# Unraveling the Relationship Between ADHD and Executive Functioning

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## What is ADHD?

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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#### 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.

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.

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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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## 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.



## 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 orbitofrontal cortex (OFC) plays a key role in impulse control, maintenance of set, monitoring ongoing behavior and socially appropriate behaviors.
- •The anterior cingulate cortex (ACC) is involved in emotional drives, experience and integration, inhibition of inappropriate responses, decision making and motivation.



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



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#### Standardization Data From The Comprehensive Executive Function Inventory

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

#### **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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#### 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**.





CONCLUSION FROM EXPLORATORY FACTOR ANALYSES

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















Group Differences: Mood Disorders 110. 10 2.5 95. -\*- Mo od 87.5 80. Parent Teacher Self-Report e 8.21 Diff nd Matched General Popula Matched Gen. Pop. s: CEFI Full Sca F (df) n Mood D Mood Disc d-ratio p -1.11 22.66 (1, 71) < .001 14.9 (1,57) -1.01 <.001 16.34 (1, 53) -1.09 <.001









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## What is the Relationship of EF and ADHD?

- ADHD is a Diagnosis/EF is a set of Processes.
- ADHD is defined by behavior/EF is defined by Processes.
- 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 research consensus/EF has no such consensus thus far.
   ADHD is not EFDD!

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