Understanding and Managing the Neuropsychological Impact of COVID 19 on Executive Functioning in Children and Adolescents

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TEDx
Sam Goldstein, Ph.D.
The Power Of Resilience

1

Relevant Disclosure

- Co-author of the Autism Spectrum Rating Scales (MHS, 2009).
- Co-author of Assessment of Autism Spectrum Disorders 1st and 2nd Editions (Guilford, 2009, 2018).
- 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.

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Goals for This Presentation

- What Do We Know About COVID 19?
- Historical Perspective and Need
- Definitions of Executive Function
- Executive Function or Functions?
- Rating Scales for EF
- Examining EF with the Comprehensive Executive Function Inventory (CEFI)
- EF and instruction

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Jornal de Pediatria
Volume 97, Issue 4, July–August 2021, Pages 369-377

Review article

The potential impact of the COVID-19 pandemic on child growth and development: a systematic review

Liubiana Arantes de Araújo [a], Cássio Frederico Veloso [b], Matheus de Campos Souza [c], João Marcos Coelho de Azevedo [c], Giulio Tarro [d, e, f, g]

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https://doi.org/10.1016/j.jped.2020.08.008

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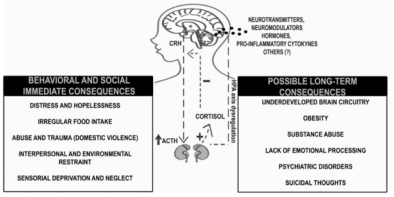
COVID-19 PANDEMIC IMPACTS ON CHILDREN AND ADOLESCENTS



Adrenocorticotropic Hormone (ACTH) is a hormone produced in the anterior, or front, pituitary gland in the brain. The function of ACTH is to regulate levels of the steroid hormone cortisol, which released from the adrenal gland.

Corticotrophin Releasing Factor (CRF) is a hypothalamic hormone, which acts on the anterior pituitary to stimulate the secretion of corticotropin, thereby regulating the synthetic/secretory activity of the adrenal cortex

Cortisol is a steroid hormone that regulates a wide range of vital processes throughout the body, including metabolism and the immune response

Cytokines are cell signalling molecules that aid cell to cell communication in immune responses and stimulate the movement of cells towards sites of inflammation, infection and trauma.

Prog Neuropsychopharmacol Biol Psychiatry. 2021 Mar 2; 106: 110171.
Published online 2020 Nov 11. doi: 10.1016/j.pnpbp.2020.110171

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COVID 19 Impact on Youth

- Since the Coronavirus disease 2019 (COVID-19) pandemic was announced, we had an unprecedented change in the way we organize ourselves socially and in our daily routine.
- Children and adolescents were also greatly impacted by the abrupt withdrawal from school, social life and outdoor activities.
- The stress they are subjected to directly impacts their mental health on account of increased anxiety, changes in their diets and in school dynamics, fear or even failing to scale the problem.
- Although youngsters appear to be less vulnerable to COVID-19, the side effects of the pandemic can be devastating
- Children and adolescents may be highly exposed to biopsychosocial stressors generated by the pandemic and once population's containment measures to reduce virus spread are required, they could be potentially affected by the disruption in daily life routine as a result of social isolation and their unseasoned ability to conceive and comprehend the short- and long-term consequences of this outbreak.

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COVID 19 Impact on Youth

- Recently, an early published study evaluated 1036 quarantined children and adolescents in China in an age range from 6 to 15 years, of which 112, 196, and 68 presented depression, anxiety, and both, respectively.
- Another study demonstrated a high prevalence of psychological distress in quarantined children and adolescents due to the COVID-19 pandemic in India. These children experienced helplessness (66.11%), worry (68.59%) and fear (61.98%), compared to non-quarantined children.
- It was also reported in China that children and adolescents aged 3–18 years presented symptoms of inattention, clinging, worry and irritability during this pandemic.

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COVID 19 and ASD

- Children and youth with ASD are as vulnerable to the effects of prolonged isolation or quarantine as other children but may experience greater difficulty adapting to our new norms, especially as inflexibility and insistence on sameness are hallmark characteristics of this disorder.
- The consequences of a pandemic and the measures put in place to decrease transmission of COVID-19 have the potential to adversely affect children and youth with ASD and their families, including siblings.
- Parental anxiety around job loss, economic uncertainty, lack of access to health care facilities and treatment centers and extension of wait-lists for early intervention programs may cripple a caregiver's or parent's ability to cope with the COVID-19 pandemic.

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Current COVID/ASD Resources

- Handle the Autism Spectrum Condition during Coronavirus (COVID-19) *Stay at Home* Period: Ten Tips for Helping Parents and Caregivers of Young Children. **https://doi.org/10.3390/brainsci10040207**
- Autism and COVID-19: A Case Series in a Neurodevelopmental Unit **https://doi.org/10.3390/jcm9092937**
- Could Autism Spectrum Disorders Be a Risk Factor for COVID-19? https://doi.org/10.1016/j.mehy.2020.109899
- An Expert Discussion on Autism in the COVID-19 Pandemic https://doi.org/10.1089/aut.2020.29013.sjc
- Neuropsychology of COVID-19: Anticipated Cognitive and Mental Health Outcomes https://doi.org/10.1037/neu0000731

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COVID 19 and ADHD

The Association Between ADHD and the Severity of COVID-19 Infection Eugene Merzon, Margaret D. Weiss, et. al. Journal of Attention Disorders 2022, Vol. 26(4) 491 –501

DOI: 10.1177/10870547211003659

Objective: Patients with ADHD are at increased risk of acquiring COVID-19. The present study assessed the possibility that ADHD also increases the risk of severe COVID-19 infection.

Method: We assessed 1,870 COVID-19 positive patients, aged 5 to 60 years, registered in the database of Leumit Health Services (LHS, Israel), February to -June 2020, of whom 231 with ADHD. Logistic regression analysis models evaluated the association between ADHD and the dependent variables of being symptomatic/referral to hospitalization, controlling for demographic and medical variables.

Results: Age, male sex, and BMI were confirmed to be significant risk factors for increased COVID-19 severity. ADHD was found to be associated with increased severity of COVID-19 symptoms (OR = 1.81, 95% CI [1.29, 2.52], p< .05) and referral to hospitalization (OR =1.93, 95% CI [1.06, 3.51], p = .03).

Conclusion: ADHD is associated with poorer outcomes in COVID-19 infection. (J. of Att. Dis. 2022; 26(4) 491-501)

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Long COVID: Assessment of Neuropsychiatric Symptoms in Children and Adolescents - A Clinical Data Analysis

Jan Frölich, M.D., Ph.D., Tobias Banaschewski, M.D., Ph.D. & Annabelle Ulmer, M. Sc

https://doi.org/10.1101/2021.09.03.21257002

Abstract: COVID-19 infections in adults often result in medical, neuropsychiatric, and unspecific symp-toms, called Long COVID, and the premorbid functional status cannot be achieved. Regarding the course in children and adolescents, however, reliable data are not yet available.

Objective: 380 children and adolescents/young adults aged between 6 and 21 years, being treated for various psychiatric diseases in an outpatient clinical service, were examined for COVID-19 infections and Long COVID symptoms following a structured protocol.

Results: Three patients had COVID-19; one patient had symptoms of Long COVID in his medical his-tory, but they could not be objectivized in an in-depth neuropsychiatric and neuropsychological assessment.

Conclusions: Long COVID seems to occur rarely in children and adolescents. Objectivizing the symptoms is a difficult task that requires various diagnostic considerations.

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Review (2/2022)
Long COVID in Children and Adolescents

Valentina Fainardi , Aniello Meoli , Giulia Chiopris , Matteo Motta , Kaltra Skenderaj , Roberto Grandinetti , Andrea Bergomi , Francesco Antodaro , Stefano Zona and Susanna Esposito https://doi.org/10.3390/life12020285

The paucity of studies on long COVID, including a control group of children not infected by SARS-CoV-2, prevents us from drawing firm conclusions. Whether the neuropsychiatric symptoms widely observed in children and adolescents with long COVID are the consequence of SARS-CoV-2 infection or are due to the tremendous stress resulting from the restrictions and the pandemics is still not clear. In both cases, psychological support can play a fundamental role in managing COVID pandemics in children. More knowledge is needed to share a standardized definition of the syndrome and improve its management and treatment.

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Legacy of COVID-19 infection in children: long-COVID will have a lifelong health/economic impact

Munblit, Frances Simpson, Jeremy Mabbitt, Audrey Dunn-Galvin, Semple, Warner1,

http://dx.doi.org/10.1136/archdischild-2022-321882

There is an urgent need to study the impacts of the pandemic on all children as well as those who have had acute infection followed by long-COVID. Such research will help to elaborate on clinical features, mechanisms and strategies to mitigate adverse outcomes. The direct effects must be distinguished from those induced by lockdowns, school closures, parental loss of income, quarantine and other illnesses. This will provide the evidence to influence government action and design of appropriate service provision to protect children and young people from the potentially lifelong adverse effects of the pandemic. Thankfully, a large UK investigation of 3000 infected and 3000 uninfected children has now been funded, 'The CLoCk Study'. The next step will be trials of interventions to mitigate the potentially lifelong adverse effects of this devastating pandemic.

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Pediatr Infect Dis J. 2021 Dec; 40(12): e482–e487.
Published online 2021 Sep 16. doi: 10.1097/INF.0000000000003328
PMCID: PMC8575095
PMID: 34670992

How Common is Long COVID in Children and Adolescents?

Petra Zimmermann, MD, PhD,[1,2] Laure F. Pittet, MD-PhD,[3,4] and Nigel Curtis, FRCPCH, PhD[1,2]

In children, the risk of coronavirus disease (COVID) being severe is low. However, the risk of persistent symptoms following infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is uncertain in this age group, and the features of "long COVID" are poorly characterized. We reviewed the 14 studies to date that have reported persistent symptoms following COVID in children and adolescents. Almost all the studies have major limitations, including the lack of a clear case definition, variable follow-up times, inclusion of children without confirmation of SARS-CoV-2 infection, reliance on self- or parent-reported symptoms without clinical assessment, nonresponse and other biases, and the absence of a control group. Of the 5 studies which included children and adolescents without SARS-CoV-2 infection as controls, 2 did not find persistent symptoms to be more prevalent in children and adolescents with evidence of SARS-CoV-2 infection. This highlights that long-term SARS-CoV-2 infection–associated symptoms are difficult to distinguish from pandemic-associated symptoms.

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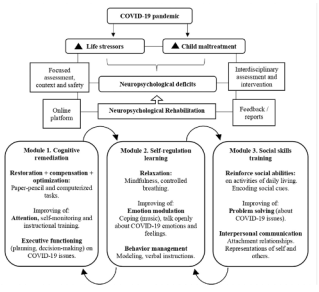
Addressing the Interactive Effects of Maltreatment and COVID-19 Related Stressors on the Neuropsychological Functioning in Children

Natalia E. Fares-Otero and Sebastian Trautmann

doi: 10.3389/fpsyg.2021.764768



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Why are These Data a Concern?

- Stress and neuroinflammation.
- Social isolation and diet.
- Brain plasticity: social behavior; social inequalities, neglect and distress.
- Diminished opportunity for play and access to the community environment.
- Reduced public health and support.
- It is the nature of human beings to be social and, despite the need for these restraint measures, it is of great concern how this pandemic period can affect the young brain under development.
- Therefore, the search for strategies to mitigate a harmful long-term impact on it should be sought. This knowledge will bring us information and guide us in the future should we have to face another world wide like the COVID-19 pandemic.

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The Five Student Challenge

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

How do we help children be skillful?

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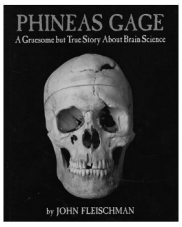
The Curious Story of Phineas Gage

John Fleischman's book "Phineas Gage: A Gruesome but True Story About Brain Science" is an excellent source of information about this person, his life, and how this event impacted our understanding of how the brain works; and particularly the frontal lobes.



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The Curious Story of Phineas Gage

- **Before** the accident 'he possessed a well-balanced mind, was seen as a shrewd, smart business man, very energetic and persistent in executing all his plans of operation' (p 59)
- **After** the accident his mind was radically changed; so much so that his friends said he was no longer Phineas Gage
- Although most of his brain was not damaged, his frontal lobes were significantly injured.

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The Curious Story of Phineas Gage

- Phineas and his tamping iron
- This presentation is about the important role of the frontal lobes and the unique function this part of the brain provides we now call "Executive Function(s)".

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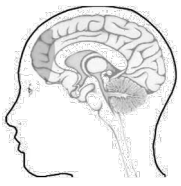
The case of Phineas Gage and others spurred scientists in the mid 1800s to seek to develop an understanding of the frontal lobes in particular the pre-frontal cortex.



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A Bit of EF Neuroanatomy

- Prefrontal
- Rich cortical, sub-cortical and brain stem connections.

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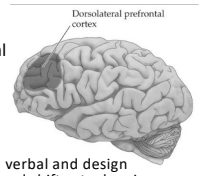
More Specifically



- The dorsolateral prefrontal cortex (DLPFC) is involved with integrating different dimensions of cognition and behavior.
- This area is associated with verbal and design fluency, ability to maintain and shift set, planning, response inhibition, working memory, organizational skills, reasoning, problem solving and abstract thinking.
- Chronic pain patients show declines in DLPFC functioning.

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More Specifically:

- The anterior cingulate cortex (ACC) is involved in emotional drives, experience and integration, inhibition of inappropriate responses, decision making and motivation
- Lesions in this area can lead to low drive states such as apathy and may also result in low drive states for such basic needs as food or drink and possibly decreased interest in social or vocational activities and sex.
- Chronic pain patients also show declines in ACC function.

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And Finally:

- The orbitofrontal cortex (OFC) plays a key role in impulse control, maintenance of set, monitoring ongoing behavior and socially appropriate behaviors.

- Lesions in this area can cause dis-inhibition, impulsivity, aggressive outbursts, sexual promiscuity and antisocial behavior.

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Another View: *Hot* and *Cool* EF

- Cool (metacognitive) – functions associated with cognition such as planning and problem solving (deficits leading to a Dorsolateral Syndrome).
- Hot (emotional/motivational) – functions associated with coordinating and controlling emotions (deficits leading to an Orbitofrontal/Medial Syndrome).

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What do we mean by the term Executive Function(s)?

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Executive Function (s)

- In 1966 Alexandr Luria first wrote and defined the concept of Executive Function (EF)
- He credited Bianchi (1895) and Bekhterev (1905) with the initial definition of the process

1902 - 1977

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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

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Does Experience Shape EF?

- The Family Life Project has demonstrated that poverty is associated with elevated cortisol in infancy and early childhood.
- This association is mediated through characteristics of the household.
- Parenting sensitivity mediates the relationship between poverty and stress physiology.
- In combination parenting sensitivity and elevated cortisol mediate the association between poverty and poor EF in children.

Family Life PROJECT

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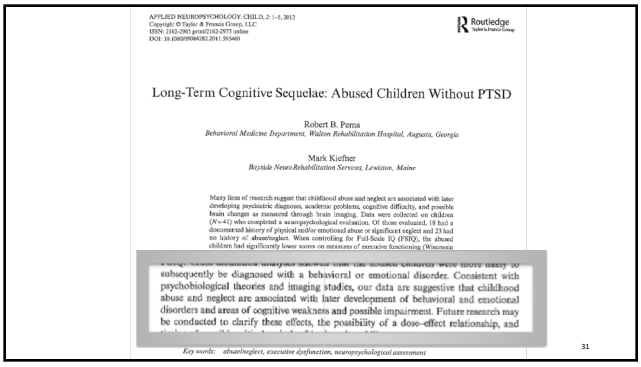

APPLIED NEUROPSYCHOLOGY: CHILD, 2: 1–5, 2013
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Routledge
Taylor & Francis Group

Long-Term Cognitive Sequelae: Abused Children Without PTSD

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Behavioral Medicine Department, Walton Rehabilitation Hospital, Augusta, Georgia

Mark Kiefner
Bayside Neuro-Rehabilitation Services, Lewiston, Maine

Many lines of research suggest that childhood abuse and neglect are associated with later developing psychiatric diagnoses, academic problems, cognitive difficulty, and possible brain changes as measured through brain imaging. Data were collected on children ($N = 41$) who completed a neuropsychological evaluation. Of those evaluated, 18 had a documented history of physical and/or emotional abuse or significant neglect and 23 had no history of abuse/neglect. When controlling for Full-Scale IQ (FSIQ), the abused children had significantly lower scores on measures of executive functioning (Wisconsin

subsequently be diagnosed with a behavioral or emotional disorder. Consistent with psychobiological theories and imaging studies, our data are suggestive that childhood abuse and neglect are associated with later development of behavioral and emotional disorders and areas of cognitive weakness and possible impairment. Future research may be conducted to clarify these effects, the possibility of a dose-effect relationship, and

Key words: *abuse/neglect, executive dysfunction, neuropsychological assessment*

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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.

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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).

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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).

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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).

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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).

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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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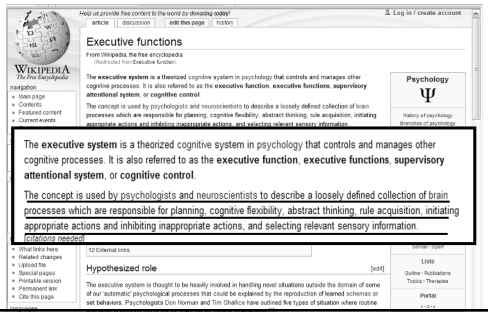
Executive Functions



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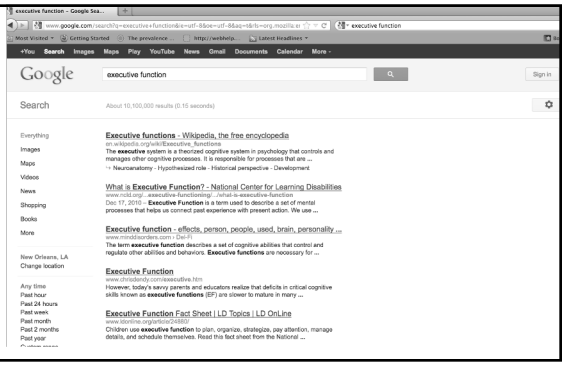

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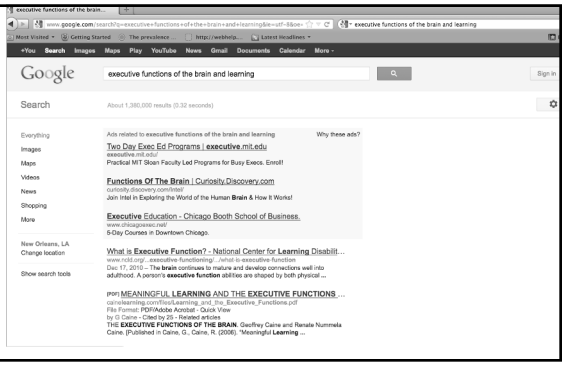

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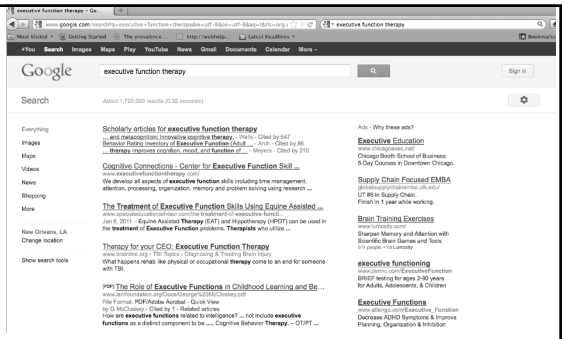

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And Finally. . . .

A NICHD panel in 1994
identified 33 EFs by consensus!

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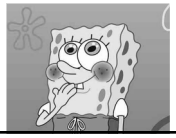
The Top Six Were:

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



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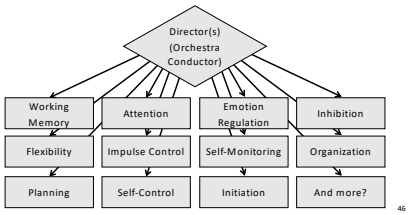
Three Categories of Theories

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



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A similarly named ability and behavior (e.g. planning) may only overlap to a small extent in explaining outcome.

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In fact EF ability likely forms the foundation reflected in behavior, achievement, emotional regulation and socialization. The contributed variance likely is impacted by a host of other variables. Ability and knowledge interact with these variables to shape skillful behavior.

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Are EF challenges associated with other psychiatric and developmental conditions?

"Oh yes. We single out someone every week and highlight their performance."

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EF and ADHD

EF deficits are not necessarily unique to ADHD. They are neither necessary nor sufficient to make a diagnosis of ADHD. When EF impairments are measured in children with ADHD they tend to reflect specific rather than global impairments.

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EF and Other Disruptive Disorders (ODD & CD)

Early reviews reported that EF deficits were not characteristic of children and adolescents with ODD and CD after co-morbid ADHD was factored out. More recent studies, however, suggest that inhibition deficits may be characteristic of both ADHD and CD but whether children with CD display impairments on additional EF measures is equivocal.

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EF and Tourette's

Distinct and robust impairments in EF do not appear to be characteristic of children with TD.

52

EF and Anxiety Disorders

EF deficits in set-shifting, cognitive flexibility, concept formation, interference control, and verbal fluency have been documented among children with separation anxiety disorder, overanxious disorder, and PTSD. EF in OCD has not been well addressed.

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EF and Depression

Scant research has been conducted on the EF abilities among youth with depression. Studies that have included older adolescents have suggested some degree of sensitivity of EF tasks in identifying unipolar depression, but less specificity.

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EF and Bi-Polar Disorder

There is a growing consensus about the nature of BD among children. Several studies have targeted its EF concomitants. Although results often have been confounded with significant co-morbidity issues, children and adolescents with BD reliably have demonstrated impairments relative to those without any history of mood disorders on several EF measures (e.g. working memory, set shifting).

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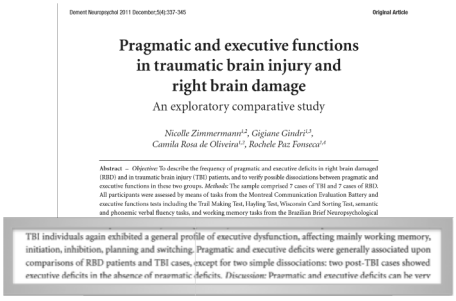
EF and Traumatic Brain Injury



Dement Neuropsychol 2011 December;5(4):337-345 Original Article

Pragmatic and executive functions in traumatic brain injury and right brain damage

An exploratory comparative study

Nicolle Zimmermann[1,2], Gigiane Gindri[2,3], Camila Rosa de Oliveira[1,2], Rochele Paz Fonseca[2,4]

Abstract – *Objective:* To describe the frequency of pragmatic and executive deficits in right brain damaged (RBD) and in traumatic brain injury (TBI) patients, and to verify possible dissociations between pragmatic and executive functions in these two groups. *Methods:* The sample comprised 7 cases of TBI and 7 cases of RBD. All participants were assessed by means of tasks from the Montreal Communication Evaluation Battery and executive functions tests including the Trail Making Test, Hayling Test, Wisconsin Card Sorting Test, semantic and phonemic verbal fluency tasks, and working memory tasks from the Brazilian Brief Neuropsychological

TBI individuals again exhibited a general profile of executive dysfunction, affecting mainly working memory, initiation, inhibition, planning and switching. Pragmatic and executive deficits were generally associated upon comparisons of RBD patients and TBI cases, except for two simple dissociations: two post-TBI cases showed executive deficits in the absence of pragmatic deficits. *Discussion:* Pragmatic and executive deficits can be very

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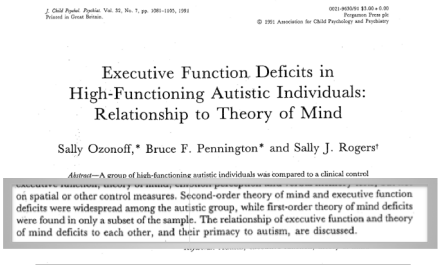
EF Deficits and ASD



J. Child Psychol. Psychiat. Vol. 32, No. 7, pp. 1081–1105, 1991
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0021-9630/91 $3.00 + 0.00
Pergamon Press plc
© 1991 Association for Child Psychology and Psychiatry

Executive Function Deficits in High-Functioning Autistic Individuals: Relationship to Theory of Mind

Sally Ozonoff,* Bruce F. Pennington* and Sally J. Rogers†

Abstract—A group of high-functioning autistic individuals was compared to a clinical control

on spatial or other control measures. Second-order theory of mind and executive function deficits were widespread among the autistic group, while first-order theory of mind deficits were found in only a subset of the sample. The relationship of executive function and theory of mind deficits to each other, and their primacy to autism, are discussed.

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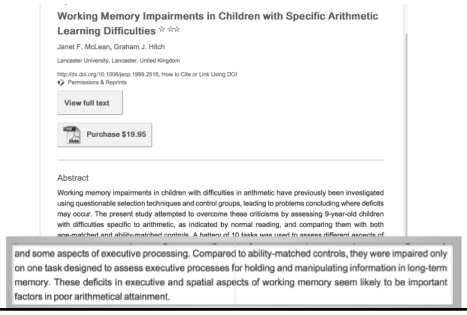
EF and Learning Disabilities



Working Memory Impairments in Children with Specific Arithmetic Learning Difficulties ☆☆☆

Janet F. McLean, Graham J. Hitch

Lancaster University, Lancaster, United Kingdom

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Abstract

Working memory impairments in children with difficulties in arithmetic have previously been investigated using questionable selection techniques and control groups, leading to problems concluding where deficits may occur. The present study attempted to overcome these criticisms by assessing 9-year-old children with difficulties specific to arithmetic, as indicated by normal reading, and comparing them with both

and some aspects of executive processing. Compared to ability-matched controls, they were impaired only on one task designed to assess executive processes for holding and manipulating information in long-term memory. These deficits in executive and spatial aspects of working memory seem likely to be important factors in poor arithmetical attainment.

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If all of these conditions are statistically related to behaviors and abilities reflecting EF than a common denominator must exist.

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Impairment in behaviors associated with EF can have multiple etiologies often operating simultaneously.

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Impaired Behavior Associated With Poor EF Can Result From:

- Lack of ability.
- Lack of knowledge.
- Lack of motivation.
- Internalizing symptoms.
- Externalizing symptoms.
- Poor impulse control.

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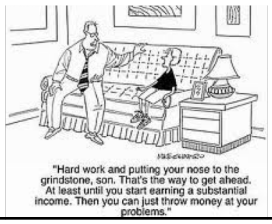
Starting with an assessment of EF behaviors defines the real life landscape and can be used as a foundation to than explore etiologies.



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Executive Function

- EF is a **unitary** construct (e.g., Duncan & Miller, 2002; Duncan & Owen, 2000).
- EF is **unidimensional** in early childhood not adulthood.
- Both views are supported by some research (Miyake et al. , 2000), -- EF is a **unitary construct …but with partially different components**.

Executive Functions

- EF has **three components**: *inhibitory control, set shifting (flexibility), and working memory* (e.g., Davidson, et al., 2006; Miyake et al., 2000).
- EF has independent **abilities** (Wiebe, Espy, & Charak, 2008).
- Executive Function**s** is a **multidimensional** model (Friedman et al., 2006; Miyake et al., 2000).

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Executive Function(s)

- Given all these definitions of EF(s) we wanted to address the question…
  Executive Function***s …*** or
  Executive Function?

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Executive Function(s)

- One way to examine this issue is to research the factor structure of behaviors related to EF(s)
- To do so, we examined the factor structure of the Comprehensive Executive Function Inventory (CEFI)
- We conducted a series of research studies to answer the following question:
  - What is the underlying structure of the behaviors assessed on the CEFI?
  - Is there is just one underlying factor called executive function), or do the behaviors group together into different constructs suggesting a multidimensional structure?

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Exploratory Factor Analyses

- 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
- The sample …

CEFI Scales
Attention
Emotion Regulation
Flexibility
Inhibitory Control
Initiation
Organization
Planning
Self-Monitoring
Working Memory

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CEFI Standardization Samples

- 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
  - Parent (N=1,400), Teacher (N=1,400) and Self (N=700) ratings were obtained

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ITEM FACTOR ANALYSES – PART 1

- For the *first half* of the normative sample for Parent, Teacher and Self ratings' **item scores** (90 items) was analyzed using exploratory factor analysis
- The *scree plots* and the *very simple solution* criterion both indicated that only **one factor**.
- The *ratio of the first and second eigenvalues* was greater than four for all three forms, which indicated a **one factor solution.**

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Item Factor Analyses – Part 1

- Item level factor analysis clearly indicted that one factor was the best solution

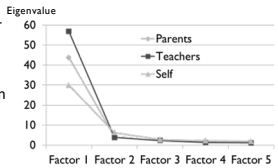

Table 8.2. Eigenvalues from the Inter-Item Correlations

	Factor						
Form	1	2	3	4	5	6	7
Parent	43.7	4.1	2.3	1.5	1.3	1.3	1.0
Teacher	56.8	3.8	2.3	1.3	1.1	1.1	0.8
Self-Report	29.9	6.3	2.7	2.1	1.9	1.8	1.5

Note. Extraction ripal Axis Factoring. Only the first 10 eigenvalues are presented.

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Scale Factor Analyses – Part 2

- 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**.

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Item Factor Analyses – Part 1

- Scale level factor analysis clearly indicted that one factor was the best solution

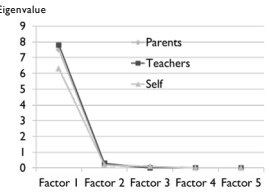

Table 8.4. Eigenvalues of the CEFI Scales Correlations

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

Note. Extraction method: Prg.

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Exploratory Factor Analyses

- Coefficients of Congruence – all very high

Table 8.6. Consistency of Factor Loadings Across Groups

Grouping Factor	CEFI Form	Coefficient of Congruence	Group 1				Group 2			
			Level	*N*	*M*	*SD*	Level	*N*	*M*	*SD*
Gender	Parent	.999	Male	700	98.1	14.9	Female	699	101.8	15.0
	Teacher	.999	Male	700	96.7	14.4	Female	700	103.2	15.0
	Self-Report	.992	Male	350	98.9	15.4	Female	350	101.0	14.6
Race/ Ethnic Group	Parent	.996	Non-White	615	99.8	15.6	White	784	100.0	14.6
	Teacher	.999	Non-White	609	97.8	15.3	White	791	101.6	14.6
	Self-Report	.995	Non-White	308	100.3	15.0	White	392	99.7	15.1
Age	Parent	.999	5 to 11	699	99.9	15.1	12 to 18	700	100.0	15.1
	Teacher	.999	5 to 11	700	100.0	15.1	12 to 18	700	100.0	15.0
	Self-Report	.995	12 to 15	400	98.7	15.0	16 to 18	300	101.6	15.0
Clinical/ Educational	Parent	.993	Non-Clinical	1,298	101.0	14.7	Clinical/Educational	277	84.6	12.4
	Teacher	.994	Non-Clinical	1,338	100.7	14.9	Clinical/Educational	280	87.1	12.2
	Self-Report	.976	Non-Clinical	632	100.8	14.8	Clinical/Educational	121	91.7	14.3

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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* function**s** is the best term to use.

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Our Conclusion. . .

The concept of Executive Function is best defined as a unitary construct….how you do what you do.

He got in it and he drew up the covers.

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Latent class analysis of frontal lobe tasks strongly suggests a general EF that reflects the efficiency and perhaps automaticity of the executive management system.

Miyake, Friedman, et al
Cognitive Psychology

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Conclusive evidence concerning the developmental trajectories of the different EF components on neuropsychological tests has yet to be established.

Huizinga, Dolan et al, 2006
Neuropsyhologica

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An examination of factor analytic studies examining EF in children finds only a single factor- planning – common to all studies.

Anderson, 2002
Clin. Neuropsych.

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EF skills may develop in different tracks but merge in function as children develop.

Wasserman and Wasserman, 2013
Applied Neuropsych. Child

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EF appears to be a unitary, more domain specific process in children

Wiebe, Scheffield, et al, 2011
J. Of Exp. Child Psych.

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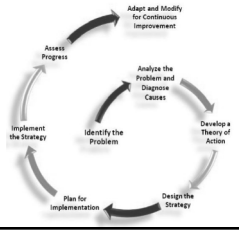
Naglieri & Goldstein, 2012

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



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EF as a Mediator of Ability and Knowledge

Ability: The skills we use to acquire and manipulate knowledge to solve problems. Also referred to as intelligence.

Knowledge: Everything we learn in life. (Also referred to as achievement.)

Executive Function: How efficiently or skillfully you do what you decide to do.

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What comprises the best means of assessment of EF?

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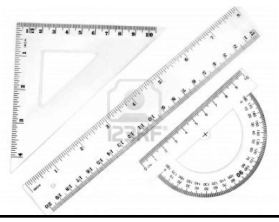
How to Measure Executive Function(s)

A review by Weyandt et al (2012) found 168 measures used to evaluate EF.



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From Weyandt et al, 2012

Executive Function Test	Number of Times Used	Sensitivity to Group Differences	Percentage of Significant Differences Between Clinical and Control Groups	Percentage of Significant Group Differences Between Two Clinical Groups
Stroop Color and Word Test and variants	41	28/73 = 38%	22/37 = 59%	6/36 = 17%
Wisconsin Card Sorting Test (including computerized and non-computerized versions)	34	75/226 = 33%	60/139 = 43%	14/88 = 16%
Trail Making Test and variants	26	43/121 = 36%	35/79 = 44%	8/42 = 19%
Continuous Performance Test and variants	19	31/72 = 43%	26/52 = 50%	5/15 = 33%
BRIEF	16	177/266 = 67%	88/104 = 85%	24/64 = 38%
Go/No-Go Test	14	37/81 = 46%	23/41 = 56%	7/17 = 41%
Tower of London test and Variants	13	3/75 = 4%	1/39 = 3%	2/39 = 5%
Rey-Osterrith Complex Figure Test (ROCF) or Rey Complex Figure Test (RCFT)	12	31/93 = 33%	24/56 = 43%	7/37 = 19%

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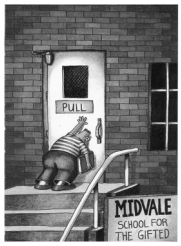
How can we reliably and validly evaluate EF?



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In general single EF tests share at most 10% of the variance with EF ratings and observations of everyday behavior.

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Batteries of combined EF tests fare a bit better sharing up to 20% of the variance with observation and reported behavior.

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The more tests in an EF battery the more factors identified in both exploratory and confirmatory studies.

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Importance of a National Norm

- The diagnostic conclusions we reach are greatly influenced by the tools we use.
- The composition of the reference group can make a substantial difference in the conclusions reached.
- Norms that represent a typical population are needed for all assessment tools.
- We have an obligation to use the highest quality tests.

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Importance of a National Norm

- What is one problem with scores based on a sample that is not representative of the U.S. populations?
  - You don't know how much the score you get is influenced by demographic variables
  - Let's look at some data …
- We created norms from our CEFI data for groups of children based on PEL levels to see just how much influence this variable could have on a standard score (Mean = 100, SD = 15).

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Importance of a National Norm

Calibration of Standard Scores (Mn = 100; SD = 15) Across Parental Educational Levels for CEFI Parent Ratings.

	Standard Scores				
Raw Score	<HS	HS Grad	Some Coll	Coll Grad	National
230	96	91	88	85	90
235	97	92	89	87	91
240	98	93	90	88	92
245	99	95	92	89	93
250	100	96	93	90	94
255	101	97	94	92	95
260	102	98	95	93	97
265	103	99	96	94	98
270	104	100	98	95	99
275	105	101	99	96	100
280	106	102	100	98	101
285	107	103	101	99	102
290	108	105	102	100	103
295	109	106	103	101	105
300	110	107	105	103	106
305	111	108	106	104	107
310	112	109	107	105	108
315	113	110	108	106	109

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Importance of a National Norm

- Only tests that yield standard scores based on a ***representative*** normal sample should be used in clinical practice.
- A comparison of EF symptoms to a normative group is essential.
- Comparisons to children who do not represent the US population can be misleading.
- The use of raw scores should be avoided in all tests (especially achievement tests).

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Importance of a National Norm

- A normative sample that is representative of the US population is absolutely required.
- The sample should be stratified carefully and that sample should be thoroughly described in the test Manual.
- Remember the key question is not how similar someone is to an impaired group but how dissimilar they are to the norm.

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CEFI Scores by Diagnosis

- We expected that individuals with ADHD, mood disorders, and Autism Spectrum Disorders might earn a low CEFI Full Scale score.
- We compared groups matched on gender, race/ethnicity, and parental education

> Impairment in executive function is common in a number of internalizing and externalizing forms of psychopathology (Willcutt et al., 2005; see chapter 2, *Theory and Research*, for further discussion). For instance, research and theory has pointed to executive function deficits in Attention-Deficit/Hyperactivity Disorder (ADHD) and mood disorders (e.g., Weyandt et al., in press), as well as Autism Spectrum Disorders (ASD; e.g., Gilbert, Bird, Brindley, Frith, & Burgess, 2008; Gilotty, Kenworthy, Sirian, Black, & Wagner, 2002; Happé, Booth, Charlton, & Hughes, 2006; Ozonoff, Pennington, & Rogers, 1991; Solomon, Ozonoff, Ursu, Ravizza, Cummings, Ly, & Carter, 2009).

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Group Differences: ADHD

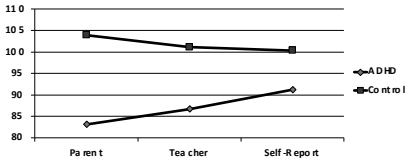

Table 8.19 Differences Between ADHD and Matched General Population Samples: CEFI Full Scale

Form		ADHD	Matched Gen. Pop.	*d*-ratio	*F* (*df*)	*P*
Parent	*M*	89.1	108.8	-1.59	216.56 (1, 340)	< .001
	SD	13.0	13.0			
	N	171	171			
Teacher	*M*	86.7	104.1	-1.07	79.93 (1, 278)	< .001
	SD	13.5	13.5			
	N	138	142			
Self-Report	*M*	91.2	100.3	-0.62	22.21 (1, 232)	< .001
	SD	14.7	14.7			
	N	117	117			

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Group Differences: ASD

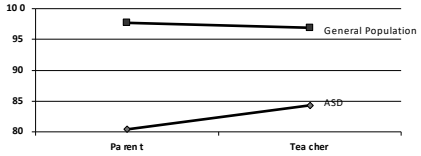

Table 8.20 Differences Between ASD and Matched General Population Samples: CEFI Full Scale

Form		ASD	Matched Gen. Pop.	*d*-ratio	*F* (*df*)	*P*
Parent	*M*	80.4	97.7	-1.41	48.96 (1, 96)	< .001
	SD	12.2	12.2			
	N	48	50			
Teacher	*M*	84.3	96.9	-0.99	23.11 (1, 92)	< .001
	SD	12.7	12.7			
	N	47	47			

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Group Differences: Learning Disabilities

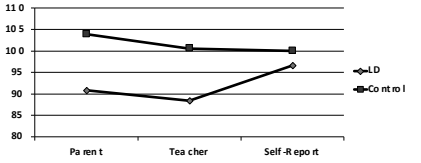

Table 8.22 Differences Between LD and Matched General Population Samples: CEFI Full Scale

Form		LD	Matched Gen. Pop.	*d*-ratio	*F* (*df*)	*p*
Parent	*M*	90.8	103.9	-0.92	19.89 (1, 93)	< .001
	SD	14.4	14.4			
	N	47	48			
Teacher	*M*	88.4	100.6	-0.91	37.29 (1, 178)	< .001
	SD	13.4	13.4			
	N	90	90			
Self-Report	*M*	96.6	100.0	-0.21	1.45 (1, 126)	0.231
	SD	15.9	15.9			
	N	64	64			

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Group Differences: Mood Disorders

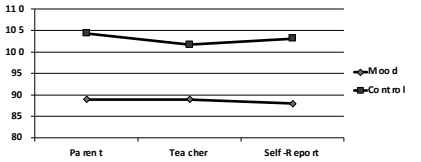

Table 8.21 Differences Between Mood Disorder and Matched General Population Samples: CEFI Full Scale

Form		Mood Disorder	Matched Gen. Pop.	*d*-ratio	*F* (*df*)	*p*
Parent	*M*	88.9	104.3	-1.11	22.66 (1, 71)	< .001
	SD	13.8	13.8			
	N	36	37			
Teacher	*M*	88.9	101.7	-1.01	14.9 (1, 57)	< .001
	SD	12.8	12.8			
	N	29	30			
Self-Report	*M*	88.0	103.1	-1.09	16.34 (1, 53)	< .001
	SD	13.9	13.9			
	N	27	28			

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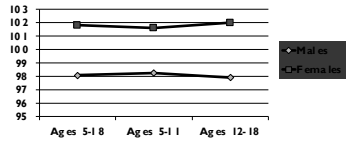
CEFI Gender Differences: Parent Raters

Girls are Smarter 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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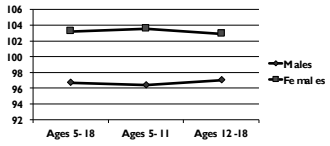
CEFI Gender Differences: Teacher Raters

- Girls are Smarter 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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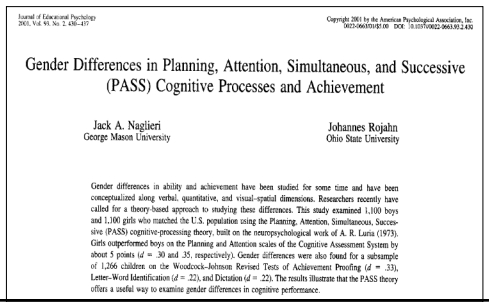
Gender Differences: Abilities Associated With EF



Journal of Educational Psychology
2001, Vol. 93, No. 2, 430–437

0022-0663/01/$5.00 DOI: 10.1037/0022-0663.93.2.430

Gender Differences in Planning, Attention, Simultaneous, and Successive (PASS) Cognitive Processes and Achievement

Jack A. Naglieri
George Mason University

Johannes Rojahn
Ohio State University

Gender differences in ability and achievement have been studied for some time and have been conceptualized along verbal, quantitative, and visual–spatial dimensions. Researchers recently have called for a theory-based approach to studying these differences. This study examined 1,100 boys and 1,100 girls who matched the U.S. population using the Planning, Attention, Simultaneous, Successive (PASS) cognitive-processing theory, built on the neuropsychological work of A. R. Luria (1973). Girls outperformed boys on the Planning and Attention scales of the Cognitive Assessment System by about 5 points (d = .30 and .35, respectively). Gender differences were also found for a subsample of 1,266 children on the Woodcock–Johnson Revised Tests of Achievement Proofing (d = .33), Letter–Word Identification (d = .22), and Dictation (d = .22). The results illustrate that the PASS theory offers a useful way to examine gender differences in cognitive performance.

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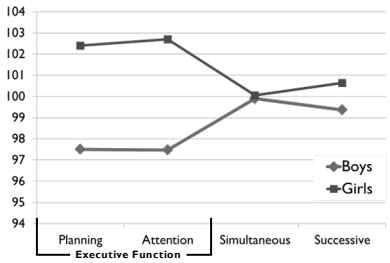
Gender Differences: Abilities Associated With EF



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CEFI: WISC-IV, CAS, and WJ III

- Data from the Neurology, Learning and Behavior Center in Salt Lake City, UT
- Children given the CEFI, WISC-IV (N = 43), CAS (N = 62), and the WJIII achievement (N = 58) as part of a typical test battery.

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CEFI, WISC-IV, CAS, Achievement

Table 8.26. Demographic Characteristics of the CAS, WISC-IV, and WJ III ACH Validity Samples

Demographic		Sample					
		CAS		WISC-IV		WJ III ACH	
		N	%	*N*	%	*N*	%
Gender	Male	38	61.3	29	67.4	36	62.1
	Female	24	38.7	14	32.6	22	37.9
Race/Ethnic Group	Hispanic	1	1.6	1	2.3	1	1.7
	Asian	2	3.2	2	4.7	2	3.4
	White	55	88.7	38	88.4	52	89.7
	Other	4	6.5	2	4.7	3	5.2
Parental Education Level	High school diploma or less	1	1.6	0	0.0	1	1.7
	Some college or associate's degree	21	33.9	12	27.9	18	31.0
	Bachelor's degree or higher	36	58.1	26	60.5	34	58.7
	Missing information	4	6.5	5	11.6	5	8.6
Diagnostic or Educational Group	ADHD	24	38.7	15	34.9	20	34.5
	Anxiety	15	24.2	9	20.9	14	24.1
	ASD	7	11.3	5	11.6	7	12.1
	LD	3	4.8	3	7.0	3	5.2
	Mood	4	6.5	3	7.0	5	8.6
	Other	9	4.8	8	4.6	9	5.1
Total		62	100.0	43	100.0	58	100.0
Age *M* (*SD*)		10.4 (2.9)		10.2 (2.6)		10.5 (2.7)	

Note. ADHD = Attention-Deficit/Hyperactivity Disorder; Anxiety = Anxiety Disorder; ASD = Autism Spectrum Disorder; LD = Learning Disorder; Mood = Mood Disorder.

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CEFI, WISC-IV, CAS, Achievement

Table 8.27 CEFI Manual Other Measure		Corrected r	N	CEFI Full Scale M	CEFI Full Scale SD	CAS, WISC-IV, or WJ III ACH M	CAS, WISC-IV, or WJ III ACH SD
WISC-IV	Full Scale	.39*	41	93.1	12.0	95.5	18.1
	Working Memory	.30	42	93.0	11.9	92.6	17.5
	Verbal Comprehension	.44**	42	93.0	11.9	96.8	14.7
	Perceptual Reasoning	.27	42	93.0	11.9	101.5	17.5
	Processing Speed	.34*	42	93.0	11.9	90.7	19.4
CAS	Full Scale	.45**	60	91.4	13.2	95.8	17.1
	Attention	.37**	60	91.4	13.2	96.5	15.1
	Planning	.49**	60	91.4	13.2	92.4	14.5
	Simultaneous	.43**	60	91.4	13.2	101.6	17.0
	Successive	.32*	60	91.4	13.2	98.0	14.6
WJ III ACH	Total Achievement	.51**	40	93.4	12.1	96.6	16.8
	Broad Reading	.48**	54	91.9	12.4	98.1	14.2
	Broad Math	.49**	53	92.0	11.9	97.7	16.9
	Broad Written Language	.47**	41	93.5	12.3	94.9	16.8

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CEFI & WISC-IV

Table H.25. Correlations Between the CEFI (5–18 Years) Teacher Form and the WISC-IV

	WISC-IV Full Scale		Working Memory		Verbal Comprehension		Perceptual Reasoning		Processing Speed		CEFI	
CEFI	Obt. r	Cor. r	Obt. r	Cor. r	Obt. r	Cor. r	Obt. r	Cor. r	Obt. r	Cor. r	M	SD
Full Scale	.37*	.39*	.28	.30	.35*	.44**	.25	.27	.35*	.34*	93.0	11.9
Attention	.36*	.39*	.36*	.40**	.25	.33*	.28	.32*	.34*	.35*	91.8	11.2
Emotion Regulation	.17	.14	-.07	-.08	.24	.25	.09	.08	.14	.11	97.2	14.7
Flexibility	.52**	.57**	.40**	.46**	.55**	.68**	.40**	.45**	.35*	.37*	93.8	11.0
Inhibitory Control	.22	.21	.09	.08	.18	.20	.13	.13	.32*	.27	97.7	13.5
Initiation	.30	.25	.24	.21	.31*	.31*	.17	.14	.32*	.25	91.2	15.1
Organization	.16	.15	.15	.14	.15	.17	.07	.06	.20	.17	92.2	13.6
Planning	.42**	.46**	.34*	.38*	.42**	.54**	.27	.31*	.37*	.39*	93.6	11.1
Self-Monitoring	.36*	.39*	.29	.33*	.35*	.45**	.28	.31*	.26	.27	92.0	11.3
Working Memory	.41**	.38*	.38*	.36*	.39*	.43**	.33*	.31*	.26	.23	92.5	13.6
WISC-IV M	95.5		92.6		96.8		101.5		90.7			
WISC-IV SD	18.1		17.5		14.7		17.5		19.4			

Note. Pair-wise deletion of missing cases was used (*N* = 41–43); Obt. *r* = Obtained *r*; Cor. *r* = Corrected *r*.

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CEFI & CAS

Table H.18. Correlations Between the CEFI (5–18 Years) Teacher Form and the CAS

	CAS Full Scale		Attention		Planning		Simultaneous		Successive		CEFI	
CEFI	Obt. r	Cor. r	Obt. r	Cor. r	Obt. r	Cor. r	Obt. r	Cor. r	Obt. r	Cor. r	M	SD
Full Scale	.45**	.45**	.33*	.37**	.43**	.49**	.42**	.43**	.28*	.32*	91.4	13.2
Attention	.40**	.41**	.26*	.30*	.36**	.42**	.38**	.39**	.30*	.35**	90.3	12.8
Emotion Regulation	.26*	.24	.24	.24	.21	.22	.26*	.23	.12	.13	96.9	14.7
Flexibility	.52**	.53**	.35**	.40**	.47**	.54**	.50**	.51**	.37**	.42**	92.2	13.0
Inhibitory Control	.27*	.25*	.17	.18	.26*	.29*	.24	.22	.19	.21	96.0	13.9
Initiation	.40**	.33**	.33**	.30*	.38**	.37**	.38**	.31*	.21	.20	89.0	16.3
Organization	.29*	.27*	.19	.20	.33**	.36**	.23	.21	.21	.23	90.5	14.3
Planning	.47**	.49**	.31*	.37**	.46**	.54**	.44**	.46**	.31*	.38**	92.5	12.4
Self-Monitoring	.48**	.50**	.37**	.43**	.42**	.50**	.46**	.49**	.29*	.35**	91.2	12.4
Working Memory	.48**	.45**	.36**	.38**	.42**	.46**	.47**	.45**	.27*	.30*	91.0	14.0
CAS M	95.8		96.5		92.4		101.6		98.0			
CAS SD	17.1		15.1		14.5		17.0		14.6			

Note. Pair-wise deletion of missing cases was used (*N* = 60–62); Obt. *r* = Obtained *r*; Cor. *r* = Corrected *r*.
*$p < .05$; **$p < .01$.

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CEFI & WJ-III *Total* Achievement

Table H.26. Correlations Between the CEFI (5–18 Years) and WJ III ACH Total Achievement Cluster

	WJ III ACH Total Achievement		CEFI	
	Obt. *r*	Cor. *r*	*M*	*SD*
Full Scale	.47**	.51**	93.4	12.1
Attention	.51**	.59**	92.5	10.9
Emotion Regulation	.22	.18	96.5	16.1
Flexibility	.56**	.61**	94.0	11.9
Inhibitory Control	.24	.23	97.8	14.0
Initiation	.37*	.32*	91.5	15.6
Organization	.32*	.32*	92.5	13.5
Planning	.51**	.58**	94.1	11.3
Self-Monitoring	.46**	.53**	92.7	11.1
Working Memory	.57**	.57**	93.2	13.1
WJ III ACH *M*	96.6			
WJ III ACH *SD*	16.8			

Note. Pair-wise deletion of missing cases was used (*N* = 40–41); Obt. *r* =

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CEFI & WJ-III *Reading*

Table H.27. Correlations Between the CEFI (5–18 Years) and WJ ACH Broad Reading Cluster

	WJ III ACH Broad Reading		CEFI	
	Obt. *r*	Cor. *r*	*M*	*SD*
Full Scale	.39**	.48**	91.9	12.4
Attention	.41**	.52**	90.9	11.7
Emotion Regulation	.25	.27*	96.9	14.6
Flexibility	.43**	.50**	92.5	12.8
Inhibitory Control	.26	.32*	96.6	13.0
Initiation	.26	.26	89.1	16.1
Organization	.27*	.31*	91.0	13.9
Planning	.43**	.54**	92.8	11.5
Self-Monitoring	.40**	.51**	91.4	11.7
Working Memory	.43**	.48**	91.5	13.7
WJ III ACH *M*	98.1			
WJ III ACH *SD*	14.2			

Note. Pair-wise deletion of missing cases was used (*N* = 54–55); Obt. *r* =

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CEFI & WJ-III Broad *Math*

Table H.28. Correlations Between the CEFI (5–18 Years) and WJ III ACH Broad Math Cluster

	WJ III ACH Broad Math		CEFI	
	Obt. *r*	Cor. *r*	*M*	*SD*
Full Scale	.44**	.49**	92.0	11.9
Attention	.40**	.46**	90.7	11.4
Emotion Regulation	.16	.15	96.7	14.8
Flexibility	.52**	.55**	93.0	12.1
Inhibitory Control	.15	.15	96.6	13.0
Initiation	.43**	.38**	89.9	15.1
Organization	.33*	.33*	90.8	13.4
Planning	.49**	.57**	93.1	10.8
Self-Monitoring	.46**	.54**	91.6	11.4
Working Memory	.59**	.60**	91.6	13.1
WJ III ACH *M*	97.7			
WJ III ACH *SD*	16.9			

Note. Pair-wise deletion of missing cases was used (*N* = 53–54); Obt. *r* =

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CEFI & WJ-III Written Language

Table H.29. Correlations Between the CEFI (5–18 Years) III ACH Broad Written Language Cluster

	WJ III ACH Broad Written Language		CEFI	
	Obt. *r*	Cor. *r*	*M*	*SD*
Full Scale	.44**	.47**	93.5	12.3
Attention	.47**	.55**	92.5	10.9
Emotion Regulation	.20	.17	97.4	15.9
Flexibility	.50**	.54**	94.2	12.2
Inhibitory Control	.27	.26	98.1	13.8
Initiation	.33*	.28	91.6	15.6
Organization	.34*	.33*	92.0	13.8
Planning	.44**	.50**	94.4	11.5
Self-Monitoring	.44**	.49**	92.5	11.5
Working Memory	.47**	.47**	93.4	13.5
WJ III ACH *M*	94.9			
WJ III ACH *SD*	16.8			

Note. Pair-wise deletion of missing cases was used (*N* = 41–42); Obt. *r* =

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A Case Study: Barry

- Barry is a 17-year-old, 11th grader with a long standing history of good academic, social and behavioral functioning.
- 5 years ago Barry's parents divorced; his mother remarried. His relationship with his mother is good but inconsistent with his father.
- Over the past year, he became increasingly depressed and socially isolated. School work has declined.
- This past fall he took a number of advanced placement classes, he was also a starter on his high school football team.
  - As the season ended his school work declined precipitously and a long standing relationship with a girlfriend ended.

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Barry

- Barry's self-report: Revised Children's Manifest Anxiety Scale = 99th percentile.
- His self-report: Reynolds Adolescent Depression Scale = 96th percentile.
- His Millon profile was characteristic of a youth feeling vulnerable, anxious, misunderstood, unappreciated, angry, depressed and disconnected from others.

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Barry

Full Scale			
Standard Score	90% Confidence Interval	Percentile Rank	Classification
70	68-73	2	Below Average

CEFI Scales

Scale	Standard Score	90% Confidence Interval	Percentile Rank	Classification	Difference from Youth's Average (72.4)	Statistically Significant? (p = .10)	Executive Function Strength/ Weakness
Attention	72	68-80	3	Below Average	-0.4	No	-
Emotion Regulation	78	73-88	7	Below Average	5.6	No	-
Flexibility	75	70-87	5	Below Average	2.6	No	-
Inhibitory Control	82	76-91	12	Low Average	9.6	Yes	-
Initiation	68	64-79	2	Well Below Average	-4.4	No	-
Organization	76	71-85	5	Below Average	3.6	No	-
Planning	62	58-71	1	Well Below Average	-10.4	Yes	Weakness
Self-Monitoring	62	59-74	1	Well Below Average	-10.4	Yes	Weakness
Working Memory	77	72-87	6	Below Average	4.6	No	-

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Barry

Scores	
Consistency Index	Standard Score = 110 Inconsistent response style is not indicated.
Negative Impression Scale	Standard Score = 72 Negative impression response style is indicated.
Positive Impression Scale	Standard Score = 128 Positive impression response style is not indicated.
Number of Omitted Items	Number of Items Omitted = 0 None of the items were omitted.

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Barry

CEFI Scales

Note: For the CEFI Scales, item scores that are substantially above the average are indicated by a lightly shaded cell (i.e.,), and those substantially below the average rating are in a darker cell (i.e.,).

Attention	
Item	Score
9. finish a boring task?	1
11. work well in a noisy environment?	2
21. work well for a long time?	2
25. concentrate while reading?	1
36. stay on topic when talking?	2
44. pay attention for a long time?	2
56. concentrate?	1
62. pay attention during a boring task?	1
75. get distracted? (R)	1
90. pay attention to details?	1
91. listen closely to instructions?	2
97. focus on one thing?	0

Emotion Regulation	
Item	Score
10. control emotions when under stress?	1
12. stay calm when handling small problems?	2
42. find it hard to control his/her emotions? (R)	1
47. get upset when plans were changed? (R)	3
64. wait patiently?	3
68. become upset in new situations? (R)	3
73. respond calmly to delays?	2
79. react well to surprises?	2
81. react with the right level of emotion?	1

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Barry

CEFI Scales

Note: For the CEFI Scales, item scores that are substantially above the average are indicated by a lightly shaded cell (i.e.,), and those substantially below the average rating are in a darker cell (i.e.,).

Attention	
Item	Score
3. finish a boring task?	1
11. work well in a noisy environment?	2
21. work well for a long time?	2
25. concentrate while reading?	1
36. stay on topic when talking?	2
44. pay attention for a long time?	2
56. concentrate?	1
62. pay attention during a boring task?	1
75. get distracted? (R)	1
80. pay attention to details?	1
91. listen closely to instructions?	2
97. focus on one thing?	0

Emotion Regulation	
Item	Score
10. control emotions when under stress?	1
12. stay calm when handling small problems?	2
42. find it hard to control his/her emotions? (R)	1
47. get upset when plans were changed? (R)	3
64. wait patiently?	3
68. become upset in new situations? (R)	3
73. respond calmly to delays?	2
79. react well to surprises?	2
81. react with the right level of emotion?	1

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Barry - Conclusions

- Barry's depression has a significant influence on what he does and how he performs on a daily basis
- Barry is intellectually capable (WAIS and CAS) and good in Planning and Attention on the CAS, but his behavior reflects poor application of those neurocognitive abilities

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EF Interventions

Can strategic, instructional interventions provide remedial and compensatory support for children with EF deficits?

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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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My Granddaughter Hones Her EF Skills

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Practice Pays Off!

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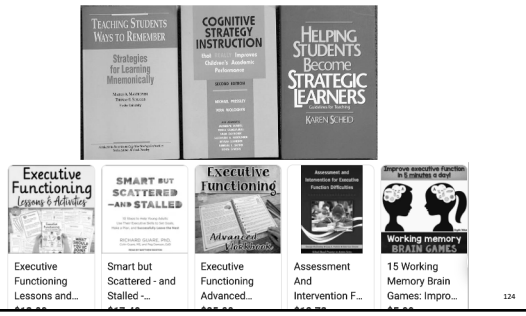
Cognitive Instructional Methods



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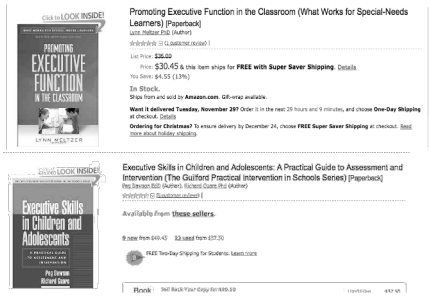
EF Instruction



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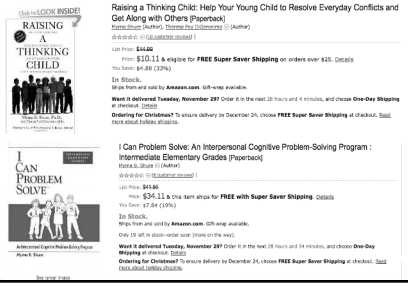

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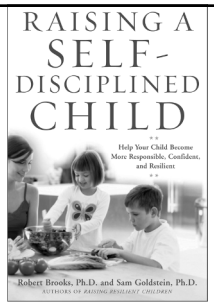

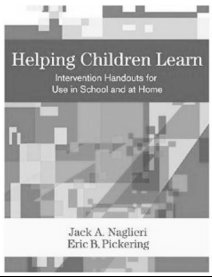

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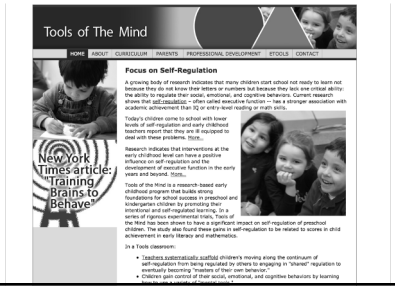
Tools of the Mind



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http://www.hoagiesgifted.org/eric/e638.html

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https://childmind.org/article/helping-kids-who-struggle-with-executive-functions/

Helping Kids Who Struggle With Executive Functions

Learning specialists on how to build organizational skills

Rachel Ehmke

The first time you hear that your 7-year-old son is weak in "executive functions" it sounds like a joke. No kidding—that's why he's a first grader, not a CEO. But executive function disorders in children are the essential self-regulating skills that we all use every day to accomplish just about everything. They help us plan, organize, make decisions, shift between situations or thoughts, control our emotions and impulsivity, and learn from past mistakes. Kids rely on their executive functions for everything from taking a shower to packing a backpack and sticking priorities.

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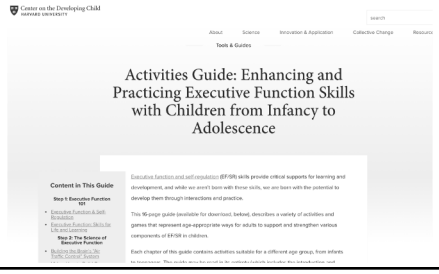
https://developingchild.harvard.edu/resources/activities-guide-enhancing-and-practicing-executive-function-skills-with-children-from-infancy-to-adolescence/



Activities Guide: Enhancing and Practicing Executive Function Skills with Children from Infancy to Adolescence

Content in This Guide

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https://www.understood.org/en/school-learning/partnering-with-childs-school/instructional-strategies/at-a-glance-classroom-accommodations-for-executive-functioning-issues

Classroom Accommodations for Executive Functioning Issues

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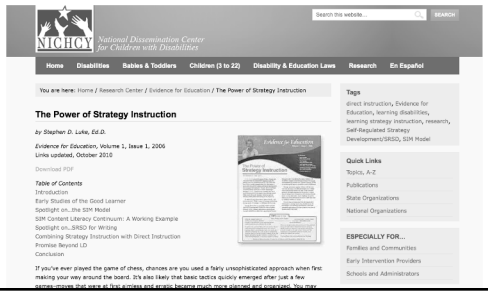
http://nichcy.org/research/ee/learning-strategies



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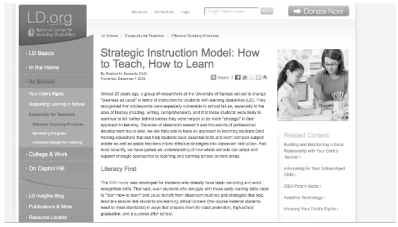
http://www.ncld.org/at-school/especially-for-teachers/effective-teaching-practices/strategic-instruction-model-sim-how-to-teach-how-to-learn



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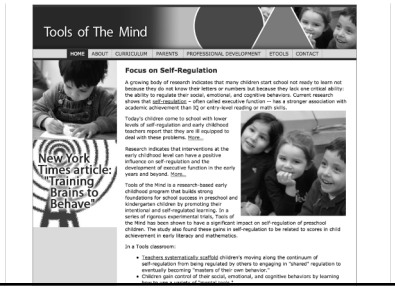
Tools of the Mind



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http://www.hoagiesgifted.org/eric/e638.html

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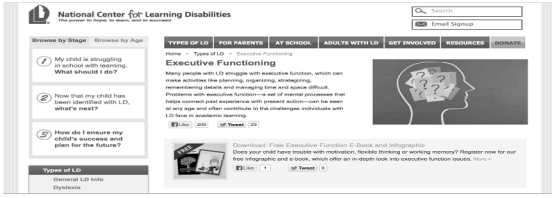

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Steps to Strategic Instruction:

- **Describe the strategy**. Students obtain an understanding of the strategy and its purpose-why it is important, when it can be used, and how to use it.
- **Model its use.** The teacher models the strategy, explaining to the students how to perform it.
- **Provide ample assisted practice time.** The teacher monitors, provides cues, and gives feedback. Practice results in automaticity so the student doesn't have to "think" about using the strategy.
- **Promote student self-monitoring and evaluation of personal strategy use.** Students will likely use the strategy if they see how it works for them; it will become part of their learning schema.
- **Encourage continued use and generalization of the strategy.** Students are encouraged to try the strategy in other learning situations.

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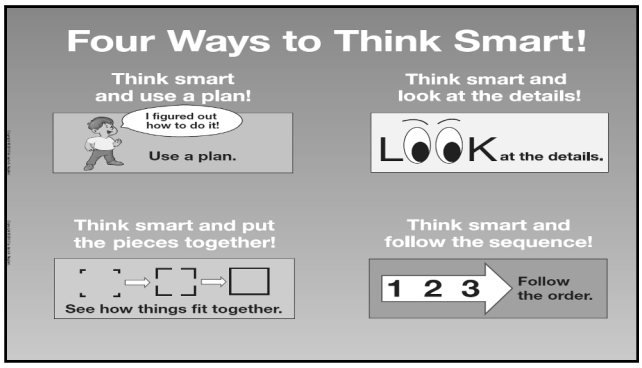

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Benefits of Strategy Instruction

- Students trust their minds
- Students know there is more than one right way to do things
- They acknowledge their mistakes and try to rectify them
- They evaluate their products and behavior
- Memories are enhanced
- Learning increases
- Self-esteem increases
- Students feel a sense of power
- Students become more responsible
- Work completion and accuracy improve
- Students develop and use a personal study process
- They know how to "try"
- On-task time increases: students are more "engaged"

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Conclusions

- The concept of EF is evolving.
- Data from the CEFI Standardization indicate that when measured using observable behaviors the term Executive Function is supported.
- The CEFI provides a well normed measure of EF that has demonstrated reliability & validity.
- There is emerging evidence that children can be taught to be more strategic – an important indication of good EF behavior and outcome.

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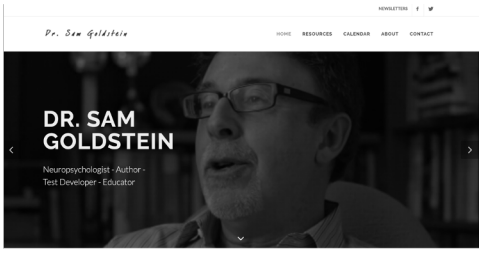
www.samgoldstein.com



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Questions?

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@CommonSenseScience

TEDx: https://www.youtube.com/watch?v=isfw8JJ-eWM

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