

# Assessing Executive Functioning with the Comprehensive Executive Functioning Inventory: 20 Years of Collaborative Work



**Jack A. Naglieri, Ph.D.**  
[jnaglieri@gmail.com](mailto:jnaglieri@gmail.com)  
[jacknaglieri.com](http://jacknaglieri.com)  
[Naglierigiftedtests.com](http://Naglierigiftedtests.com)

**Sam Goldstein, Ph.D.**  
[sam@samgoldstein.com](mailto:sam@samgoldstein.com)

Instructional Content by  
 Kathleen Kryza  
[www.kathleenkryza.com](http://www.kathleenkryza.com)

JACKNAGLIERI.COM

Jack A. Naglieri, Ph.D.

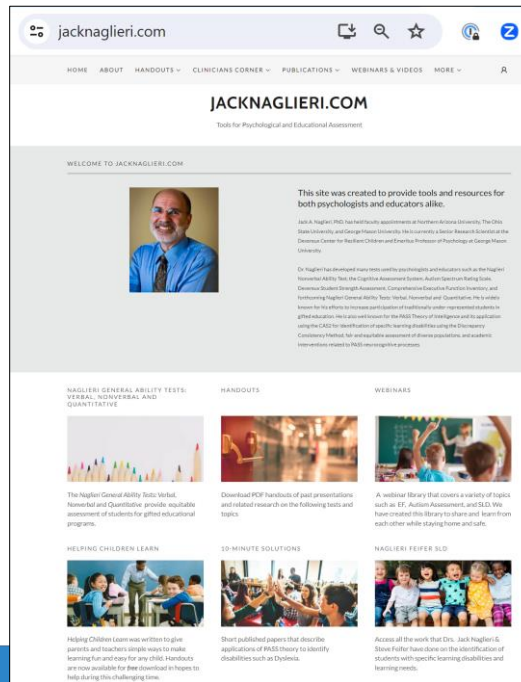
1

1

# Welcome !

2

FOR MORE  
INFORMATION,  
PLEASE GO TO  
MY WEB PAGE



## DISCLOSURES



Jack A. Naglieri, Ph.D.

3

3

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

Jack A. Naglieri, Ph.D.

4

4

## 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 Jack A. Naglieri, Ph.D. 5

5

## 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

Jack A. Naglieri, Ph.D. 6

6

## 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



A. Naglieri, Ph.D.

7

7

## 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.

Jack A. Naglieri, Ph.D.

8

8

## 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).

## 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).

Jack A. Naglieri, Ph.D. 11

11

11

## 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 control**" (p. 105).

Jack A. Naglieri, Ph.D. 12

12

12

## 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).

Jack A. Naglieri, Ph.D. 13

13

13

## 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).**

Jack A. Naglieri, Ph.D. 14

14

14

# 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).

Jack A. Naglieri, Ph.D. 15

15

15

## Executive Functions

The screenshot shows the Wikipedia page for "Executive functions". The page is titled "Executive functions" and is a redirect from "Executive function". The main text describes the executive system as a theorized cognitive system in psychology that controls and manages other cognitive processes. It is also referred to as the executive function, executive functions, supervisory attentional system, or cognitive control. The concept is used by psychologists and neuroscientists to describe a loosely defined collection of brain processes which are responsible for planning, cognitive flexibility, abstract thinking, rule acquisition, initiating appropriate actions and inhibiting inappropriate actions, and selecting relevant sensory information. The page includes a navigation sidebar on the left with links to Main page, Contents, Featured content, Current events, What links here, Related changes, Upload file, Special pages, Printable version, Permanent link, and Cite this page. There are also external links and a list of external links at the bottom. A red box highlights the main text paragraph, and a yellow box highlights the sentence "The concept is used by psychologists and neuroscientists to describe a loosely defined collection of brain processes which are responsible for planning, cognitive flexibility, abstract thinking, rule acquisition, initiating appropriate actions and inhibiting inappropriate actions, and selecting relevant sensory information.".

**Executive functions**

From Wikipedia, the free encyclopedia  
(Redirected from *Executive function*)

The **executive system** is a theorized **cognitive** system in **psychology** that controls and manages other cognitive processes. It is also referred to as the **executive function**, **executive functions**, **supervisory attentional system**, or **cognitive control**.

The concept is used by **psychologists** and **neuroscientists** to describe a loosely defined collection of **brain** processes which are responsible for planning, cognitive flexibility, abstract thinking, rule acquisition, initiating appropriate actions and inhibiting inappropriate actions, and selecting relevant sensory information.

*[citations needed]*

**Hypothesized role**

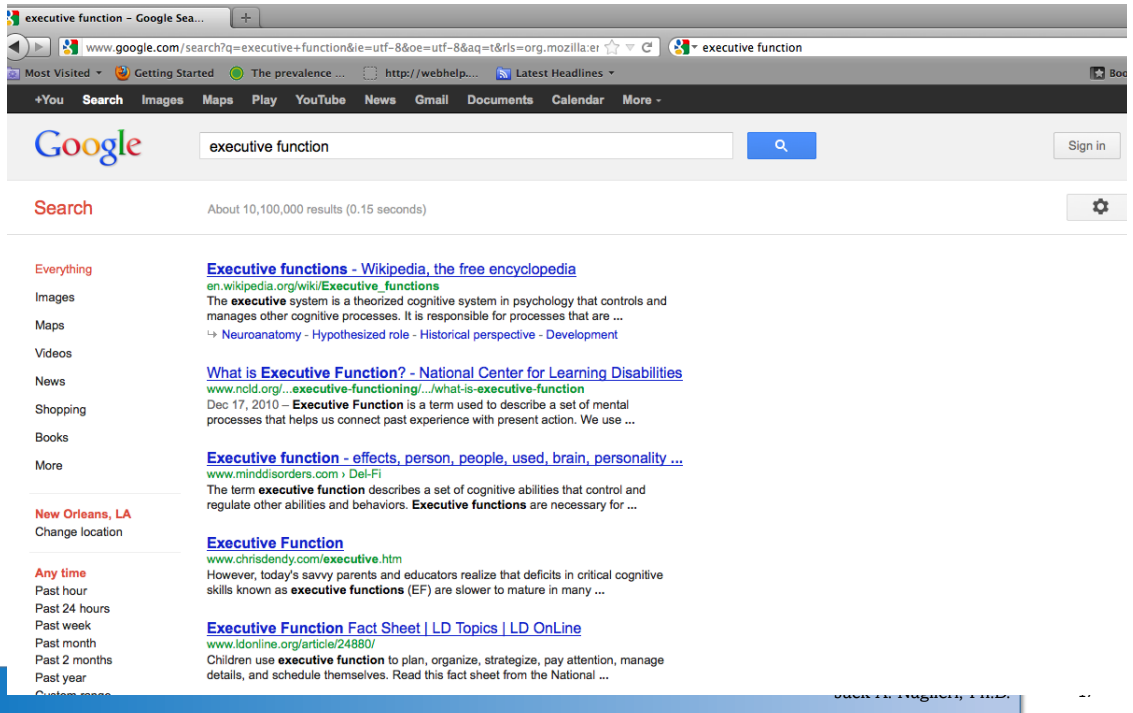
The executive system is thought to be heavily involved in handling novel situations outside the domain of some of our 'automatic' psychological processes that could be explained by the reproduction of learned schemas or set behaviors. Psychologists **Don Norman** and **Tim Shallice** have outlined five types of situation where routine activation of behavior would not be sufficient for optimal performance.<sup>[1]</sup>

Ph.D. 16

16

16





17

And Finally. . . .

An NICHD panel in 1994 identified 33 EFs by consensus!

18

## The Top Six Were:

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

Jack A. Naglieri, Ph.D. 19

19

19

## Executive Function(s)

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

Jack A. Naglieri, Ph.D. 20

20

20

## 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?

Jack A. Naglieri, Ph.D. 21

21

21

## 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).

Jack A. Naglieri, Ph.D. 22

22

22

## 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.

Jack A. Naglieri, Ph.D. 23

23

23

## 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**.

Jack A. Naglieri, Ph.D. 24

24

24

## EXPLORATORY FACTOR ANALYSES

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

**Table 8.2. Eigenvalues from the Inter-Item Correlations**

| Form        | Factor |     |     |     |     |     |     |     |     |
|-------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|
|             | 1      | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   |
| Parent      | 43.7   | 4.1 | 2.3 | 1.5 | 1.3 | 1.3 | 1.0 | 0.9 | 0.8 |
| Teacher     | 56.8   | 3.8 | 2.3 | 1.3 | 1.1 | 1.1 | 0.8 | 0.7 | 0.6 |
| Self-Report | 29.9   | 6.3 | 2.7 | 2.1 | 1.9 | 1.8 | 1.5 | 1.3 | 1.3 |

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

25

## 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**.

26

## EXPLORATORY FACTOR ANALYSES

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

**Table 8.4. Eigenvalues of the CEFI Scales Correlations**

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

Note. Extraction method: Png.

Jack A. Naglieri, Ph.D. 27

27

27

## 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/<br>Ethnic<br>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/<br>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 |

Ph.D. 28

28

28

## EXPLORATORY FACTOR ANALYSES

- Conclusions

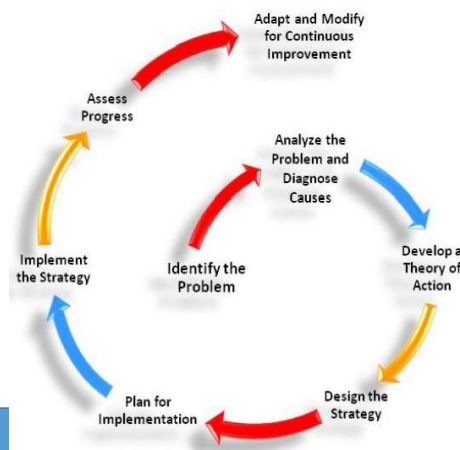
- When using parent (N = 1,400), teacher (N = 1,400), or self-ratings (N = 700) based on behaviors observed and reported for a nationally representative sample (N = 3,500) aged 5 to 18 years Executive Function *not* functions is the best term to use.

Jack A. Naglieri, Ph.D. 29

29

## Naglieri & Goldstein, 2012

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



A. Naglieri, Ph.D. 30

30



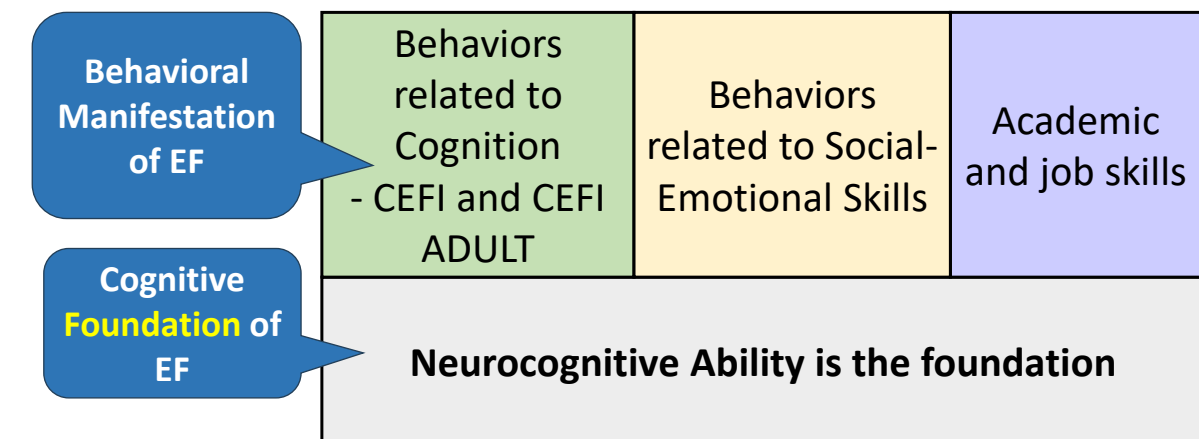
## Assessment of Executive Function using a multidimensional approach

Behaviors, Emotions, Academic Performance, Intelligence

31

31

## A Multidimensional Approach to EF Assessment



Jack A. Naglieri, Ph.D.

32

32



## Scores on the CEFI and the CEFI Adult

- **Strength based** EF measures
- Items are **positively** worded
- Higher scores = **good** behaviors related to EF
- Scores set at mean of **100**, SD of **15**
- CEFI: Ages 5-18 years rated by a parent, teacher, or the child/youth
- CEFI Adult: Ages 18+ years rated by the adult or an observer



Jack A. Naglieri, Ph.D.

33

33

## Multiple Indicators of EF Issue

CEFI (5-18 Years) Parent Interpretive Report for Brittany

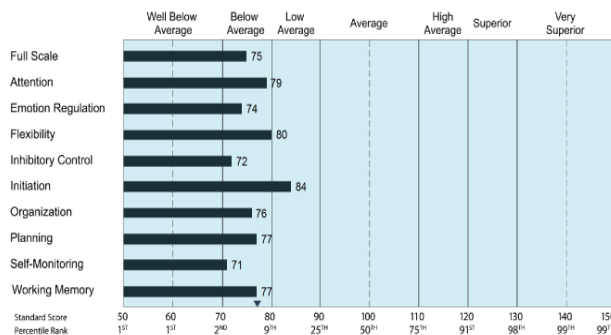
Admin Date: 05/19/2011

### Overview of Results for Brittany

#### Scores in Relation to the Norm

Brittany's ratings are provided in the graph below.

▼ Youth's Average



- CAS2 scores
  - Planning = 76
  - Attention = 81
  - Simultaneous = 103
  - Successive = 98
- Academic Skills
  - FAR Reading Comprehension = 80
  - FAM Math Calculation = 79

Jack A. Naglieri, Ph.D.

34 34

34

# CEFI

TOTAL SCORE →

- Scale Analysis helps understand the person across many different content areas

## Scores in Relation to the Norm and the Individual

Brittany Ambers's results are detailed in the tables that follow. These scores show how Brittany Ambers compares to the normative sample. They also provide an analysis of the variability of scores on the separate CEFI Scales. Differences between Brittany Ambers's average score and her standard scores on each scale are presented, as is a summary column that indicates whether or not these differences were statistically significant. If a standard score on any of the CEFI Scales is greater than 109 and significantly higher than the youth's average score on the CEFI Scales, or less than 90 and significantly lower than the youth's average score, then that score represents an Executive Function Strength or an Executive Function Weakness, respectively.

| Full Scale         |                |                         |                 |                    |  |                                      |                                      |
|--------------------|----------------|-------------------------|-----------------|--------------------|--|--------------------------------------|--------------------------------------|
| Standard Score     |                | 90% Confidence Interval |                 | Percentile Rank    |  | Classification                       |                                      |
| 66                 |                | 64-69                   |                 | 1                  |  | Well Below Average                   |                                      |
| CEFI Scales        |                |                         |                 |                    |  |                                      |                                      |
| Scale              | Standard Score | 90% Confidence Interval | Percentile Rank | Classification     | Difference from Youth's Average (68.0) | Statistically Significant? (p < .05) | Executive Function Strength/Weakness |
| Attention          | 74             | 70-80                   | 4               | Below Average      | 6.0                                    | No                                   | -                                    |
| Emotion Regulation | 58             | 55-67                   | 1               | Well Below Average | -10.0                                  | Yes                                  | Weakness                             |
| Flexibility        | 72             | 67-82                   | 3               | Below Average      | 4.0                                    | No                                   | -                                    |
| Inhibitory Control | 69             | 65-77                   | 2               | Well Below Average | 1.0                                    | No                                   | -                                    |
| Initiation         | 67             | 63-76                   | 1               | Well Below Average | -1.0                                   | No                                   | -                                    |
| Organization       | 65             | 61-73                   | 1               | Well Below Average | -3.0                                   | No                                   | -                                    |
| Planning           | 66             | 62-73                   | 1               | Well Below Average | -2.0                                   | No                                   | -                                    |
| Self-Monitoring    | 64             | 60-74                   | 1               | Well Below Average | -4.0                                   | No                                   | -                                    |
| Working Memory     | 77             | 72-84                   | 6               | Below Average      | 9.0                                    | Yes                                  | -                                    |

Copyright © 2013 Multi-Health Systems Inc. All rights reserved.



Jack A. Naglieri, Ph.D.

35 35

35

## Ratings

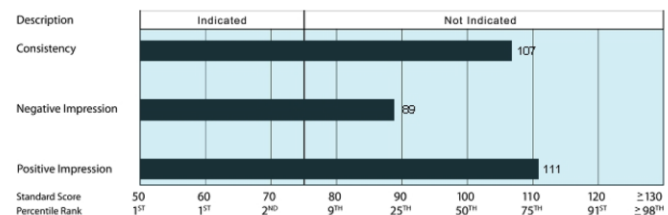
- This information helps you have confidence in the ratings

CEFI (5-18 Years) Teacher Interpretive Report for Brittany Ambers

Admin Date: 05/19/2012

### About the Ratings

This section of the report provides an evaluation of the ratings provided by this rater. Item scores were examined for consistency, negative impression, positive impression, and number of omitted items. This information can be used to determine whether responses should be reviewed with the rater to explore possible reasons response bias is indicated, and the amount of confidence one can have in the scores.



| Scores                           |  |
|----------------------------------|--|
| <b>Consistency Index</b>         | Standard Score = 107<br>Inconsistent response style is not indicated.        |
| <b>Negative Impression Scale</b> | Standard Score = 89<br>Negative impression response style is not indicated.  |
| <b>Positive Impression Scale</b> | Standard Score = 111<br>Positive impression response style is not indicated. |
| <b>Number of Omitted Items</b>   | Number of Items Omitted = 0<br>None of the items were omitted.               |

Jack A. Naglieri, Ph.D.

36 36

36

# Narrative Report and Intervention Strategies

|   |                   |
|---|-------------------|
| CEFI (5–18 Years) Teacher Interpretive Report for Brittany Ambers   | Admin Date: 05/19 |
| <b>CEFI Results</b>   |                   |
| <p>Brittany Ambers's Full Scale standard score of 66 falls in the <i>Well Below Average</i> range and is ranked at the 1st percentile. This means that her score is equal to, or greater than, 1% of those obtained by youth her age in the standardization group. There is a 90% probability that Brittany Ambers's true Full Scale standard score is within the range of 64 to 69. The CEFI Full Scale score is made up of items that belong on separate scales called Attention, Emotion Regulation, Flexibility, Inhibitory Control, Initiation, Organization, Planning, Self-Monitoring, and Working Memory. Because there was significant variation among these scales, the Full Scale score will sometimes be higher, and other times lower, than scores on the separate CEFI Scales. The Emotion Regulation scale was found to be a significant weakness, which means that Brittany Ambers's behavior in this area was a weakness both in relation to her average score and in relation to the norm.</p> <p>Brittany Ambers's Working Memory scale score describes how well she can keep information in mind that is important in knowing what to do and how to do it, including remembering important things, instructions, and steps. Her standard score of 77 falls in the <i>Below Average</i> range and is ranked at the 6th percentile. There is a 90% probability that her true Working Memory standard score is within the range of 72 to 84. Item score variability suggests that ratings for Brittany Ambers were low on taking note of instructions, knowing how to do something from memory and holding in mind instructions with many steps. (See the <i>CEFI Items by Scale</i> section of this report for additional low item scores.)</p> <p>Brittany Ambers's Attention scale score reflects how well she can avoid distractions, concentrate on tasks, and sustain attention. Her standard score of 74 falls in the <i>Below Average</i> range and is ranked at the 4th percentile. There is a 90% probability that her true Attention standard score is within the range of 70 to 80. Ratings for Brittany Ambers were low on finishing a boring task, remaining focused around noise and working well for a long time. (See the <i>CEFI Items by Scale</i> section of this report for additional low item scores.)</p> <p>Brittany Ambers's Flexibility scale score describes how she adjusts her behavior to meet circumstances, including coming up with different ways to solve problems, having many ideas about how to do things, and being able to solve problems using different approaches. Her standard score of 72 falls in the <i>Below Average</i> range and is ranked at the 3rd percentile. There is a 90% probability that her true Flexibility standard score is within the range of 67 to 82. Variability in item scores indicates that ratings for Brittany Ambers were low on coming up with a new way to reach a goal, finding different ways to solve problems and generating ideas for how to do things. (See the <i>CEFI Items by Scale</i> section of this report for additional low item scores.)</p> <p>Brittany Ambers's Inhibitory Control scale score reflects her ability to control behavior or impulses, including thinking about consequences before acting, maintaining self-control, and keeping commitments. Her standard score of 68 falls in the <i>Well Below Average</i> range and is ranked at the 2nd percentile. There is a 90% probability that her true Inhibitory Control standard score is within the range of 65 to 77. Item score variability suggests that ratings for Brittany Ambers were low on thinking before acting, controlling her actions and considering the consequences before acting. (See the <i>CEFI Items by Scale</i> section of this report for additional low item scores.)</p> <p>Brittany Ambers's Initiation scale score describes how she begins tasks or projects on her own, including</p> |                   |

|  |             |
|--|-------------|
| CEFI (5–18 Years) Teacher Interpretive Report for Brittany Ambers  | Admin Date: |
| <b>Intervention Strategies</b>   |             |
| <p>This section provides intervention strategies for improving upon the weaknesses identified by Low Average and Well Below Average scores on the CEFI Scales. References for the sources of these strategies are provided at the end of the Intervention Strategies section. (See <i>CEFI Items by Scale</i> for a full list of items with below average scores for item-level indicators of specific weaknesses.)</p>  |             |
| <b>Framework for Implementing Intervention Strategies</b>  |             |
| <p>The material on this page provides a general framework to follow when implementing the various specific intervention strategies for the behaviors measured in the CEFI that may appear on subsequent pages of this report.</p>  |             |
| <b>General Developmental Issues</b>  |             |
| <ul style="list-style-type: none"> <li>A child's developmental level should be taken into account when planning intervention strategies.</li> <li>Utilize intervention strategies that initially include external controls, prompts and cues to help the child and develop new skills.</li> <li>Gradually remove external controls to promote internalization of new behaviors and explicitly encourage children to develop and use their own strategies.</li> <li>Encourage the child by explicitly communicating that change is possible with effort and motivation to</li> <li>Carefully consider strategies to enhance generalization of new skills, across tasks, time, and setting.</li> </ul> |             |
| <b>External Support</b>  |             |
| <ul style="list-style-type: none"> <li>Structure the environment (e.g., cues, prompts), including the child's schedule (e.g., create a consistent routine with breaks and extra time for tasks) until internal control of behavior is mastered.</li> <li>Provide lists and charts that give specific suggestions for how to accomplish tasks and activities.</li> <li>Encourage children to develop their own solutions to getting things done.</li> </ul>   |             |
| <b>Motivation</b>  |             |
| <ul style="list-style-type: none"> <li>Make use of natural motivations to encourage desired behavior.</li> <li>Promote positive behavior through reward and encouragement.</li> </ul>  |             |
| <b>Internalization</b>   |             |
| <ul style="list-style-type: none"> <li>Provide feedback on the child's performance and encourage self-monitoring.</li> <li>Teach awareness strategies (e.g., training in self-management and self-monitoring skills; the technique "self-talk").</li> </ul>  |             |
| <b>Skill Building</b>  |             |

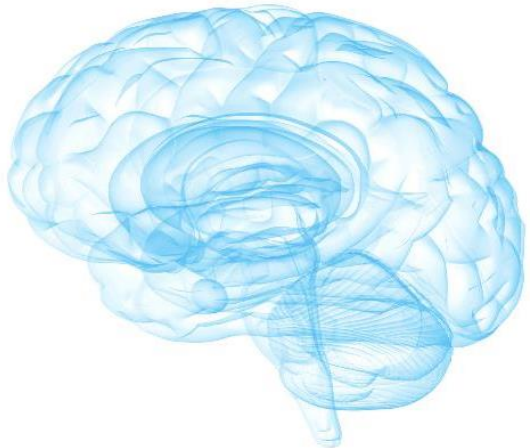
Jack A. Naglieri, Ph.D.

37 37

37

## EF is a Brain-Based Ability (AKA intelligence)

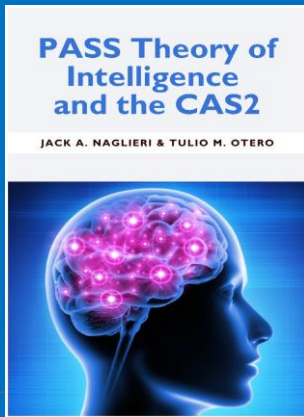
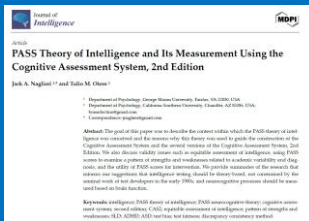
- EF is an ability (type of intelligence) by virtue of its relationship to the brain
- If we define intelligence from a neurocognitive perspective
- EF can be measured using the CAS2



Jack A. Naglieri, Ph.D.

38

38



Can we **measure EF** using tests of General Ability (g) ability (e.g., WISC, WJ, Binet)?

**We Can't...and Why Not?**

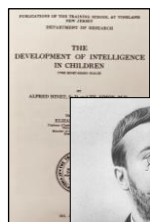
Introduction to the PASS Theory of Intelligence

Jack A. Naglieri, Ph.D.

39

39

## Stanford-Binet → Army Mental Tests → Today

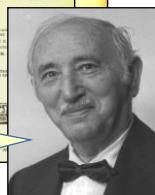


When working on the 1911 scale, Binet removed items from 1908 scale because 'they depended too much on school learning'



Terman added items dependent upon school learning into the 1916 Stanford-Binet because he believed 'intelligence at the verbal and abstract levels is the highest form of mental ability'.

Wechsler based his intelligence test on the U.S. Army Mental Tests (Verbal, Quantitative & Nonverbal)



Arthur Otis (Terman's student) was instrumental in the development of the U.S. Army Alpha (Verbal & Quantitative) and Beta (Nonverbal), the Otis-Lennon Ability Test and known for the multiple-choice format



Jack A. Naglieri, Ph.D.

40

40

# Research Supports 'g' but little More

Watkins, M. W., & Canivez, G. L. (2021). Assessing the psychometric utility of IQ scores: A tutorial using the Wechsler intelligence scale for children—fifth edition. *School Psychology Review*, 1-15.

Benson, N. F., Beaujean, A. A., McGill, R. J., & Dombrowski, S. C. (2018). Revisiting **Carroll's Survey of Factor-Analytic Studies**: Implications for the Clinical Assessment of Intelligence. *Psychological Assessment*, 30, 8, 1028–1038.

Canivez, G. L., Watkins, M. W., & Dombrowski, S. C. (2017). Structural validity of the **Wechsler Intelligence Scale for Children—Fifth Edition**: Confirmatory factor analyses with the 16 primary and secondary subtests. *Psychological Assessment*, 29, 458–472.

Canivez, G. L., & McGill, R. J. (2016). Factor structure of the **Differential Ability Scales—Second Edition**: Exploratory and hierarchical factor analyses with the core subtests. *Psychological Assessment*, 28, 1475–1488. <http://dx.doi.org/10.1037/pas0000279>

Canivez, G. L., & McGill, R. J. (2016). Factor structure of the **Differential Ability Scales—Second Edition**: Exploratory and hierarchical factor analyses with the core subtests. *Psychological Assessment*, 28, 1475–1488. <https://doi.org/10.1037/pas0000279>

Canivez, G. L. (2008). Orthogonal higher order factor structure of the **Stanford-Binet Intelligence Scales—Fifth Edition** for children and adolescents. *School Psychology Quarterly*, 23, 533–541.

Dombrowski, S. C., Canivez, G. L., & Watkins, M. W. (2017, May). Factor structure of the 10 **WISC–V** primary subtests across four standardization age groups. *Contemporary School Psychology*. Advance online publication.

Dombrowski, S. C., McGill, R. J., & Canivez, G. L. (2017). Exploratory and hierarchical factor analysis of the **WJ IV Cognitive** at school age. *Psychological Assessment*, 29, 394–407.

McGill, R. J., & Canivez, G. L. (2017, October). Confirmatory factor analyses of the **WISC–IV Spanish** core and supplemental Subtests: Validation evidence of the Wechsler and CHC models. *International Journal of School and Educational Psychology*. Advance online publication.

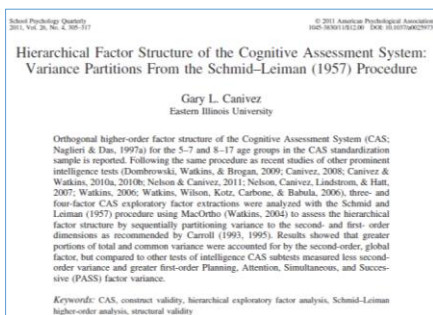
Watkins, M. W., Dombrowski, S. C., & Canivez, G. L. (2017, October). Reliability and factorial validity of the **Canadian Wechsler Intelligence Scale for Children—Fifth Edition**. *International Journal of School and Educational Psychology*.

Jack A. Naglieri, Ph.D.

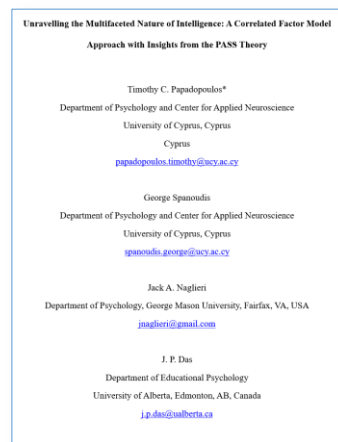
41

41

## Support for THE FOUR PASS Scales



- "...compared to the WISC–IV, WAIS–IV, SB–5, RIAS, WASI, and WRIT, the CAS subtests had less variance apportioned to the higher-order general factor (g) and greater proportions of variance apportioned to first-order (PASS...) factors.
- This is consistent with the PASS dimensions linked to PASS theory ... and neuropsychological theory (Luria)." (p. 311)



- Our results unambiguously support the notion that intelligence is not a unidimensional entity but a composite of distinct cognitive processes...which posits separate cognitive domains for Planning, Attention, Simultaneous and Successive processing... [these] emerged as the most fitting representation of intelligence [and] the best fit to the data.
- Submitted for publication 2024

Jack A. Naglieri, Ph.D.

42

42



# Intelligence as Neurocognitive Functions

- In my first working meeting with JP Das (February 11, 1984) we proposed that intelligence was better REinvented as neurocognitive processes and we began development of the **Cognitive Assessment System (CAS)**
- We conceptualized intelligence as Planning, Attention, Simultaneous, and Successive (PASS) neurocognitive processes based on Luria's concepts of brain function.

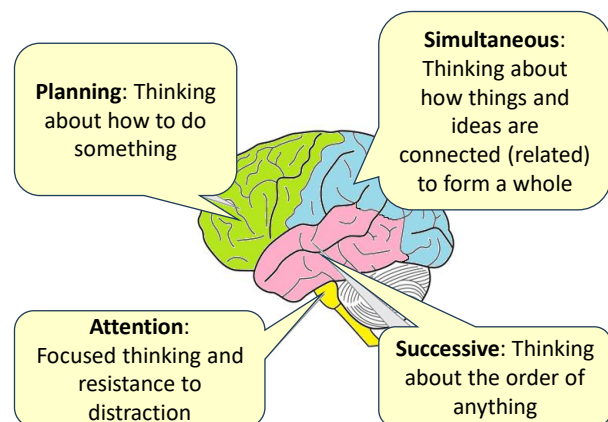


43

43

## A Way to Understand Learning, Obstacles to Learning and Specific Learning Disabilities

- PASS Theory of brain function describes the abilities that underlie all learning
- This includes everything – from learning to walk, talk, think, interact with others, cope with the demands of life...etc.



From: *Essentials of CAS2 Assessment*. Naglieri & Otero, 2017 Figure 1.2 Functional Units from A. R. Luria

Jack A. Naglieri, Ph.D.

44

44

# PASS Theory: Four Ways of Thinking

**Planning**

**Attention**

**Simultaneous**

**Successive**

Jack A. Naglieri, Ph.D.

45

45

## PASS Comprehensive System

(Naglieri, Das, &amp; Goldstein, 2014)

**Ways to Measure PASS**

CAS2 Core & Extended English & Spanish for comprehensive Assessment

CAS2 Brief for re-evaluations, instructional planning, gifted screening

CAS2 Rating Scale for teacher ratings

**CAS2 Rating Scale**  
(4 subtests)

Total Score  
Planning  
Simultaneous  
Attention  
Successive

**CAS2 Brief**  
(4 subtests  
20 minutes)

Total Score  
Planning  
Simultaneous  
Attention  
Successive

**CAS2 Core**  
(8 subtests  
40 minutes)

Full Scale  
Planning  
Simultaneous  
Attention  
Successive

**CAS2 Extended**  
(12 subtests  
60 minutes)

Full Scale  
Planning  
Simultaneous  
Attention  
Successive  
Supplemental Scales  
Executive Function  
Working Memory  
Verbal / Nonverbal  
Visual / Auditory  
Speed / Fluency

Planning & Executive Function Scores

CAS2 Digital (English & Spanish) coming in 2022

Jack A. Naglieri, Ph.D.

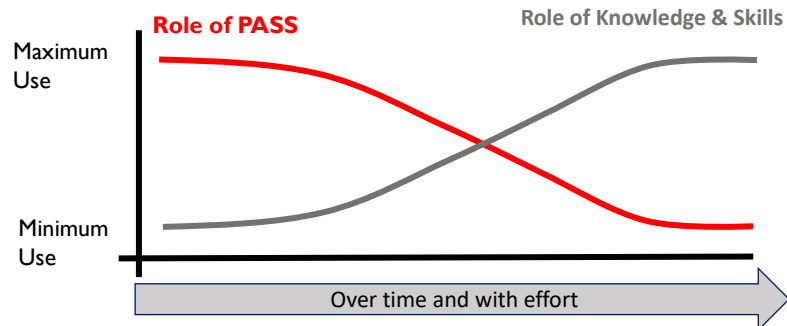
46

46

23

## Planning Learning Curves

- Learning depends upon many factors especially PASS
- When a task is practiced and learned it requires less thinking (PASS) and becomes a skill
- At first, PASS plays a major role in learning



Note: A **skill** is the ability to do something well with minimal effort (thinking)

Jack A. Naglieri, Ph.D.

47

47

## Planning (EF) and Skills

- Given that Planning (EF) demands intentionality, that means that planning processing is something that occurs over time and with effort.
- Skills are things we do with very little thinking. Automatic actions do not afford the time for thinking (planning) but rather immediate responding.
- Therefore, Planning and EF should not be described as 'skills' and direction instruction will limit the use of EF

Jack A. Naglieri, Ph.D.

48

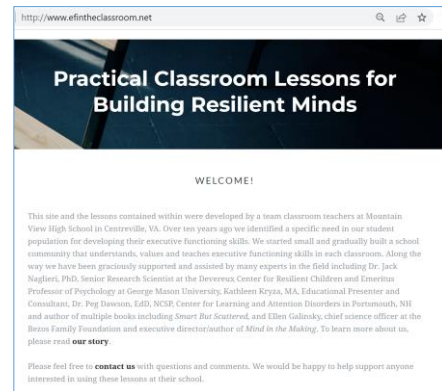
48



www.efinthe classroom.net

## FREE Interventions for EF Behaviors

| CEFI Scales        | Efinthe classroom.net |
|--------------------|-----------------------|
| Attention          | Sustained Attention   |
| Emotion Regulation | Emotional Control     |
| Flexibility        | Cognitive Flexibility |
| Inhibitory Control | Response Inhibition   |
| Initiation         | Task Initiation       |
| Organization       | Organization          |
| Planning           | Planning              |
| Self-Monitoring    | Response Inhibition   |
| Working Memory     | Working Memory        |



Jack A. Naglieri, Ph.D.

49

49

### Planning Facilitation for Math Calculation

Math calculation is a complex activity that involves recalling basic math facts, formulas, working carefully, and checking one's work. Math calculation requires a careful approach to follow all of the necessary steps. Children who are good at math can move on to more difficult math concepts and problem solving with greater ease. Children who are having problems in this area. For children who have trouble with math calculation, a technique that helps them approach the task planfully is likely to be useful. Planning facilitation is a technique.

Planning facilitation helps students develop useful strategies to carefully complete math problems through discussion and shared discovery. It encourages students to think about problems, rather than just think about whether their answers are correct. This helps students develop careful ways of doing math.

#### How to Teach Planning Facilitation

Planning facilitation is provided in three 10-minute time periods: 1) 10 minutes of discussion, and 3) 10 more minutes of math. These steps can be described as follows:

**Step 1:** The teacher should provide math worksheets for the students to complete during the 10-minute session. This gives the children exposure to the problems and ways to solve them. The teacher gives each child a worksheet and says, "Here is a math worksheet for you to try to get as many of the problems correct as you can. You will have 10 minutes to work on this instruction are okay, but do not give any additional information."

### A Cognitive Strategy Instruction to Improve Math Calculation for Children With ADHD and LD: A Randomized Controlled Study

Jackie S. Iseman<sup>1</sup> and Jack A. Naglieri<sup>1</sup>

#### Abstract

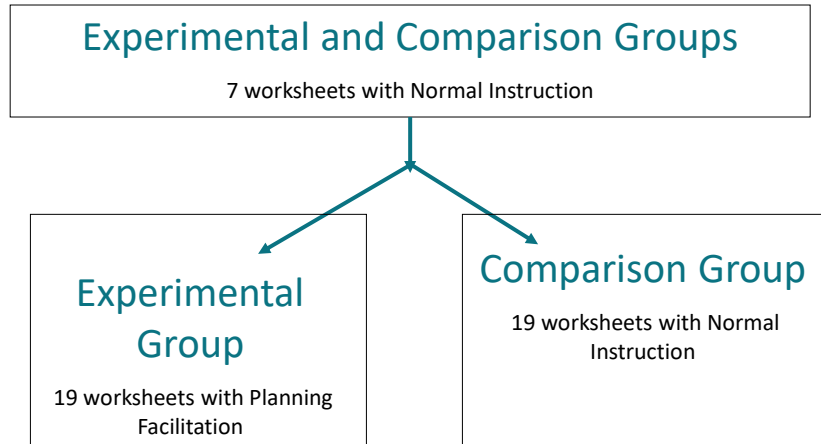
The authors examined the effectiveness of cognitive strategy instruction based on PASS (Planning, Attention, Simultaneous, Successive) given by special education teachers to students with ADHD randomly assigned by classroom. Students in the experimental group were exposed to a brief cognitive strategy instruction for 10 minutes during math instruction. Standardized tests of cognitive processes and math skills were administered pre- and postintervention, and Math follow-up. Large pre-post effect sizes were found for students in the experimental group on math worksheets (0.85 and 0.26), Math Fluency (1.17 and 0.09), and Numerical Computation (0.85 and 0.26). At 1 year follow-up, the experimental group continued to outperform the comparison group on math worksheets (0.85 and 0.26), Math Fluency (1.17 and 0.09), and Numerical Computation (0.85 and 0.26). Students with ADHD evidenced greater improvement in math worksheets, far more than students in the comparison group (which measured the skill of generalizing learned strategies to other similar tasks) when provided the PASS-based cognitive strategy instruction.



50

# Design of the Study

Iseman & Naglieri (2005)



Jack A. Naglieri, Ph.D.

51

51

## Strategy Instruction

Iseman & Naglieri (2005)

- Teachers facilitated discussions to help students become more self-reflective about use of strategies
- Teachers asked questions like:
  - What was your goal?
  - Where did you start the worksheet?
  - What strategies did you use?
  - How did the strategy help you reach your goal?
  - What will you do again next time?
  - What other strategies will you use next time?



Jack A. Naglieri, Ph.D.

52

52

# Iseman & Naglieri (2005)

*Iseman and Naglieri*

**Table 3. Students' Comments During Planning Facilitation Sessions**

**Goals**

- "My goal was to do all of the easy problems on every page first, then do the others."
- "To get as many correct as I can."
- "To get as many right as quickly as possible."
- "To take time and make sure I get them correct."

**Starting place**

- "I started on the first one."
- "I skipped around."
- "I do the easy ones first."
- "I look at the type of problem and the number of steps and decide which problems to do first."

**Overall plan**

- "I did all the easy problems on a page and went onto the next one."
- "I do all the addition first, then the easy minus, and then I move onto the harder ones."
- "I do the problems I know, then I check my work."

**Specific strategies**

- "I simplify fractions first."
- "Skip the longer multiplication questions."
- "The problems that have lots of steps take more time, so I skip them."
- "I do them [the algebra] by figuring out what I can put in for X to make the problem work."
- "I draw lines so I don't get my columns confused [on the multiplication]."
- "I stopped drawing lines because it slowed me down."
- "If a problem is taking a long time I skip it and come back to it if I have time."
- "I did the ones that take the least time."
- "Remember that anything times 0 is 0."

**Noticing patterns in the worksheets**

- "I did all the problems in the brain-dead zone first."
- "I started in the middle of the page, the problems on top take longer."
- "Next time I'll skip the hard multiplication at the top of the first page."

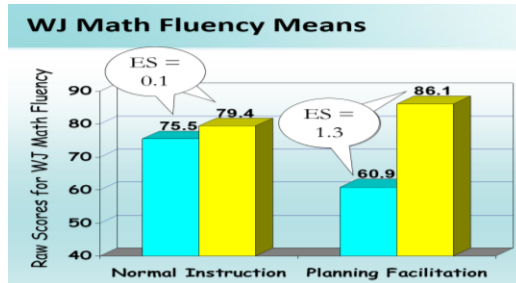
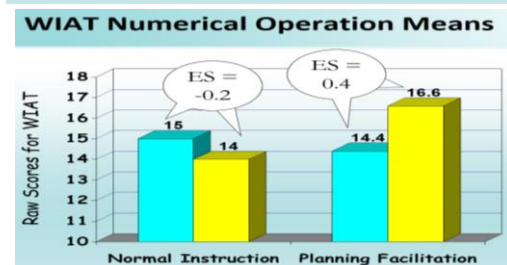
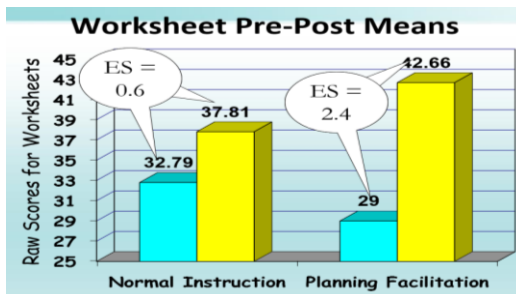
- "My goal was to do all of the easy problems on every page first, then do the others."
- "I do the problems I know, then I check my work."
- "I did all the problems in the brain-dead zone first."



53

53

## Iseman & Naglieri (2005)



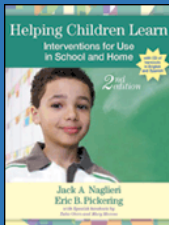
At 1-year follow-up, 27 of the students were retested on the WJ-III ACH Math Fluency subtest as part of the school's typical yearly evaluation of students. This group included 14 students from the comparison group and 13 students from the experimental group. The results indicated that the improvement of students in the experimental group ( $M = 16.08$ ,  $SD = 19$ ,  $d = 0.85$ ) was significantly greater than the improvement of students in the comparison group ( $M = 3.21$ ,  $SD = 18.21$ ,  $d = 0.09$ ).

Jack A. Naglieri, Ph.D.

54

54

# Using good EF to overcome a neurocognitive processing disorder (Dyslexia)



55

32

Helping Children Learn

## Ben's Problem with Successive Processing



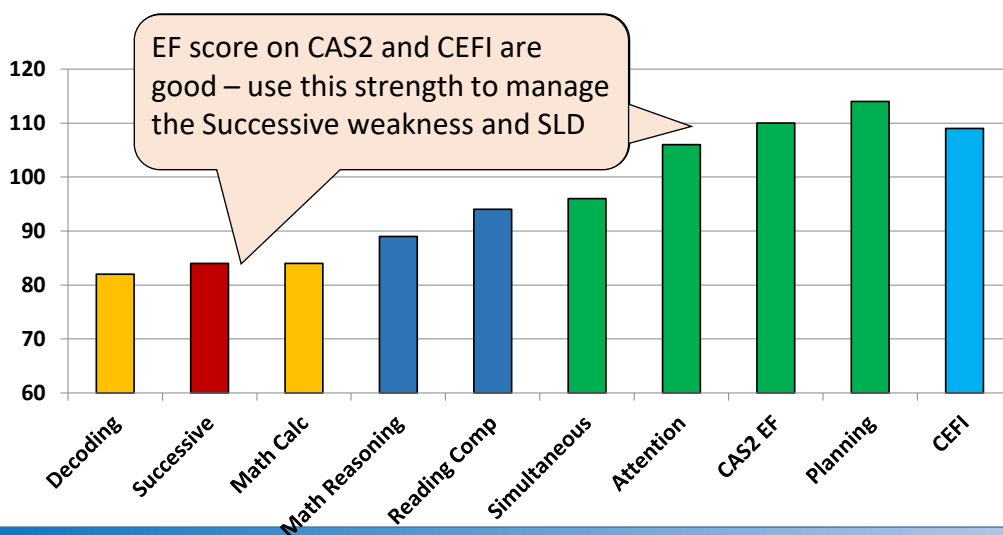
Ben was an energetic but frustrated third-grade student who liked his teachers, was popular with his peers, and fit in well socially at school. However, Ben said he did not like school at all, particularly schoolwork. Ben was good at turning in all of his work on time, and he worked hard, but he earned poor grades. He appeared to be getting more and more frustrated at school.

In general, Ben struggled to perform well because he had a lot of trouble following directions that were not written down, his writing often did not make sense, and he did not appear to comprehend what he read. Ben's teachers noticed that when directions for assignments and projects were given orally in class, he often only finished part of the task. Ben's teacher described an assignment in which students had to collect insects, label them, organize them into a collection, and then give a brief presentation about each insect. Unlike any other student, Ben chose to make the labels for the insects first and then go look for the insects. He found only a few of the insects he had made labels for, and when he put them in the collection, they were not in the order that had been specified. He also had trouble with the spelling of the scientific names of the insects and made many errors in the sequence of letters in the words.

Jack A. Naglieri, Ph.D.

55

## Ben's Strength in EF & Problem with Successive processing



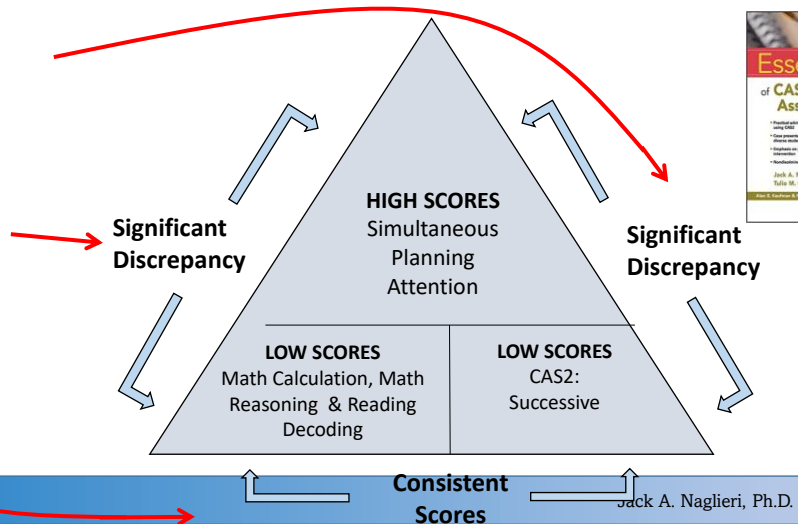
Jack A. Naglieri, Ph.D.

56

56

## Ben's SLD: Discrepancy Consistency Method

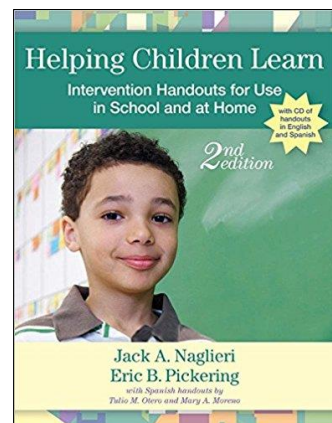
- **Discrepancy** between high and low processing scores
- **Discrepancy** between high processing and low achievement
- **Consistency** between low processing and low achievement



57

## Teach Children about their Abilities

- Helping Children Learn Intervention Handouts for Use in School and at Home, *Second Edition* (Naglieri, & Pickering, 2011)
- Spanish handouts by Tulio Otero & Mary Moreno



Jack A. Naglieri, Ph.D.

58

58

# Ben's Problem with Successive Ability

Teach him to use his strength in EF (Planning)


**How Can You Be Smarter?**

You can be smarter if you **PLAN** before doing things. Sometimes people say, "Look before you leap," "Plan your work and work your plan," or "Stop and think." These sayings are about using the ability to plan. When you stop and think about *how* to study, you are using your ability to plan.

You will be able to do more if you remember to use a plan. An easy way to remember to use a plan is to look at the picture "Think smart and use a plan" (Figure 1). You should always use a plan for reading, vocabulary, spelling, writing, math problem solving, and science.

Do you have a favorite plan for learning spelling words? Do you use flashcards or go on the Internet to learn? Do you ask the teacher or another student for help? You can learn more by using a plan for studying that works best for you.

**Think smart and use a plan!**



**Use a plan.**

It is smart to have a plan for doing all schoolwork. When you read, you should have a plan. One plan is to look at the questions you have to answer about the story first. Then read the story to find the answers. Another plan is to make a picture of what you read so that you can see all the parts of the story. When you write you should also have a plan. Students who are good at writing plan and organize their thoughts first. Then they think about what they are doing as they write. Using a plan is a good way to be smarter about your work!

**How to Be Smart: Planning**

When we say people are smart, we usually mean that they know a lot of information. But being smart also means that someone has a lot of ability to learn new things. Being smart at learning new things includes knowing and using your *thinking abilities*. There are ways you can use your abilities *better* when you are learning.

**What Does Being Smart Mean?**

One ability that is very important is called *Planning*. The ability to *plan* helps you figure out *how to do things*. When you don't know *how* to solve a problem, using Planning ability will help you figure out how to do it. This ability also helps you control what you think and do. It helps you to stop before doing something you shouldn't do. Planning ability is what helps you wait until the time is right to act. It also helps you make good decisions about what to say and what to do.

Jack A. Naglieri, Ph.D.

59

59

Phineas had  
Social  
Emotional  
Deficit

- Phineas had profound social emotional problems after his injury to the frontal lobes
- Phineas was
  - Insulting
  - impulsively says things
  - uses vulgar language
  - can't manage his emotions
  - inconsistent in social situations
  - doesn't recognize he is offensive
  - loses control in interactions with others

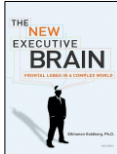
Jack A. Naglieri, Ph.D.

60

60

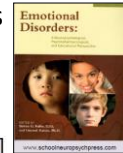
# Readings Regarding Frontal Lobes and Emotion

Goldberg (2011, p 116-117)



- the “emphasis in the classic studies of frontal lobe syndromes was on cognition [intelligence] rather than on affect [social emotional]”
- ‘very few researchers have attempted to merge cognitive and emotional aspects of frontal lobe dysfunction’

- Feifer’s Emotional Disorders book contains a collection of papers on the relationship between EF and Emotional Disorders



- And see Feifer@comcast.net

Jack A. Naglieri, Ph.D.

61