ANALYSES

- Using the *second half* of the normative sample EFA was conducted using raw scores for the Attention, Emotion Regulation, Flexibility, Inhibitory Control, Initiation, Organization, Planning, Self-Monitoring, and Working Memory scales
- Both the Kaiser rule (eigenvalues > 1) *and* the Eigenvalue Ratio criterion (> 4) unequivocally indicated **one factor**.

36

36

EXPLORATORY FACTOR ANALYSES

- Factor analysis of the CEFI Scales also clearly indicated a one factor solution

Table 8.4. Eigenvalues of the CEFI Scales Correlations

Form	Factor								
	1	2	3	4	5	6	7	8	9
Parent	7.5	0.2	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Teacher	7.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Self-Report	6.3	0.2	0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1

Note. Extraction method: Png.

37

EXPLORATORY FACTOR ANALYSES

- Conclusions
  - When using parent (N = 1,400), teacher (N = 1,400), or self-ratings (N = 700) based on behaviors observed and reported for a nationally representative sample (N = 3,500) aged 5 to 18 years Executive Function *not* functions is the best term to use.

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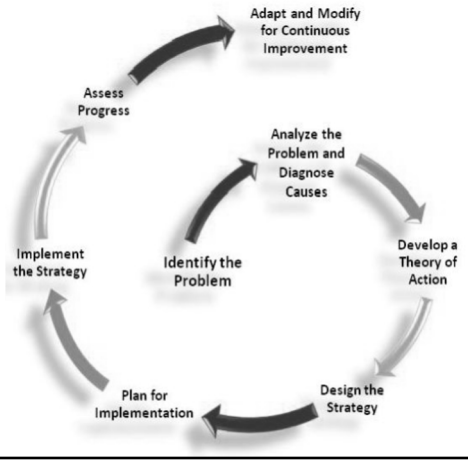
Naglieri & Goldstein, 2012

- Executive Function is: how efficiently you do what you decide to do.



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What is Attention?

- Attention appears to primarily involve the basal ganglia, cerebellum and the frontal lobes.
- Problems with attention are often a bio-psychosocial phenomena often leading to/interacting with cognitive deficits causing impairment in all walks of life.
- The symptoms of inattention as reflected in ADHD lead to a nearly infinite number of consequences (Barkley, 2015).

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Current diagnostic criteria specify that ADHD involves difficulties with inattention and/or hyperactivity/impulsivity. Researchers using factor analysis have consistently found support for an inattention factor in both children and adults. Findings have been mixed regarding whether hyperactivity and impulsivity reflect one or two dimensions.

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Inattention appears to be a condition stemming in part from inefficient operation of the physical brain moderated by the mind relative to task and environmental demands leading to poor execution of behavior.

42

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ADHD is not the equivalent of poor attention to detail

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ADHD reflects exaggeration of normal behavior.

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Poor regulation of attention leads to a nearly infinite number of consequences

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Self-regulation

- The ability to inhibit
- The ability to delay
- The ability to separate thought from feeling
- The ability to separate experience from response
- The ability to consider an experience and change perspective
- The ability to consider alternative responses

46

Self-regulation

- The ability to choose a response and act successfully towards a goal
- The ability to change the response when confronted with new data
- The ability to negotiate life automatically
- The ability to track cues

47

Poor self-regulation is synonymous with. . .

Poor self-control

48

Poor self-regulation leads to . . .

Impulsive behavior

49

Poor self-regulation leads to:

- Knowing what to do is not the same as doing what you know
- Cue-less behavior
- Inconsistent behavior
- Unpredictable behavior
- The illusion of competence
- Riding an emotional roller coaster
- Problems with automatic behavior

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In light of these data it is not surprising that inattention contributes to EF deficits and that both fuel poor emotional regulation.

51

Assessment

- ADHD and EF: Both by observation, testing and questionnaires.
- The end point for ADHD is a diagnosis. This only requires reported or observed behavior over time in multiple settings.
- The end point for EF is an overview of strengths and weaknesses. This requires observation and assessment.

52

Symptom relief is not synonymous with changing long term outcome.

53

Cognitive Strategy = EF Instruction

- A strategy is a procedure that the learner uses to perform academic tasks
- Using a strategy means the child thinks about 'how you do what you do'
- Successful learners use many strategies.
- Some of these strategies include visualization, verbalization, making associations, chunking, questioning, scanning, using mnemonics, sounding out words, and self-checking and monitoring.

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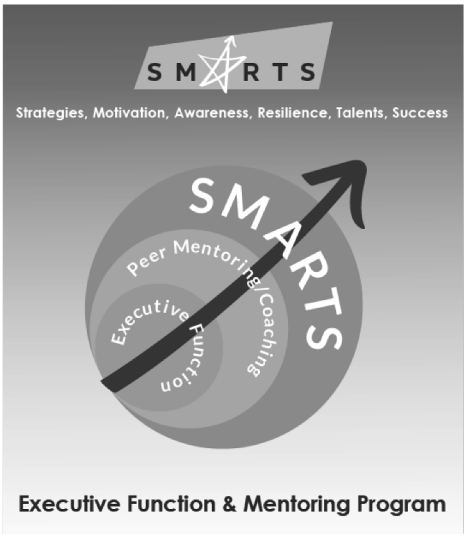
A Promising Program



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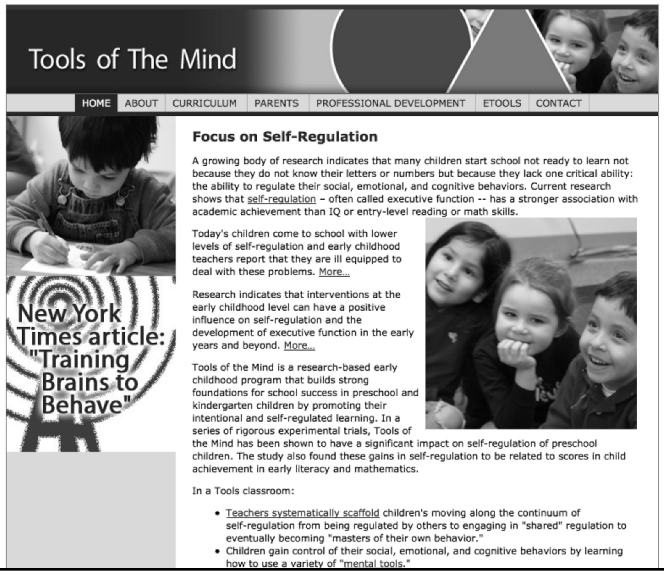
A Promising Program



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Promising Resources

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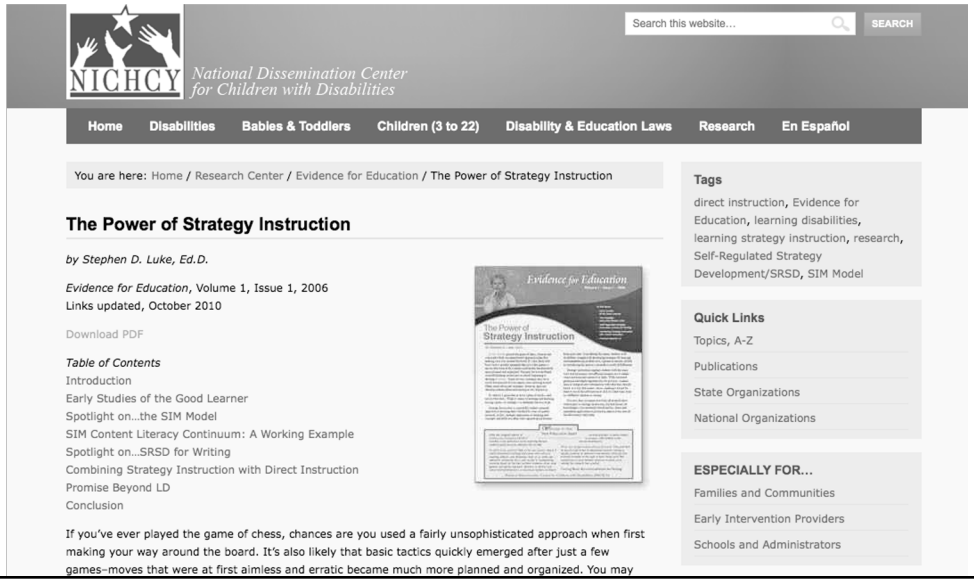
Promising Resources



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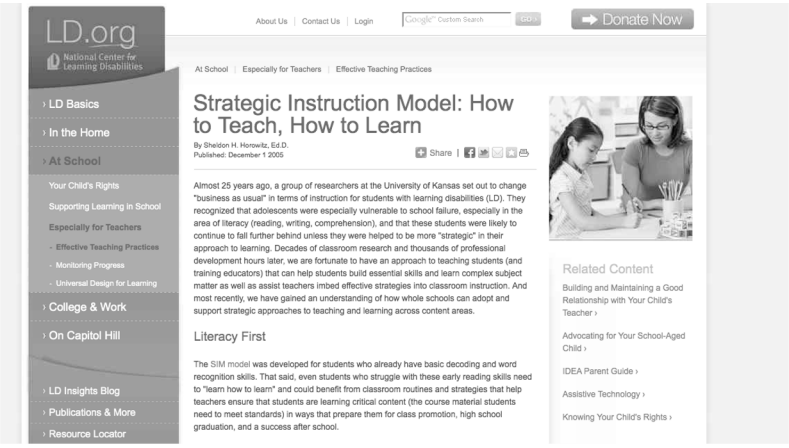
Promising Resources



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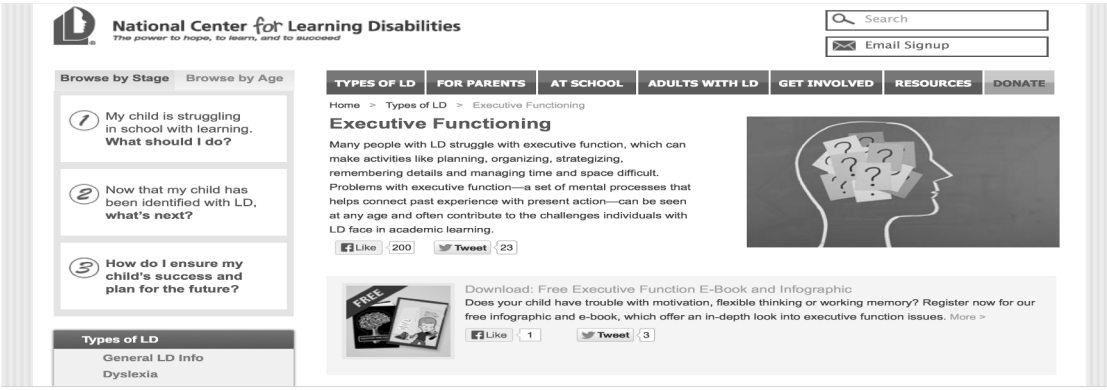
Promising Resources



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Conclusions

The concept of EF is evolving.

Not unexpectedly there is a strong relationship between EF and attention. Thus EF and ADHD.

Not unexpectedly both are bi-directional in their relationship to emotional regulation.

There is emerging evidence that children can be taught to be more strategic – an important indication of good EF behavior and outcome.

This process may or may not enhance the progress and outcome of children with ADHD

61

61

Questions?

www.samgoldstein.com

info@samgoldstein.com

@drsamgoldstein

@doctorsamgoldstein

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62