What is ADHD?

ADHD is a bio-psychosocial condition characterized by core symptoms of inattention, hyperactivity and impulsivity leading to/interacting with cognitive deficits causing impairment in all walks of life.
What is ADHD?

➢ ADHD appears to primarily involve the basal ganglia, cerebellum and the frontal lobes.
➢ Co-morbidity of other developmental, emotional and behavioral conditions with ADHD probably confounds findings from different study groups. (Hendren et al, JAACP, (2000) 39, 815-820.
➢ The symptoms of ADHD lead to a nearly infinite number of consequences.

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 (For Review see Barkley, 3rd Edition, 2005).

Examining the Dimensionality of ADHD Symptomatology in Young Adults Using Factor Analysis and Outcome Prediction

The prediction of outcomes provided support that complemented confirmatory factor analysis for the separation of the hyperactivity and impulsivity constructs. Impulsivity uniquely predicted more outcomes than hyperactivity alone. Results were consistent with the conceptualization of ADHD as primarily a disorder of behavioral inhibition. Future research using alternative outcomes and clinical populations should be conducted. (JAD, 2012)
ADHD appears to be a condition stemming in part from inefficient operation of EF.

**A Bit of EF Neuroanatomy**

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

**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.
And:

➢ 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.

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.

Another View: Hot and Cool EF

➢ Cool (metacognitive) – functions associated with cognition such as planning and problem solving (leading to a Dorsolateral Syndrome).
➢ Hot (emotional/motivational) – functions associated with coordinating and controlling emotions (leading to an Orbitofrontal/Medial Syndrome).
What do we mean by the term Executive Function(s)?

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

What is 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
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.

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.

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.
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).
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).
7. Roberts & Pennington (1996): EF “a collection of related but somewhat distinct abilities such as planning, set maintenance, impulse control, working memory, and attentional control” (p. 105).
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).

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).

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).
Executive Functions

Executive functions are a set of cognitive processes that control and manage other cognitive processes. These processes are also referred to as executive functions, supervisory attentional system, or cognitive control. They include processes such as planning, cognitive flexibility, abstract reasoning, inhibition, shifting, and selective and sustained attention.

And Finally...

An NICHD panel in 1994 identified 33 EFs by consensus!
The Top Six Were:
➢ Self-regulation
➢ Sequencing of behavior
➢ Flexibility
➢ Response inhibition
➢ Planning
➢ Organization of behavior

What is the relationship of EF to ADHD and other defined disorders?

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.
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.

EF and Tourette’s

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

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.
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.

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).

EF and Traumatic Brain Injury

Pragmatic and executive functions in traumatic brain injury and right brain damage
An exploratory comparative study

Nadieh Ziemannes, Cigano Ginder, Carolee Ross di Oliettinis, Rachel Baz Fossena

Objective: To study the frequency of pragmatic and executive deficits in right brain damaged (RBD) and non-traumatic brain injured (NTBI) patients, and to verify possible differences between pragmatic and executive functions in these two groups. Methods: The sample comprised 7 cases of TBI and 7 cases of RBD. The TBI group included 3 males and 4 females with a mean age of 24.3 years (range 18-37). The RBD group included 3 males and 4 females with a mean age of 23.3 years (range 16-30). The mean time elapsed since injury was 3 years (range 1-10). The methods used were the Test of Memory and Learning (TOMAL), Trail Making Test, Time Use, Memory Card Sorting Test, and the Boff Test. Results: The RBD group showed significant differences between pragmatic and executive functions, with the following results: (1) RBD patients scored lower on the TOMAL than the TBI group. (2) RBD patients had a higher number of errors on the Trail Making Test than the TBI group. (3) RBD patients had a higher number of perseverative errors on the Memory Card Sorting Test than the TBI group. Conclusion: The results indicate that RBD patients have more significant pragmatic and executive deficits than TBI patients. Further research is needed to clarify these findings and to determine the specific mechanisms underlying these deficits.
EF Deficits and ASD

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 group matched on IQ, age, sex and SES. Significant group differences were found on executive function, theory of mind, memory persistence, and verbal memory tests, but not on spatial or other control measures. Kendall-order theory of mind and memory persistence were significantly correlated. Memory persistence, theory of mind and executive function did not correlate. The results are discussed in terms of the relationship between theory of mind and executive function. One possibility is that theory of mind is encoded in executive function, or that both abilities reflect a common denominator. Possible interpretations and implications of results are also discussed.

Keywords: Autism, executive function, theory of mind.

EF and Learning Disabilities

Working Memory Impairments in Children with Specific Arithmetic Learning Difficulties

Jared P. McCloskey, Chantel J. Hinch

Abstract

Working memory impairments in children with difficulties in arithmetic have previously been investigated using standardized selection techniques and control groups, leading to problems concluding where deficits may occur. The current study attempted to overcome these criticisms by assessing 8-year-old children with difficulties specific to arithmetic, as assessed by normative testing, and comparing them with age-matched and ability-matched controls. A battery of 7 tasks were used to assess different aspects of working memory, including verbal and spatial working memory, and short-term memory. The group with specific arithmetic difficulties had normal phonological working memory but were impaired on spatial working memory, and some aspects of executive processing. Compared to ability matched controls, they were impaired on a 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 arithmetic achievement.

If all of these conditions are statistically related to behaviors and abilities reflecting EF than a common denominator must exist.
An examination of older factor analytic studies examining EF in children finds only a single factor—planning—common to all studies.

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 Functions is a multidimensional model (Friedman et al., 2006; Miyake et al., 2000).

Executive Function(s)

➢ Given all these definitions of EF(s) we wanted to address the question...

Executive Functions ... or Executive Function?
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 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?

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).

CEFI Standardization
➢ 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.
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.

EXPLORATORY FACTOR ANALYSES

➢ Item level factor analysis clearly indicated that one factor was the best solution.

Table 8.2. Eigenvalues from the Inter-Item Correlations

<table>
<thead>
<tr>
<th>Form</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
<th>Factor 5</th>
<th>Factor 6</th>
<th>Factor 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent</td>
<td>43.7</td>
<td>41.2</td>
<td>23.1</td>
<td>15.1</td>
<td>13.1</td>
<td>13.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Teacher</td>
<td>56.8</td>
<td>38.3</td>
<td>23.1</td>
<td>13.1</td>
<td>11.1</td>
<td>11.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Self-Report</td>
<td>29.9</td>
<td>63.6</td>
<td>27.2</td>
<td>21.9</td>
<td>18.1</td>
<td>18.1</td>
<td>15.1</td>
</tr>
</tbody>
</table>

Note: Extraction: Principal Axis Factoring; Only the first 10 eigenvalues are presented.

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.
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

<table>
<thead>
<tr>
<th>Form</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent</td>
<td>7.5</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Teacher</td>
<td>7.8</td>
<td>0.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Self-Report</td>
<td>6.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-0.1</td>
</tr>
</tbody>
</table>

Note: Extractor method PAF.

EXPLORATORY FACTOR ANALYSES

➢ Coefficients of Congruence – all very high

Table 8.6. Consistency of Factor Loadings Across Groups

<table>
<thead>
<tr>
<th>Grouping Factor</th>
<th>CEFI Form</th>
<th>Coefficient of Congruence</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Parent</td>
<td>Male 700 90.3 14.9</td>
<td>Female 699 101.4</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>Male 700 90.7 14.4</td>
<td>Female 700 103.2</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>Self-Report</td>
<td>Male 702 90.8 15.4</td>
<td>Female 708 103.0</td>
<td>14.7</td>
</tr>
<tr>
<td>Race/Ethnic Group</td>
<td>Parent</td>
<td>Non-White 615 97.8 15.6</td>
<td>White 704 100.0</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>Non-White 609 97.8 15.3</td>
<td>White 701 101.4</td>
<td>14.1</td>
</tr>
<tr>
<td></td>
<td>Self-Report</td>
<td>Non-White 765 101.3</td>
<td>15.6</td>
<td>White 302 96.7</td>
</tr>
<tr>
<td>Age</td>
<td>Parent</td>
<td>5 to 11 699 99.9 15.5</td>
<td>12 to 18 706 100.2</td>
<td>15.7</td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>5 to 11 700 100.0 15.3</td>
<td>12 to 18 700 100.0</td>
<td>15.3</td>
</tr>
<tr>
<td></td>
<td>Self-Report</td>
<td>12 to 15 402 99.7 15.8</td>
<td>18 to 26 408 101.4</td>
<td>15.2</td>
</tr>
<tr>
<td>Clinical/educational</td>
<td>Parent</td>
<td>Non-Probable</td>
<td>277 101.4</td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td>Teacher</td>
<td>Non-Probable</td>
<td>277 101.4</td>
<td>14.5</td>
</tr>
<tr>
<td></td>
<td>Self-Report</td>
<td>Non-Probable</td>
<td>277 101.4</td>
<td>14.5</td>
</tr>
</tbody>
</table>

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

Latent class analysis of frontal lobe tasks strongly suggests a general EF that reflects the efficiency and perhaps automaticity of the executive management system.
EF skills may develop in different tracks but merge in function as children develop.

Wasserman and Wasserman, 2013
Applied Neuropsych. Child

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


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

Huizinga, Dolan et al, 2006
Neuropsychologia
We expected that individuals with ADHD, mood disorders, and Autism Spectrum Disorders might earn a low scores on this measure of EF behaviors.

We compared groups matched on gender, race/ethnicity, and parental education (Naglieri, J. A., & Goldstein, S. (2013). Comprehensive Executive Functioning Index. Toronto: Multi Health Systems.)
Table 4.20 Differences Between ASD and Matched General Population Samples: CEFI Full Scale

<table>
<thead>
<tr>
<th>Form</th>
<th>ASD</th>
<th>Matched Gen. Pop.</th>
<th>z-score</th>
<th>F(df)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent</td>
<td>60</td>
<td>67</td>
<td>-1.41</td>
<td>48.96</td>
<td>&lt; .01</td>
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<tr>
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<td></td>
<td>30</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher</td>
<td>60</td>
<td>67</td>
<td>0.59</td>
<td>21.11</td>
<td>&lt; .01</td>
</tr>
<tr>
<td></td>
<td>50</td>
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<td></td>
<td>30</td>
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</tr>
</tbody>
</table>

Figure 8.2. Mean Standard Scores by Group: ASD & Matched General Population Samples

Table 6.22 Differences Between LD and Matched General Population Samples: CEFI Full Scale

<table>
<thead>
<tr>
<th>Form</th>
<th>LD</th>
<th>Matched Gen. Pop.</th>
<th>z-score</th>
<th>F(df)</th>
<th>p</th>
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<tbody>
<tr>
<td>Parent</td>
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<td></td>
<td>30</td>
<td>30</td>
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</tr>
<tr>
<td>Teacher</td>
<td>60</td>
<td>67</td>
<td>0.81</td>
<td>37.29</td>
<td>&lt; .01</td>
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<td></td>
<td>30</td>
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</tr>
<tr>
<td>Self-Report</td>
<td>60</td>
<td>67</td>
<td>0.21</td>
<td>1.05</td>
<td>0.231</td>
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<td>30</td>
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</tr>
</tbody>
</table>
**CEFI Scales: SLD** *(Naglieri & Goldstein, 2013)*

Figure 1. Mean Standard Scores by Group: LD & Matched General Population Samples

**Group Differences: Mood Disorders** *(Naglieri & Goldstein, 2013)*

Table 3. 21 Differences Between Mood Disorder and Matched General Population Samples: CEFI Full Scale

**CEFI Scales: Mood Disorders** *(Naglieri & Goldstein, 2013)*

Figure 6. Mean Standard Scores by Group: Mood Disorder & Matched General Population Samples
How can we reliably and validly evaluate EF?

A recent review by Weyandt et al (2012) found 168 measures used to evaluate EF.
In general single EF tests share at most 10% of the variance with EF ratings and observations of everyday behavior.

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

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

- Measures real world behavior
- Able to sample multiple sources (self, parents, teachers)
- Efficient ways to evaluate EF
- However:
  - self-ratings may be limited by impaired self-awareness
  - Observers may not be good at observing!

---

**Executive Function Full Scale**

- **Attention**: Measures how well an adult can avoid distractions, concentrate on tasks, and sustain attention
- **Inhibitory Control**: Reflects an adult’s control over behavior or impulses
- **Planning**: Reflects how well an adult develops and implements strategies to accomplish tasks
- **Emotion Regulation**: Measures an adult’s control and management of emotions
- **Initiation**: Describes an adult’s ability to begin tasks or projects without being prompted
- **Self-Monitoring**: Describes an adult’s self-evaluation of his/her performance or behavior
- **Flexibility**: Describes how well an adult can adapt to circumstances, including problem solving
- **Organization**: Describes how well an adult manages personal effects, work, or multiple tasks
- **Working Memory**: Reflects how well an adult can keep information in mind that is important for knowing what to do and how to do it

---

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

<table>
<thead>
<tr>
<th>Category</th>
<th>CAS</th>
<th>WISC-IV</th>
<th>WJ III ACH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>56</td>
<td>56</td>
<td>56</td>
</tr>
<tr>
<td>Female</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td><strong>Birth Class Group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>77</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Black</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Parental Education Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Than High School Diploma or Less</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>High School Diploma or Less</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Some College or Associate Degree</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Bachelor's Degree or Higher</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Clerical</td>
<td>34</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
</tbody>
</table>

Note: CAS = Comprehensive Assessment System; WISC-IV = Wechsler Intelligence Scale for Children—Fourth Edition; WJ III ACH = Woodcock-Johnson III Achievement.
Table H.10. Correlations Between the CEFI (5–18 Years) Teacher Form and the CAS

<table>
<thead>
<tr>
<th>CEFI &amp; CAS</th>
<th>Full Scale</th>
<th>Achievement</th>
<th>Executive Regulation</th>
<th>Flexibility</th>
<th>Inhibitory Control</th>
<th>Initiation</th>
<th>Organization</th>
<th>Planning</th>
<th>Self-Monitoring</th>
<th>Working Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEFI</td>
<td>0.34**</td>
<td>0.41**</td>
<td>0.40**</td>
<td>0.41**</td>
<td>0.42**</td>
<td>0.40</td>
<td>0.40</td>
<td>0.42**</td>
<td>0.39**</td>
<td>0.36**</td>
</tr>
<tr>
<td>CAS</td>
<td>0.34**</td>
<td>0.41**</td>
<td>0.40**</td>
<td>0.41**</td>
<td>0.42**</td>
<td>0.40</td>
<td>0.40</td>
<td>0.42**</td>
<td>0.39**</td>
<td>0.36**</td>
</tr>
<tr>
<td>Cor. r</td>
<td>0.34**</td>
<td>0.41**</td>
<td>0.40**</td>
<td>0.41**</td>
<td>0.42**</td>
<td>0.40</td>
<td>0.40</td>
<td>0.42**</td>
<td>0.39**</td>
<td>0.36**</td>
</tr>
<tr>
<td>SD</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Note: Pair-wise deletion of missing cases was used (N = 90–62); Obs. r = Obtained r; Cor. r = Corrected r; **p < 0.01.

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

<table>
<thead>
<tr>
<th>CEFI &amp; WJ-III Total Achievement</th>
<th>Full Scale</th>
<th>Achievement</th>
<th>Executive Regulation</th>
<th>Flexibility</th>
<th>Inhibitory Control</th>
<th>Initiation</th>
<th>Organization</th>
<th>Planning</th>
<th>Self-Monitoring</th>
<th>Working Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEFI</td>
<td>0.53**</td>
<td>0.55**</td>
<td>0.52**</td>
<td>0.52**</td>
<td>0.52**</td>
<td>0.52</td>
<td>0.52</td>
<td>0.52</td>
<td>0.52**</td>
<td>0.52**</td>
</tr>
<tr>
<td>WJ-III</td>
<td>0.53**</td>
<td>0.55**</td>
<td>0.52**</td>
<td>0.52**</td>
<td>0.52**</td>
<td>0.52</td>
<td>0.52</td>
<td>0.52</td>
<td>0.52**</td>
<td>0.52**</td>
</tr>
</tbody>
</table>

Note: Pair-wise deletion of missing cases was used (N = 60–41); Obs. r =

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

<table>
<thead>
<tr>
<th>CEFI &amp; WJ-III Reading</th>
<th>Full Scale</th>
<th>Achievement</th>
<th>Executive Regulation</th>
<th>Flexibility</th>
<th>Inhibitory Control</th>
<th>Initiation</th>
<th>Organization</th>
<th>Planning</th>
<th>Self-Monitoring</th>
<th>Working Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEFI</td>
<td>0.34**</td>
<td>0.41**</td>
<td>0.40**</td>
<td>0.41**</td>
<td>0.42**</td>
<td>0.40</td>
<td>0.40</td>
<td>0.42**</td>
<td>0.39**</td>
<td>0.36**</td>
</tr>
<tr>
<td>WJ ACH Bread Reading</td>
<td>0.34**</td>
<td>0.41**</td>
<td>0.40**</td>
<td>0.41**</td>
<td>0.42**</td>
<td>0.40</td>
<td>0.40</td>
<td>0.42**</td>
<td>0.39**</td>
<td>0.36**</td>
</tr>
</tbody>
</table>

Note: Pair-wise deletion of missing cases was used (N = 64–55); Obs. r =
Conclusions

➢ The concept of EF is evolving.
➢ Data from the our Standardization Sample indicate that when measured using observable behaviors the term Executive Function is supported.
➢ Good research can provide a well normed measure of EF that has demonstrated reliability & validity.
➢ There is also emerging evidence that children can be taught to be more strategic – an important indication of efficient EF.