Assessment of Executive Functions

Dean C. Delis, Ph.D., A.B.P.P.

Professor Emeritus of Psychiatry

University of California, San Diego, School of Medicine

- Historical perspective: Why Executive Function Tests have been slow to be adopted in clinical and school settings.
- Rationale and methods behind the executive function tests that we have developed.
- Present case studies to illustrate the dissociations between IQ or G factor and Executive Functions.
- Common mistakes that psychologists make in the assessment of Executive Functions
- Subgroups of typically developing children and adolescents with dissociations between IQ or G factor and Executive Functions. Common to miss children with Executive Dysfunction Disabilities.
- Limitations and strengths of behavioral rating scales of executive functions (e.g., BRIEF; D-REF).

Conflict of Interest Disclosures?

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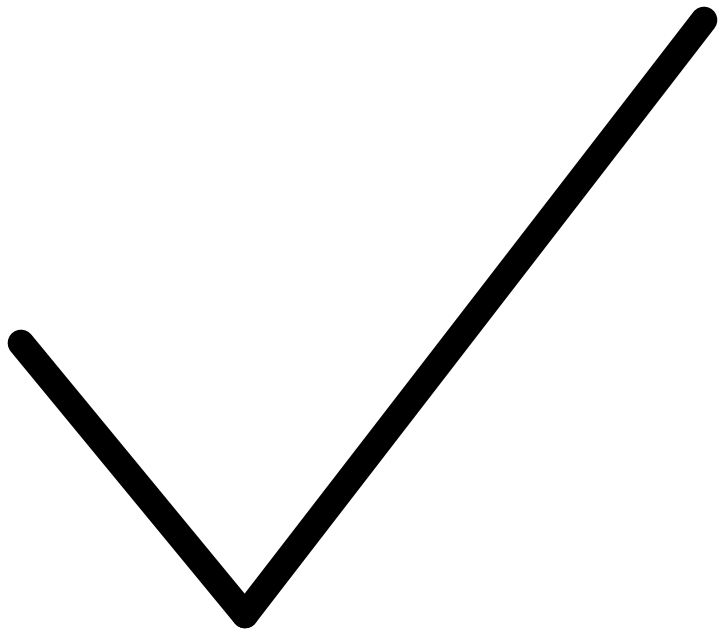
Yes



Why have Executive Function Tests been slow to be adopted in school settings?

Spearman (1927)

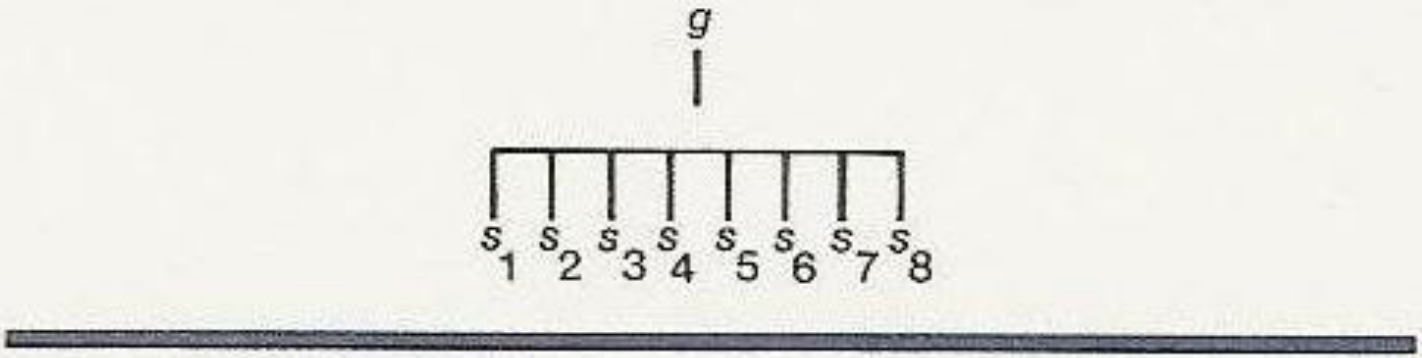


Figure 3-5. Spearman's two-factor theory of intelligence (*g* refers to the general factor, or general ability, and *s* to specific factors).

Why have Executive Function Tests been slow to be adopted in school settings?

The Study of Mental Abilities Circa 1900 to 1950

↓

Traditional Psychometric Theory of Cognition

↓

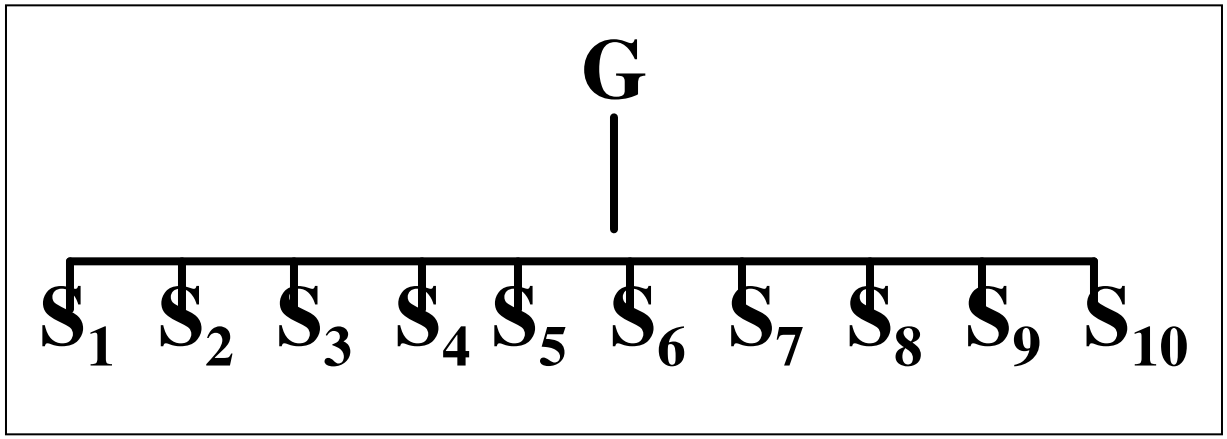


Figure 3-2. Alfred Binet.

Binet-Simon Scale (1905)

Stanford-Binet Scale (1916)

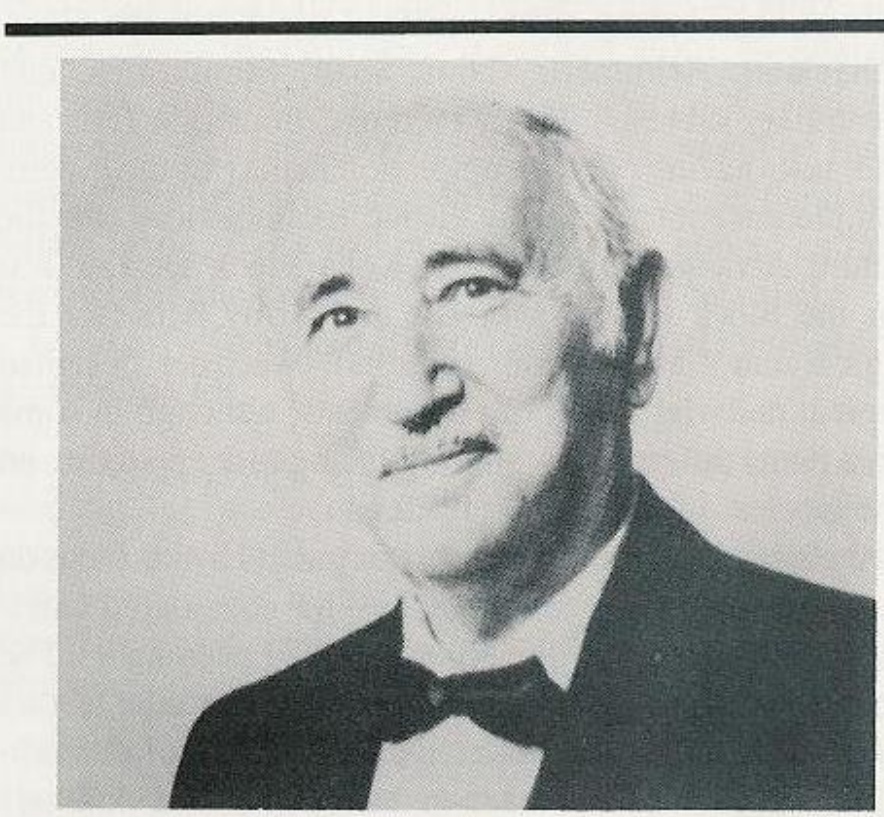


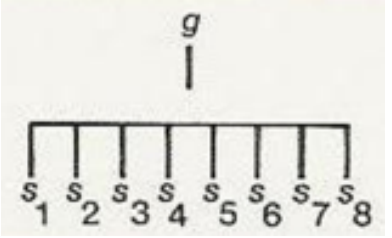
Figure 3-4. David Wechsler. Courtesy of The Psychological Corporation.

Wechsler-Bellevue Scale (1939)

School and University Settings

- Group achievement tests (CTBS; MAT; SAT; Iowa Test)
- Individual assessment: IQ and achievement tests (WIAT; WRAT; Woodcock-Johnson)

- College Entrance Exams (SAT)
- Graduate Entrance Exams (GRE)

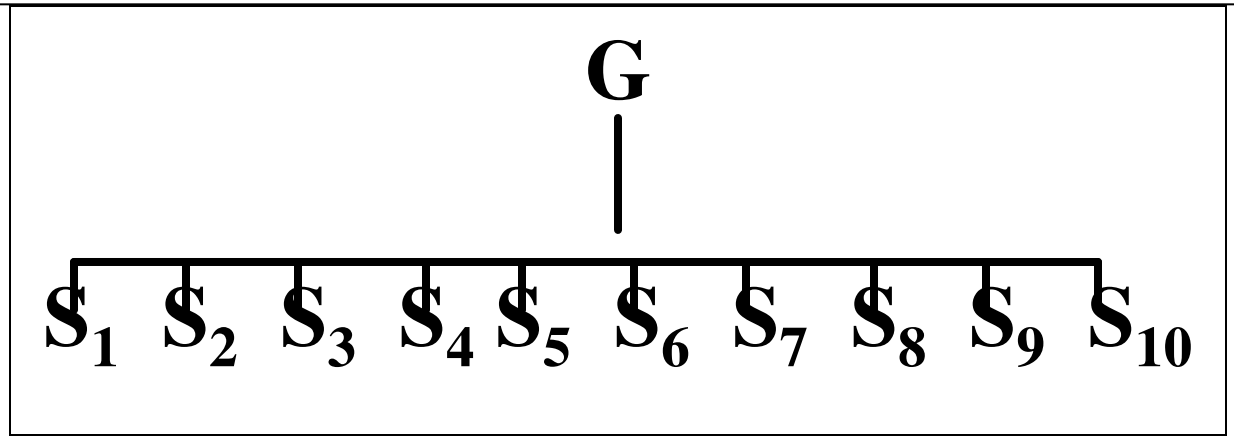


Schools of Psychology Studying Mental Abilities Circa 1940s and 1950s

Cognitive Psychology

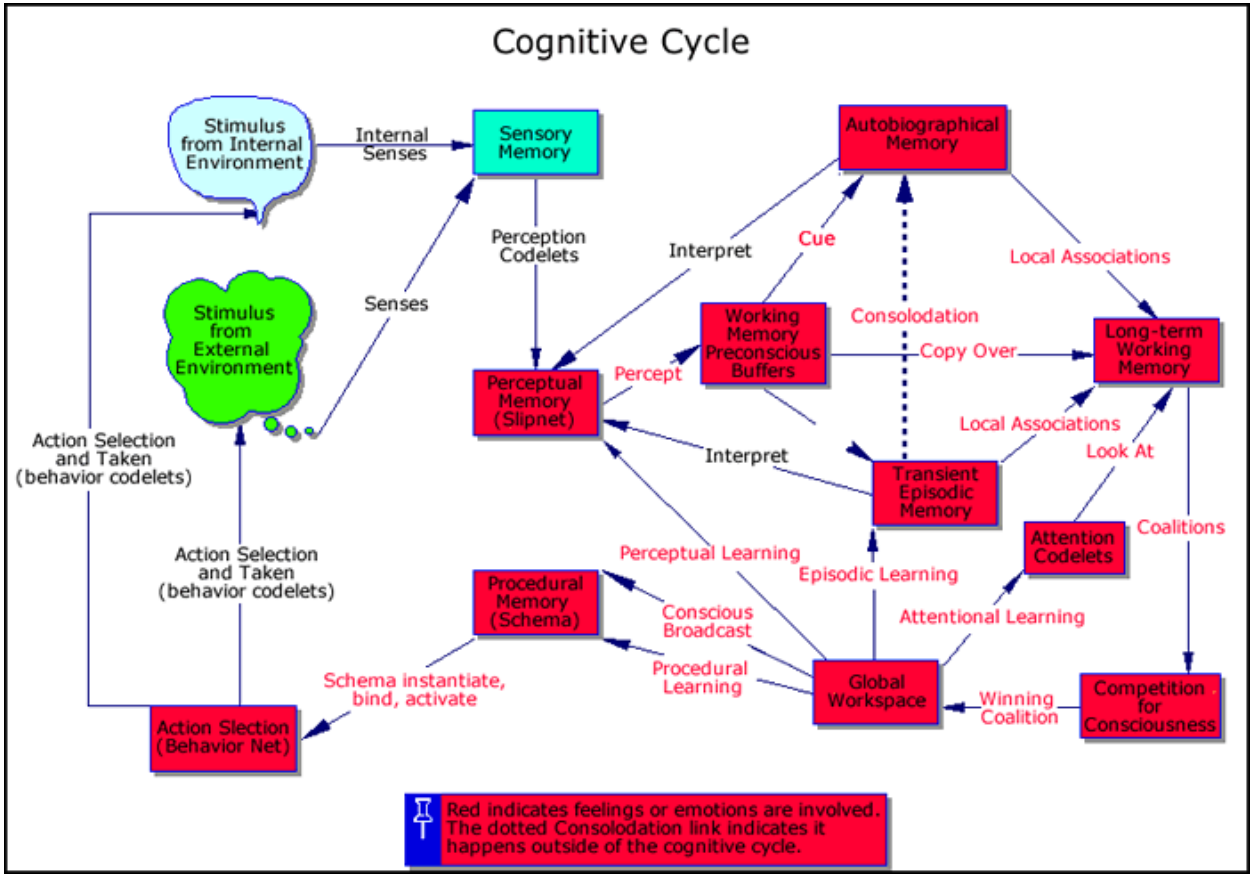
Neuropsychology

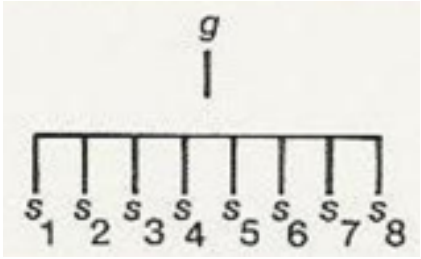
Traditional Psychometric Theory



Cognitive Psychology

Traditional Psychometric Theory





Neuropsychology: IQ tests are not sufficient

- Trail Making Test, Partington, 1938
- Verbal Fluency Test, Thurstone, 1939
- Category Test, Halstead, 1944
- Wisconsin Card Sorting Test, Grant & Berg, 1948; Heaton, 1981

Lezak et al.: Trail Making Test developed by Army Psychologists in 1944

Trail Making Test (TMT)

This test, originally part of the *Army Individual Test Battery* (1944), has enjoyed wide use as an easily administered test of scanning and visuomotor tracking, divided attention, and cognitive flexibility. Developed by U.S. Army psychologists, it is in the public domain and can be reproduced without permission. It is given in two parts, A and B (see Fig. 9.12, p. 372). The sub-

THE

PSYCHOLOGICAL SERVICE CENTER ~~BULLETIN~~ JOURNAL

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Partington's Pathways Test

by JOHN E. PARTINGTON
Personal Counselor
Veterans Administration Regional Office
Roanoke, Virginia

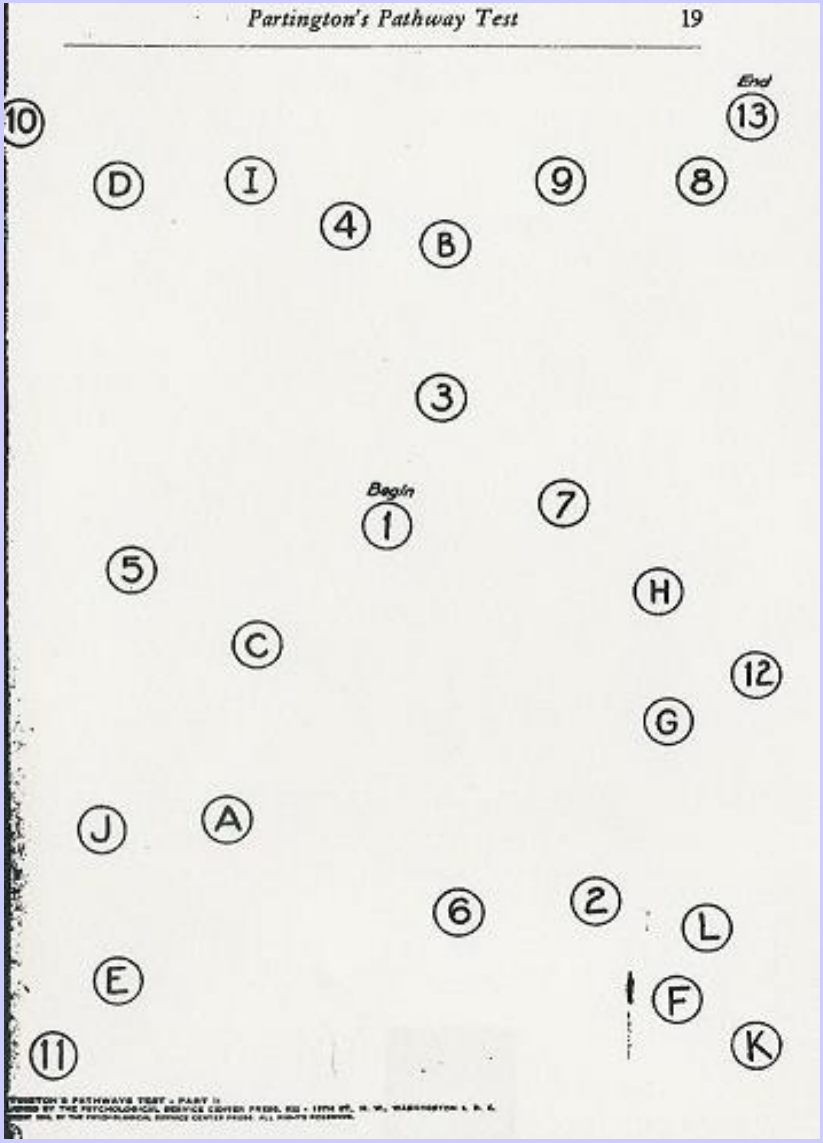
In Collaboration With

RUSSELL GRAYDON LEITER
Chief, Hospital and Special Rehabilitation Advisement Division
Veterans Administration, Central Office
Washington, D. C.

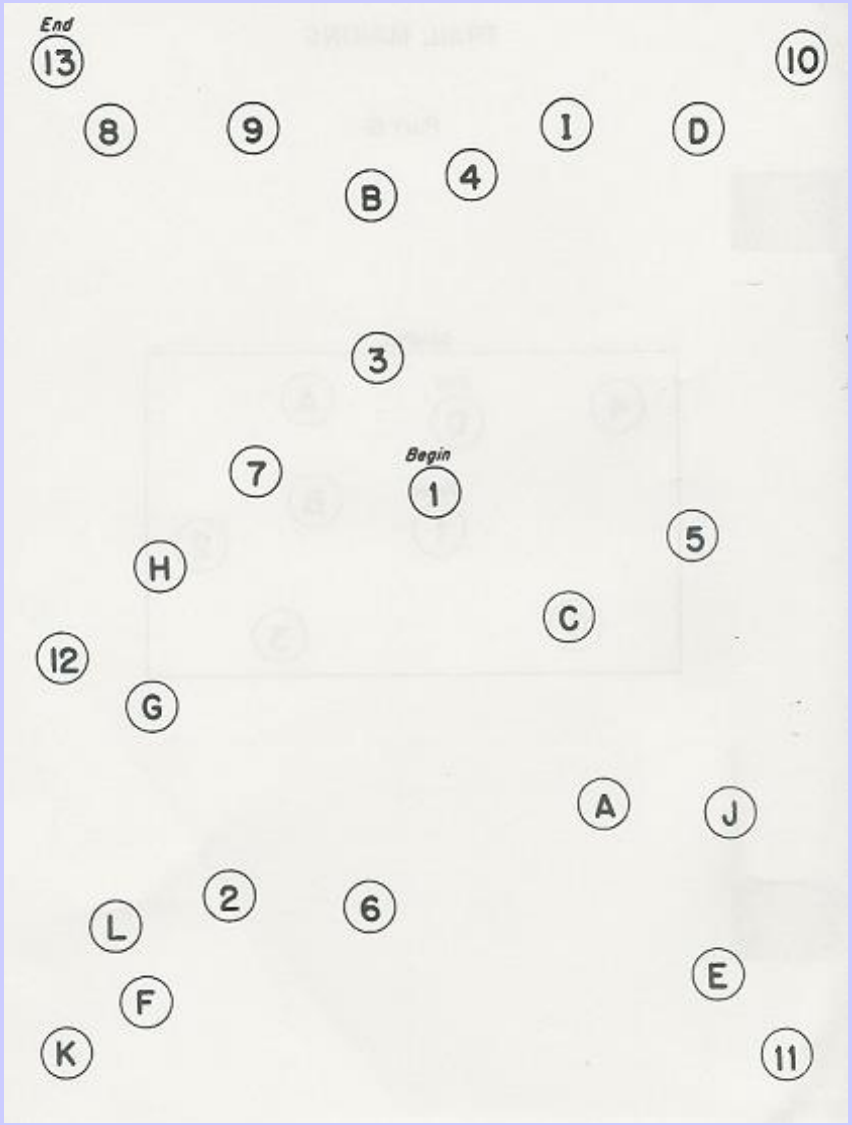
INTRODUCTION

The Pathways Test, formerly called Distributed Attention, was originally devised in 1938 as part of a battery of tests to compare a matched group of adult subjects with respect to a variety of intellectual functions different from those measured by the Wechsler-Bellevue Intelligence Scale (1).

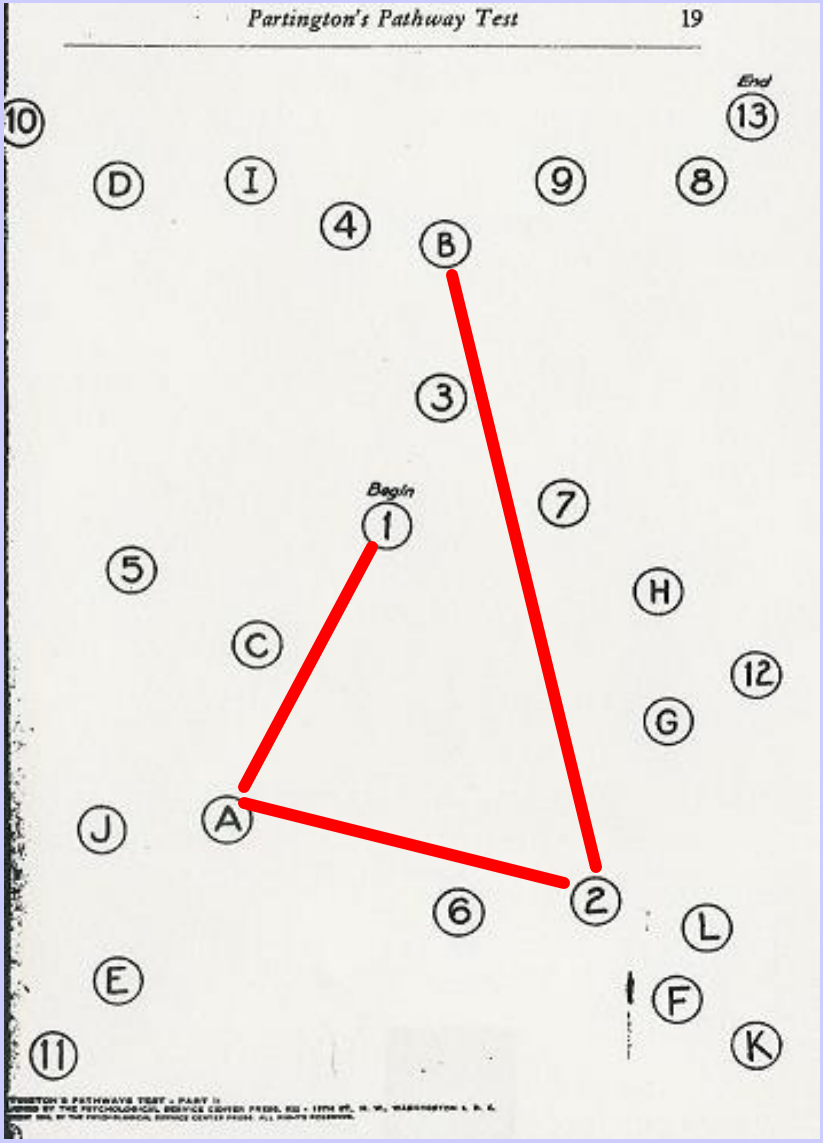
Partington Pathway Test
(Circa 1938)



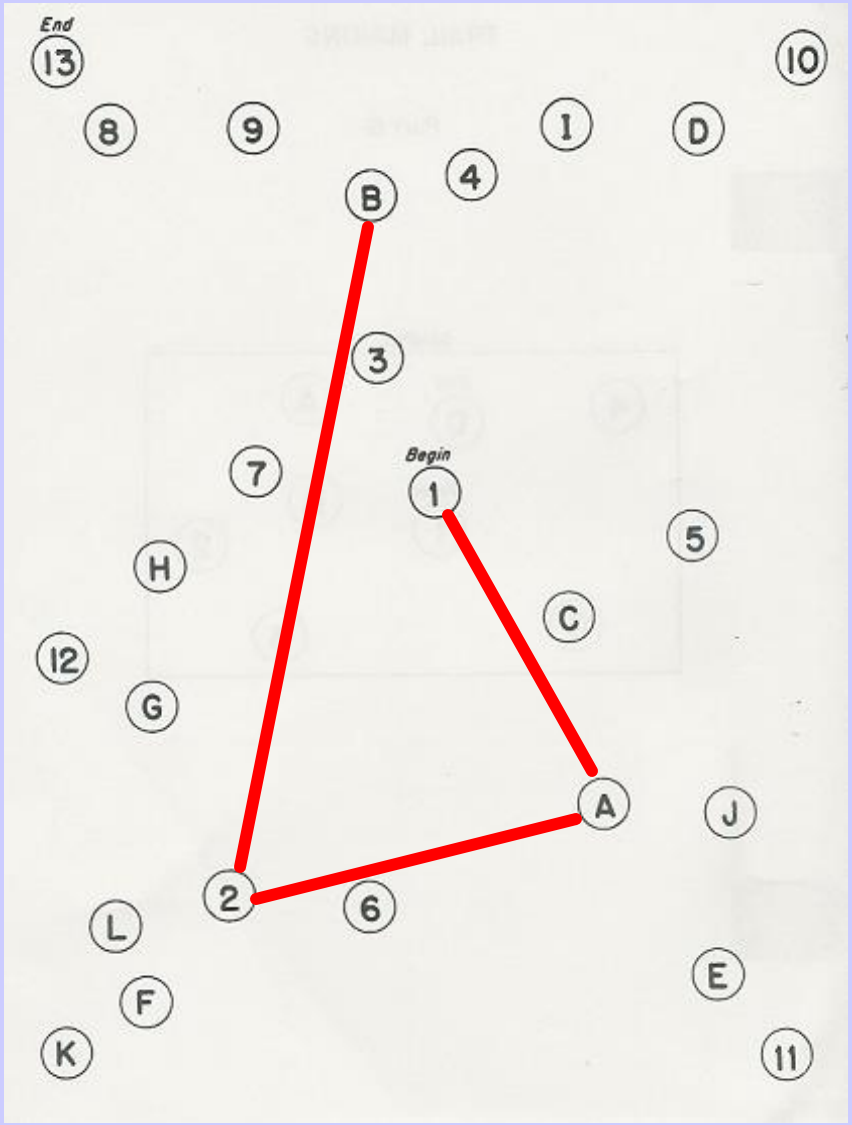
Trail Making Test
(Circa 1944)



Partington Pathway Test
(Circa 1938)

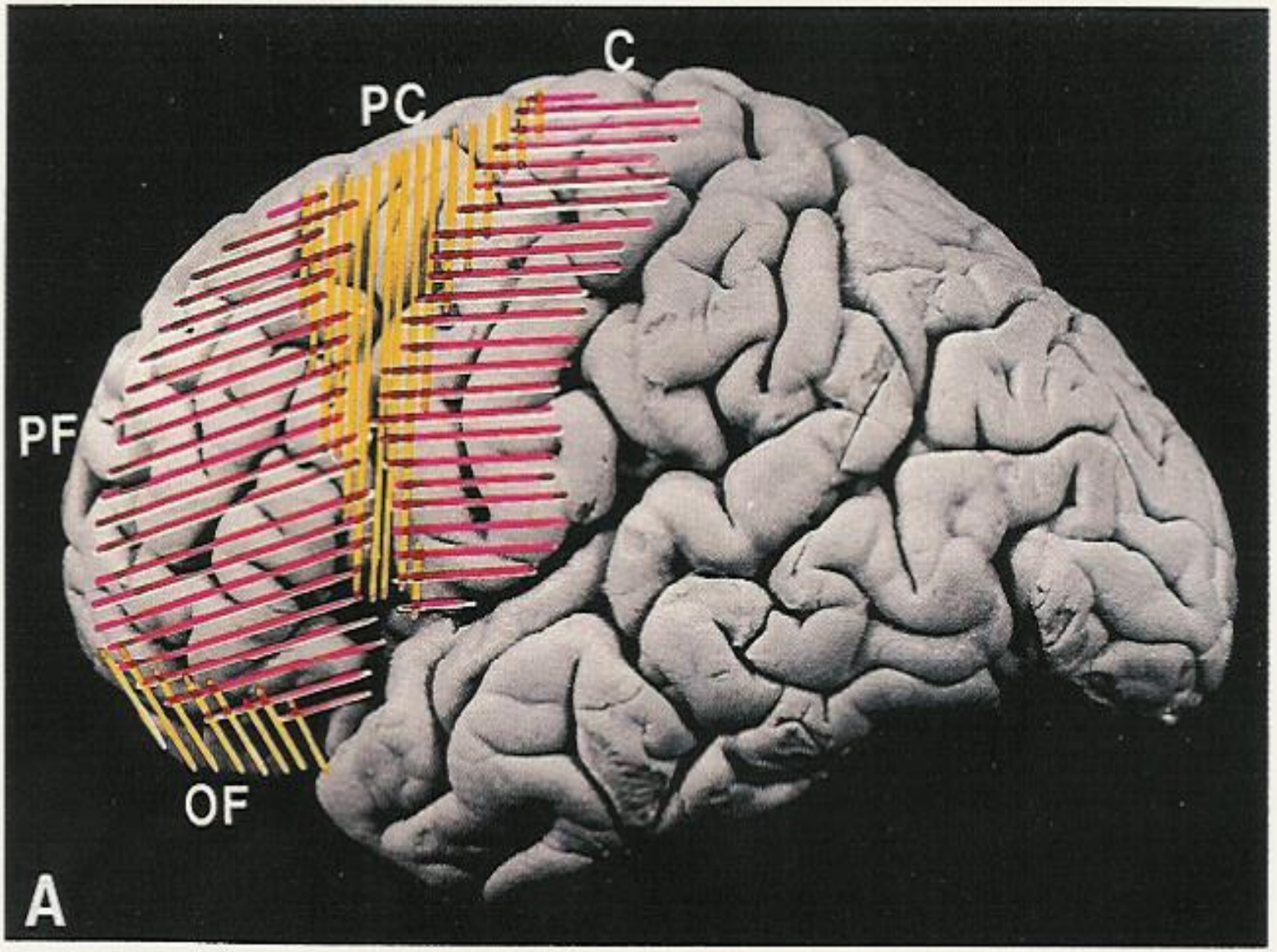


Trail Making Test
(Circa 1944)



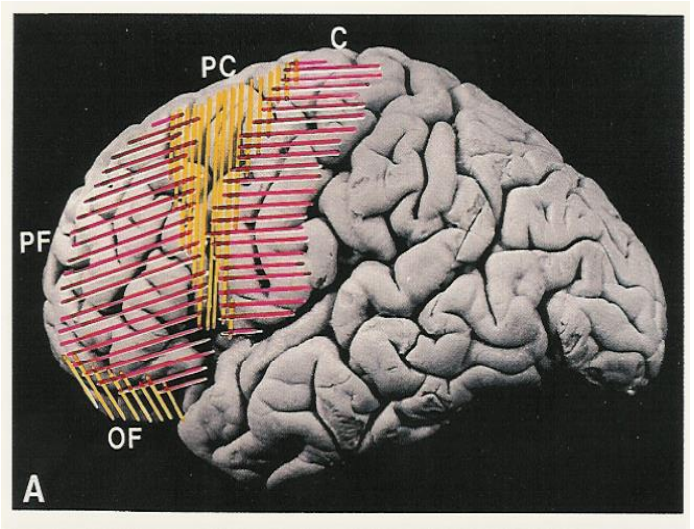
Traditional Executive Function Tests

- Trail Making Test, Partington, 1938
- Verbal Fluency Test, Thurstone, 1939
- Category Test, Halstead, 1944
- Wisconsin Card Sorting Test, Grant & Berg, 1948; Heaton, 1981


C
PC
PF
OF
A

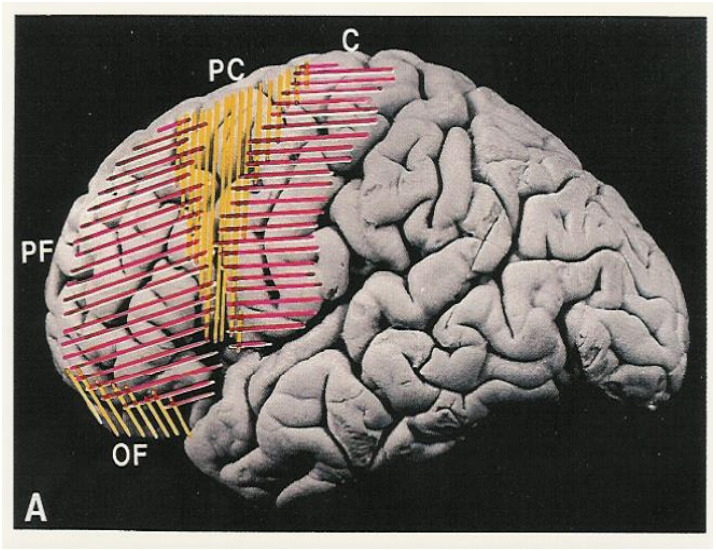
Current Understanding of Executive Functions: Cognitive Component

- Abstract Thinking
- Concept Formation
- Novel Problem Solving
- Creativity
- Fluent Novel Thinking
- Multi-Tasking
- Planning and Organization
- Inhibit responses from the immediate environment



Current Understanding of Executive Functions: Behavioral and Emotional Components

- Disinhibition
- Inappropriate Behavior
- Jocularity
- Child-Like Behavior
- Impulsivity
- Emotional Lability
- Apathy
- Poor Judgment
- Irritability/anger
- Emotional Dyscontrol

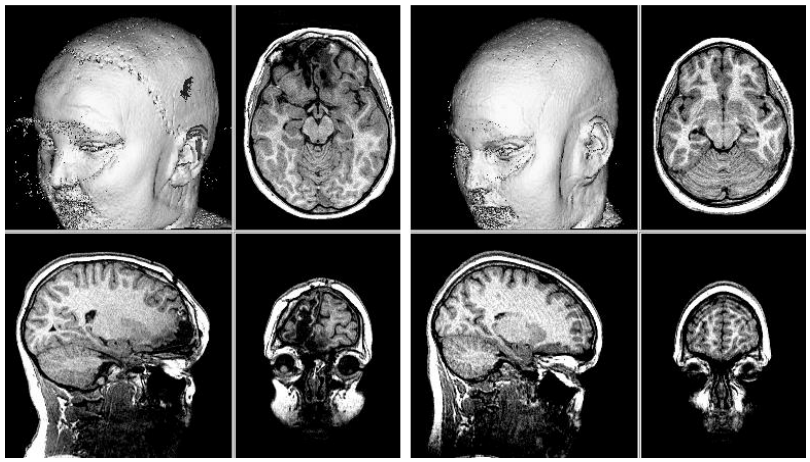


Three Cases

IQ > EF

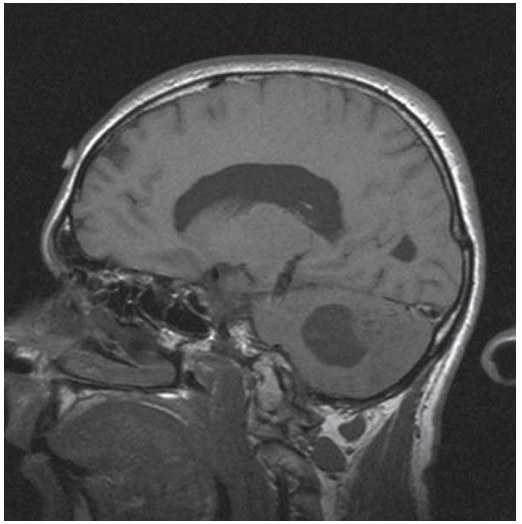
TBI at
Age 27

TBI SIB



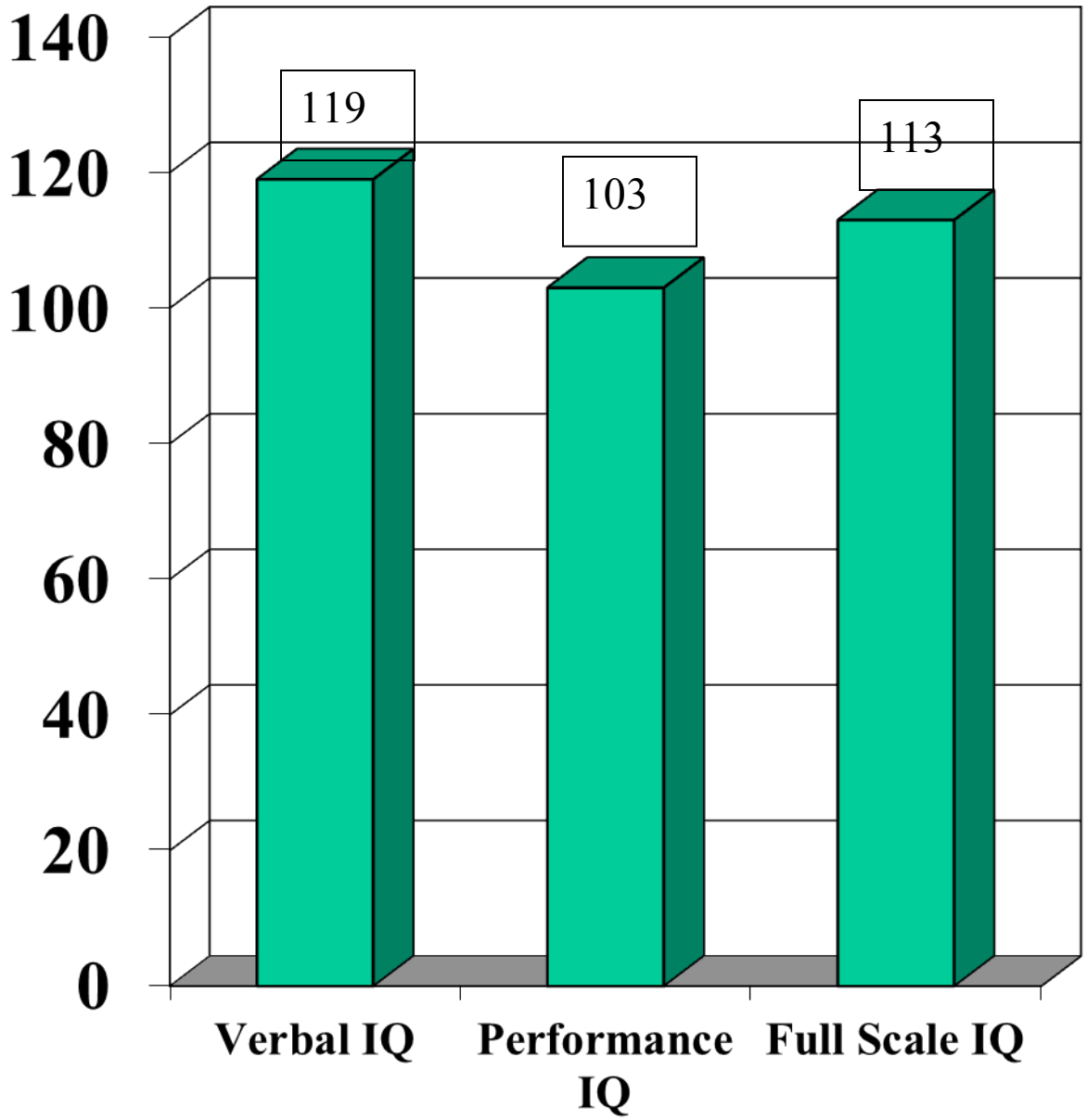
TBI at
Age 7

EF > IQ

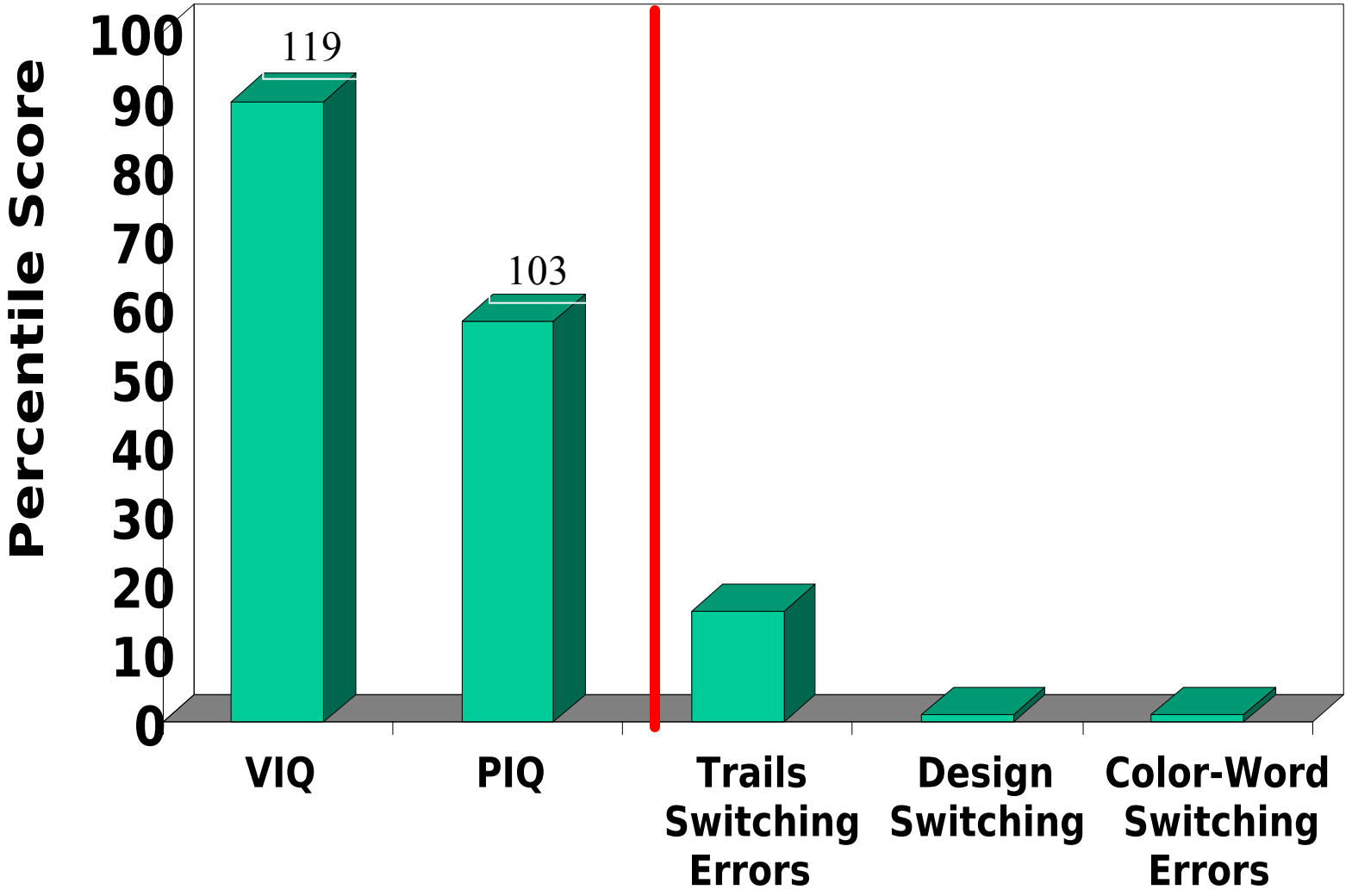


Cerebellar tumor
resected at Age 1

C.D.'s Current IQ Scores

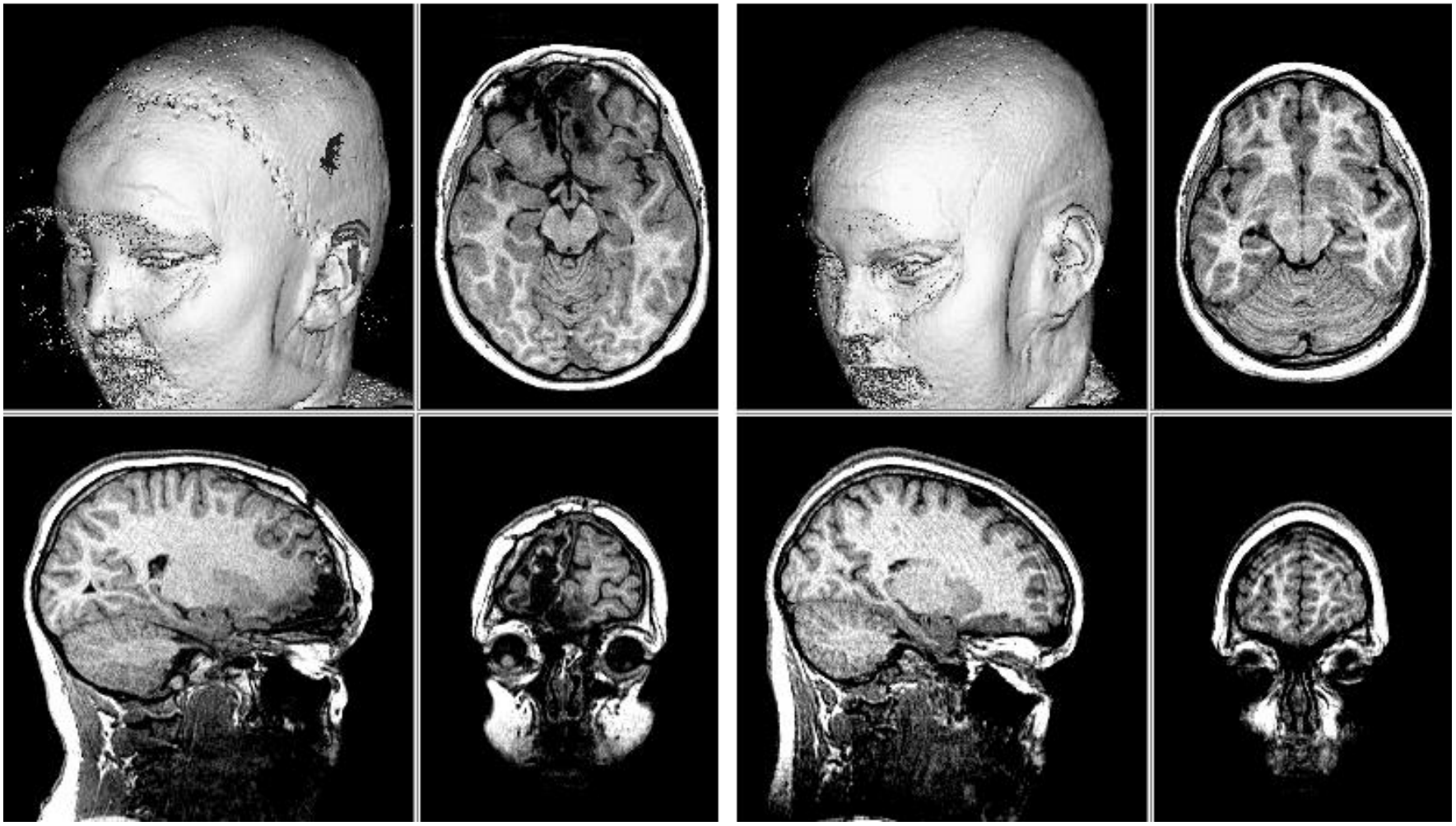


CD's Percentile Rank Scores on Selective Measures

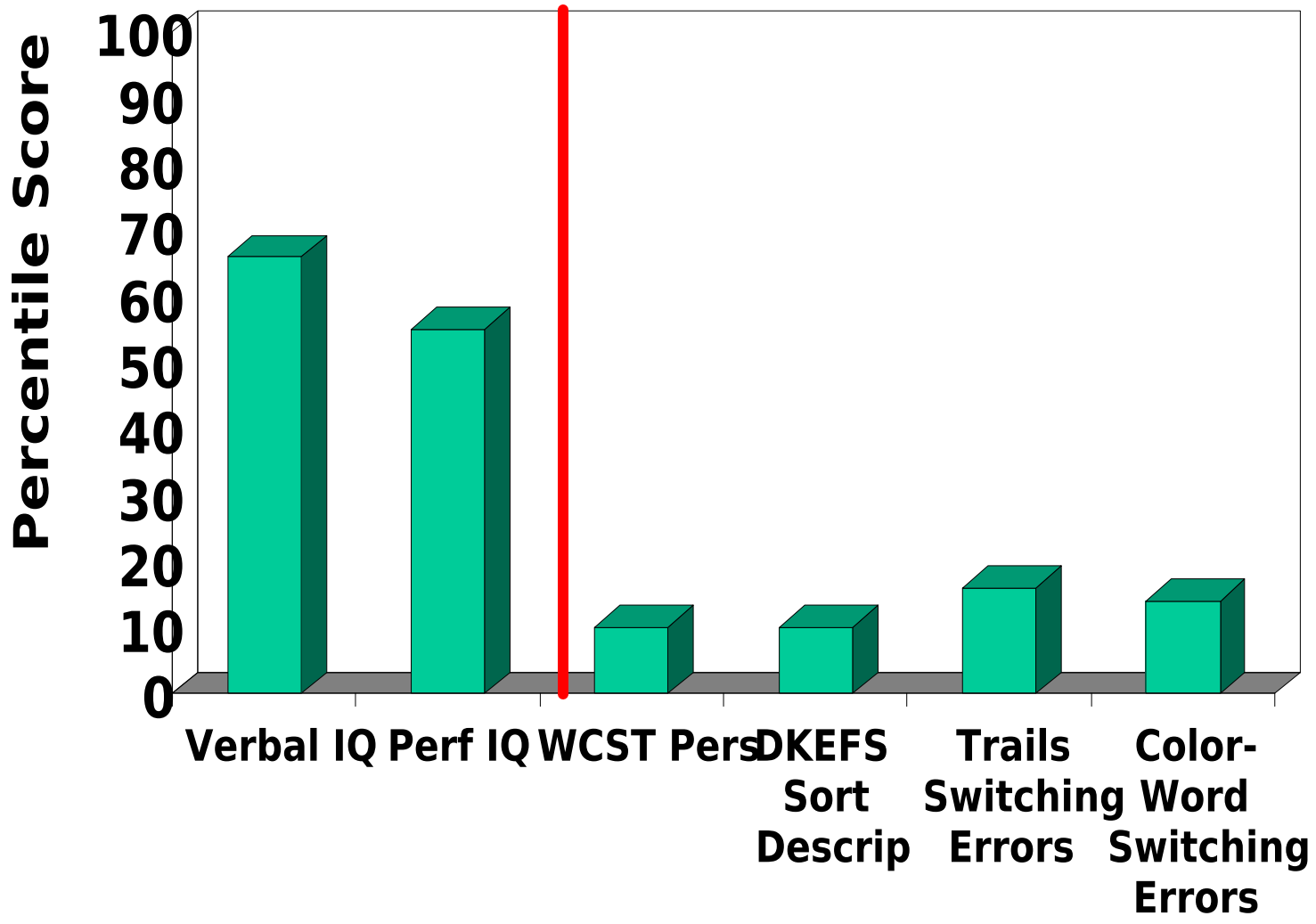


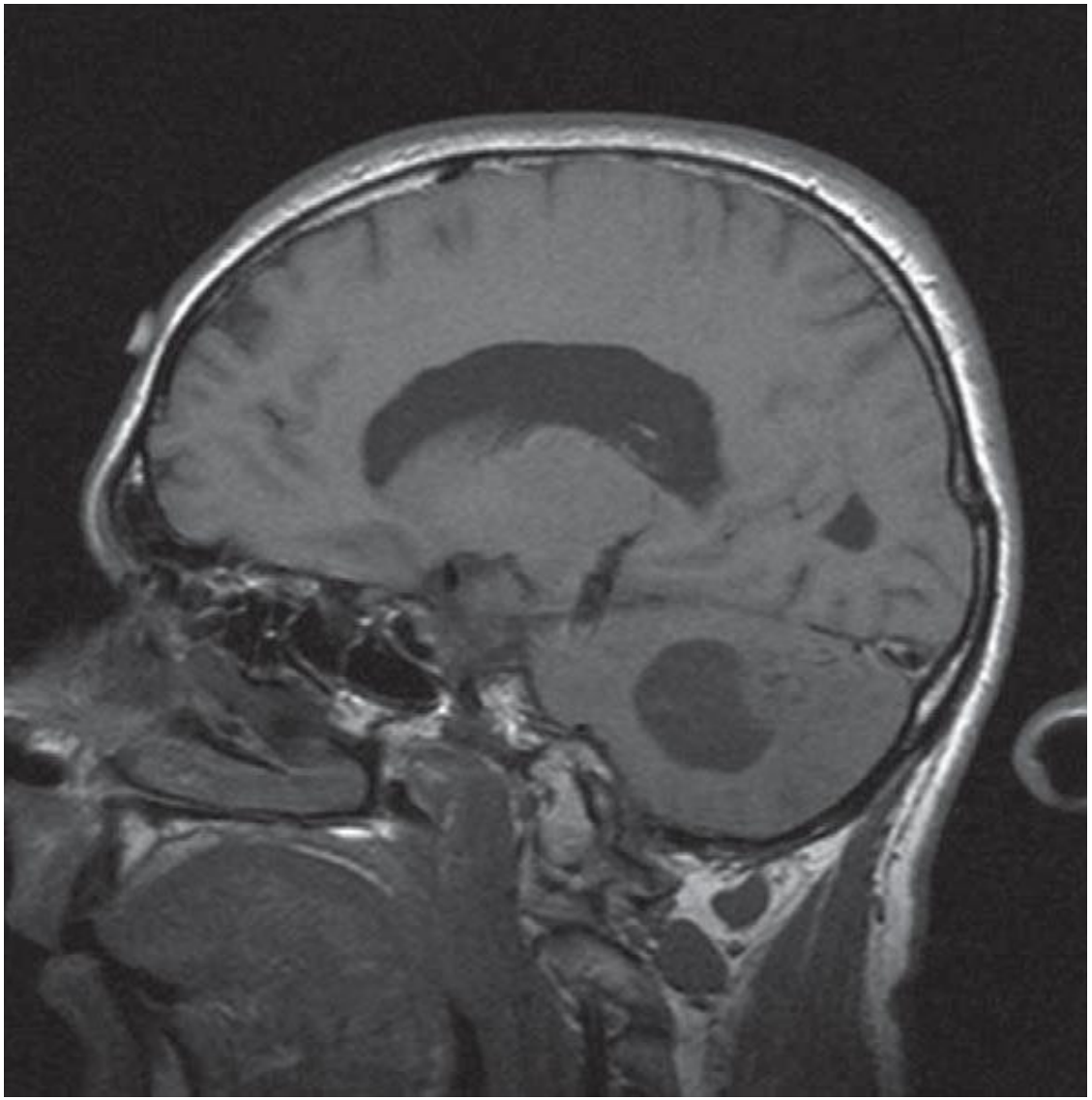
TBI

SIB

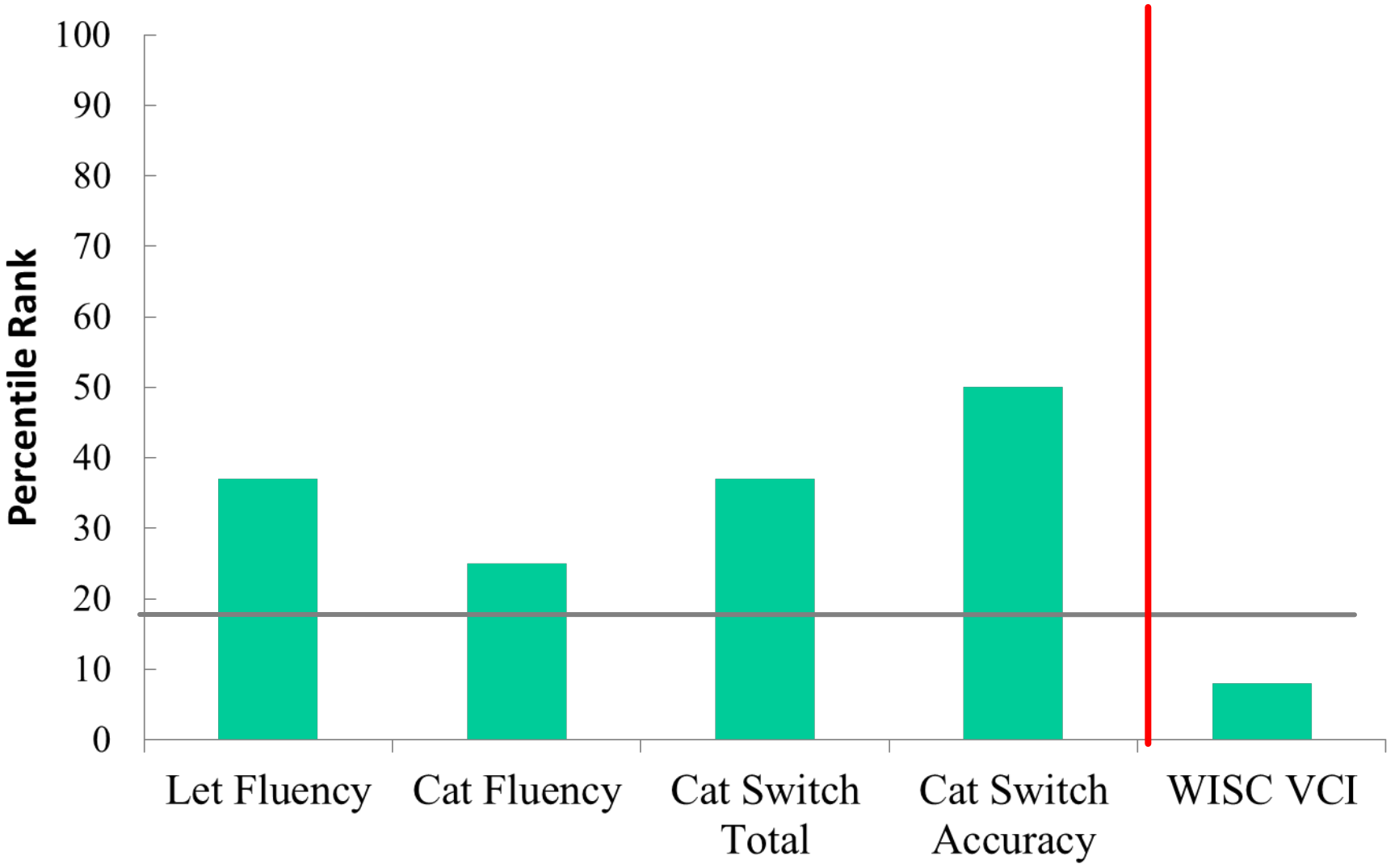


PF's Scores on IQ Versus Executive Function Tests





J.H.’s Scores on the D-KEFS Verbal Fluency Test



Delis-Kaplan Executive Function System™ (D-KEFS™) 2001

OVERVIEW

Ages
8 to 89 years

Two Forms
Standard Record Forms: Includes all nine D-KEFS tests
Alternate Record Forms: Includes alternate versions of the D-KEFS Sorting, Verbal Fluency, and 20 Questions Test

Norms
Normed on over 1,500 individuals demographically and regionally matched with the U.S. population

Administration
Flexibility in test selection; 90 minutes if all nine tests are administered; hand scorable; individual administration

Qualifications Level
C-level

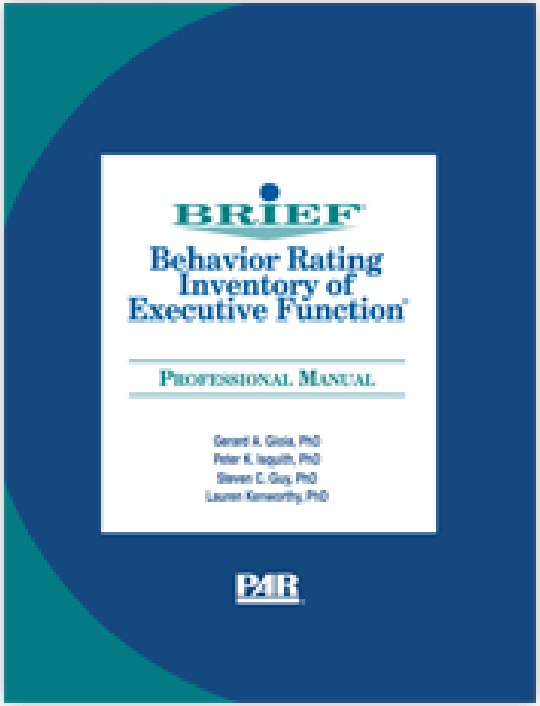
Ages
Birth to Three
Child
Adolescent
Adult

Dean C. Delis, Edith Kaplan, Joel H. Kramer

Assess key components of executive functions within verbal and spatial modalities

BEST SELLER

Can Rating Scales Evaluate the Cognitive Component of Executive Functions?



D-REF Delis Rating of Executive Functions

Pearson

Journal of the International Neuropsychological Society (2010), Page 1 of 11.

doi:10.1017/S1355617710000093

Is the behavior rating inventory of executive function more strongly associated with measures of impairment or executive function?

TARA MCAULEY, SHIRLEY CHEN, LISA GOOS, RUSSELL SCHACHAR, AND JENNIFER CROSBIE

Department of Psychiatry Research, The Hospital for Sick Children, Toronto, Ontario, Canada

Abstract

The Behavior Rating Inventory of Executive Function (BRIEF) is commonly used in the assessment of children and adolescents presenting with a wide range of concerns. It is unclear, however, whether the questionnaire is more closely related to general measures of behavioral disruption and impairment or to specific measures of executive function. In the present study, associations between the Behavioral Regulation Index and Metacognition Index of the BRIEF and cognitive, behavioral, and academic measures were examined in a sample of clinic-referred youth ($n = 60$) and healthy youth ($n = 37$) 6–15 years of age. Measures included ratings of inattentive and hyperactive-impulsive symptoms in youth, ratings of how well youth functioned in their everyday environments, youth's scores on measures of reading and math, and youth's scores on measures of inhibition, performance monitoring, and working memory. Although both BRIEF indices were strongly related to parent and teacher ratings of behavioral disruption and impairment, neither was associated with youth's scores on the performance-based tasks of executive function. These findings support the use of the BRIEF as a clinical tool for assessing a broad range of concerns, but raise questions about the relation of the BRIEF to performance-based tasks that are commonly used to assess executive function. (*JINS*, 2010, 1–11.)

JOURNAL OF CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY
2011, 33 (6), 704–714

Are self-reported symptoms of executive dysfunction associated with objective executive function performance following mild to moderate traumatic brain injury?

Dawn M. Schiehser[1,2], Dean C. Delis[1,2,3], J. Vincent Filoteo[1,2], Lisa Delano-Wood[1,2], S. Duke Han[4], Amy J. Jak[1,2], Angela I. Drake[5], and Mark W. Bondi[1,2]

Background and objective: We examined the relationship between self-reported pre- and post-injury changes in executive dysfunction, apathy, disinhibition, and depression, and performance on neuropsychological tests of executive function, attention/processing speed, and memory in relation to mood levels and effort test performance in individuals in the early stages of recovery from mild to moderate traumatic brain injury (TBI). *Method:* Participants were 71 noncombat military personnel who were in a semiacute stage of recovery (<3 months post injury) from mild to moderate TBI. Pre- and post-TBI behaviors were assessed with the Frontal Systems Behavior Scale (FrSBe; Grace & Malloy, 2001) and correlated with levels of depressive symptoms, effort test performance, and performance on objective measures of attention, executive function, and memory. *Results:* Self-reported symptoms of executive dysfunction generally failed to predict performance on objective measures of executive function and memory, although they predicted poorer performance on measures of attention/processing speed. Instead, higher levels of depressive symptomatology best predicted poorer performance on measures of executive function and memory. However, the relationship between memory performance and TBI symptoms was no longer significant when effort performance was controlled. *Conclusions:* Our findings suggest that, among individuals in early recovery from mild to moderate TBI, self-reported depressive symptoms, rather than patients' cognitive complaints, are associated with objective executive function. However, self-reported cognitive complaints may be associated with objectively measured inattention and slow processing speed.

Substitute Self-Report, Teacher-Report, or Parent-Report for actual IQ Testing?

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Birth to Three
Child
Adolescent
Adult

Dean C. Delis, Edith Kaplan, Joel H. Kramer

Assess key components of executive functions within verbal and spatial modalities

BEST SELLER

Our Goals

- Develop a wide range of executive function tests in both the verbal and nonverbal modalities.
- Develop different test conditions to parse out more fundamental component skills from higher-level executive functions
- Provide scores not only for correct responses or time to completion (i.e., achievement), but also for process measures, including error analysis and strategies.
- Obtain normative data for both achievement and process measures.

Verbal Tests

Verbal Fluency Test

Word Context Test

Proverb Test

Visual-Spatial Tests

Design Fluency Test

Tower Test

Verbal and Visual-Spatial Modality

Sorting Test

Twenty Questions Test

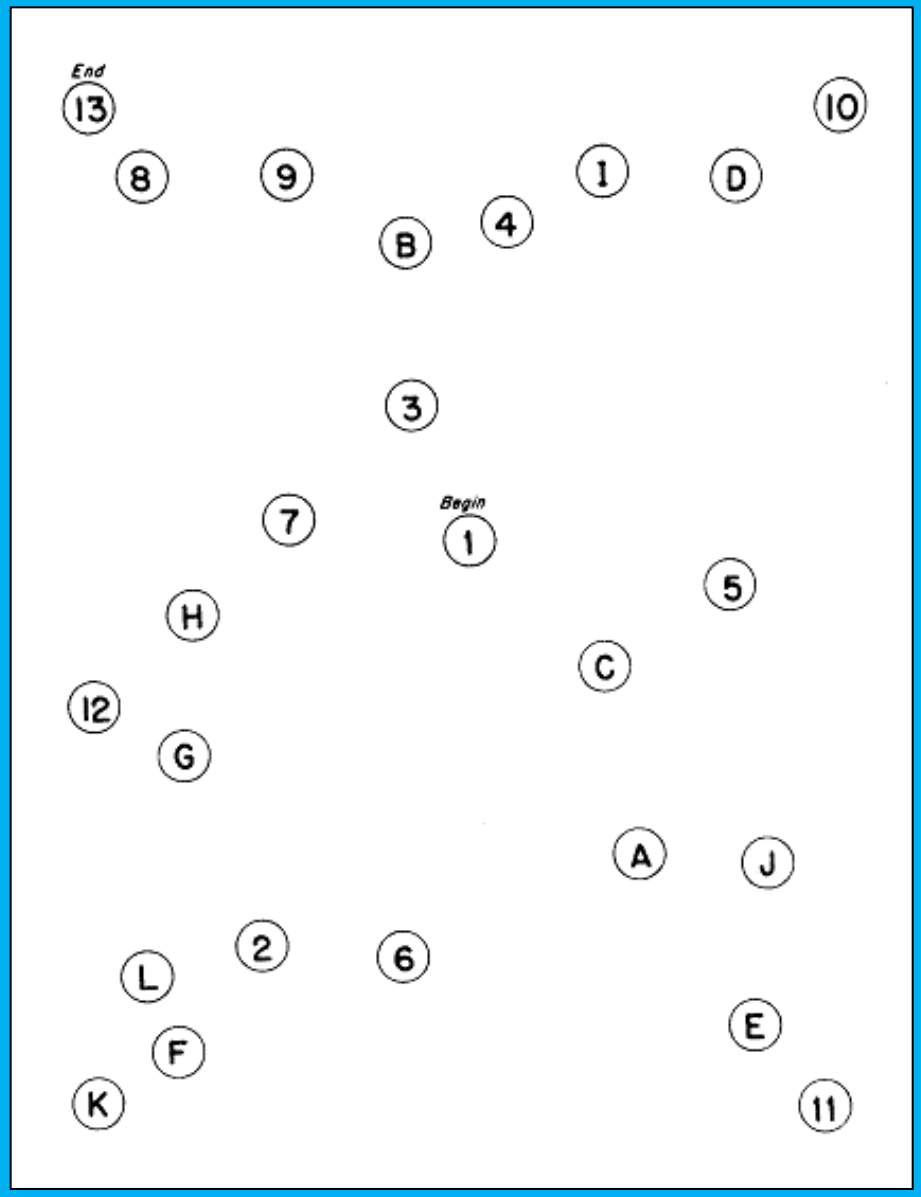
Color-Word Interference Test

Trail Making Test

Top 3 Mistakes Made by Psychologists in Assessing Executive Functions

3. A high standardized score on the final "achievement" measure of an "Executive Function" test means that the patient does not have an executive function deficit as assessed by this test.

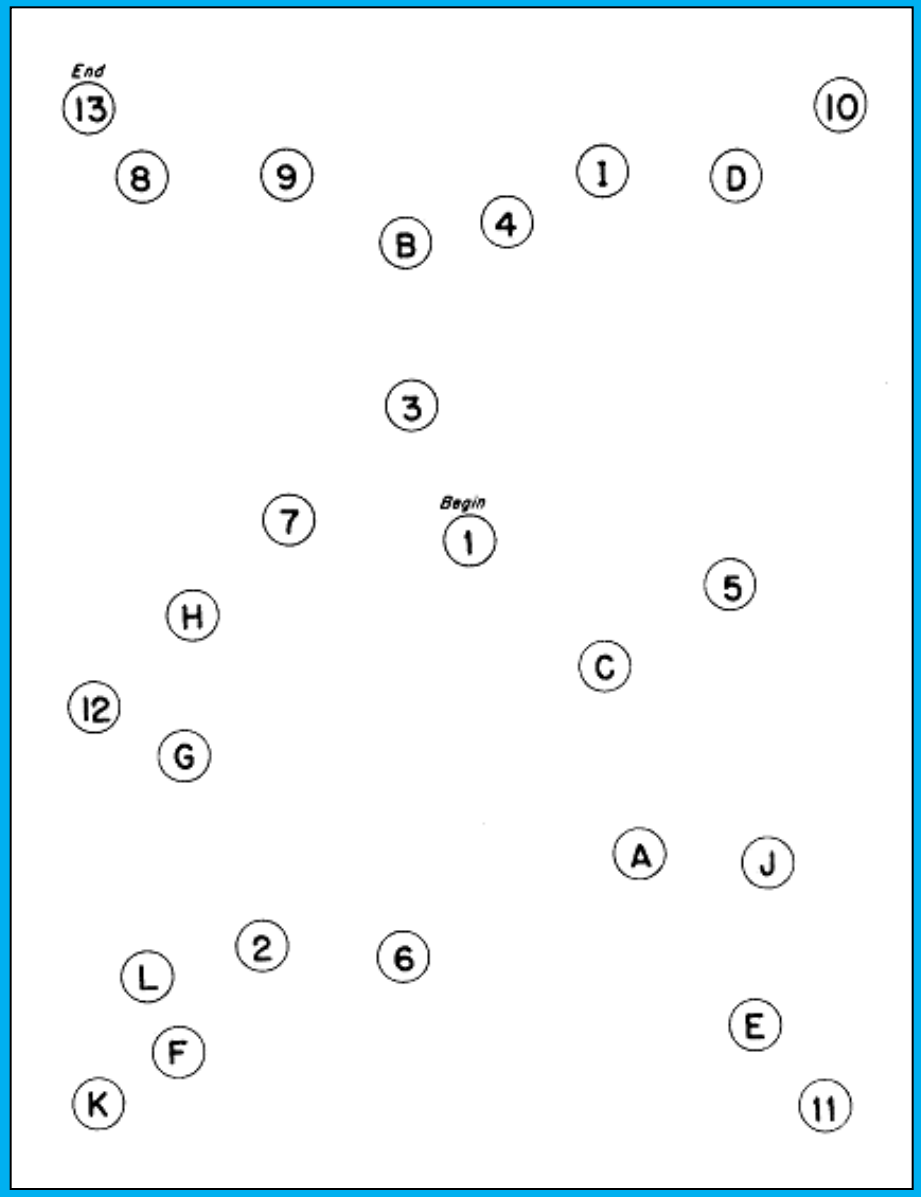
Traditional Trail Making Test: Part B



Top 3 Mistakes Made by Psychologists in Assessing Executive Functions

2. If a patient makes a "classic" error on an "Executive Function" test, this means that the patient has an executive function deficit as assessed by this test.

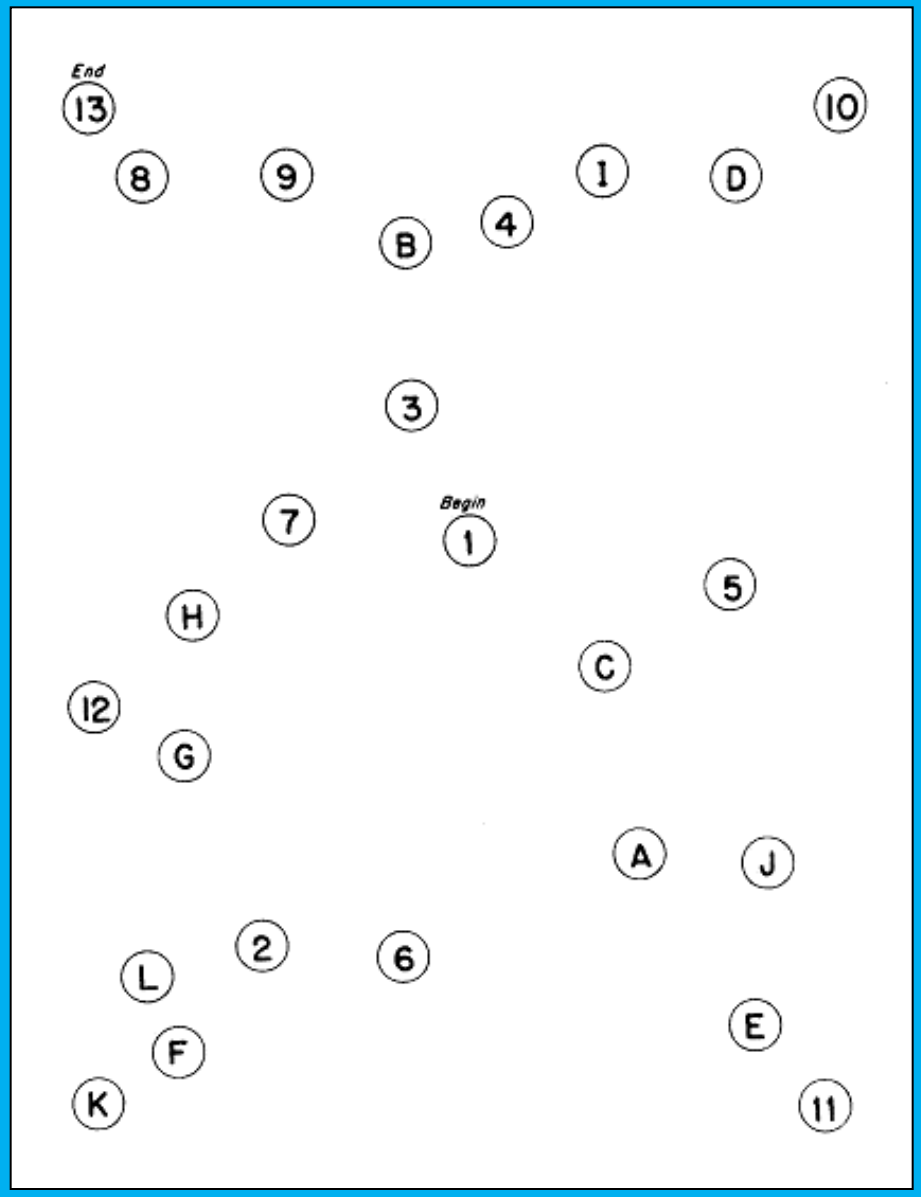
Traditional Trail Making Test: Part B

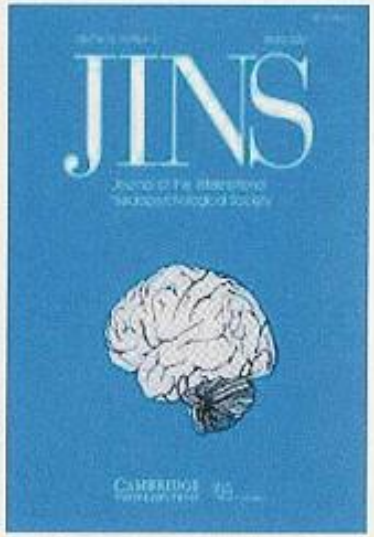


Top 3 Mistakes Made by Psychologists in Assessing Executive Functions

1. A low score on an "Executive Function" test means that the patient has an executive function deficit as assessed by this test.

Traditional Trail Making Test: Part B





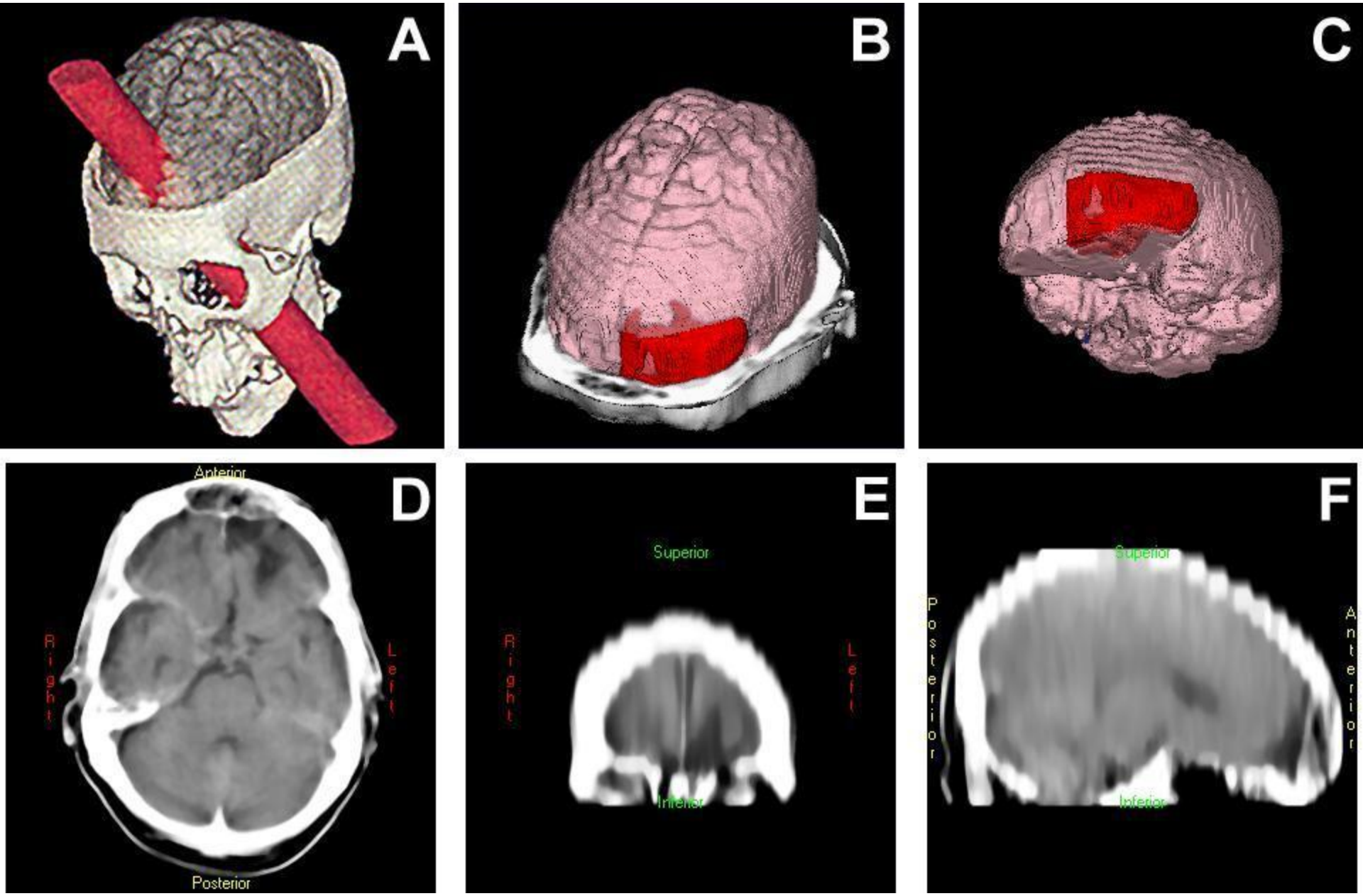
Journal of the International Neuropsychological Society (2004), **10**, 453–465.

DOI: 10.1017/S1355617704103123

CASE STUDY

Assessing the elusive cognitive deficits associated with ventromedial prefrontal damage: A case of a modern-day Phineas Gage

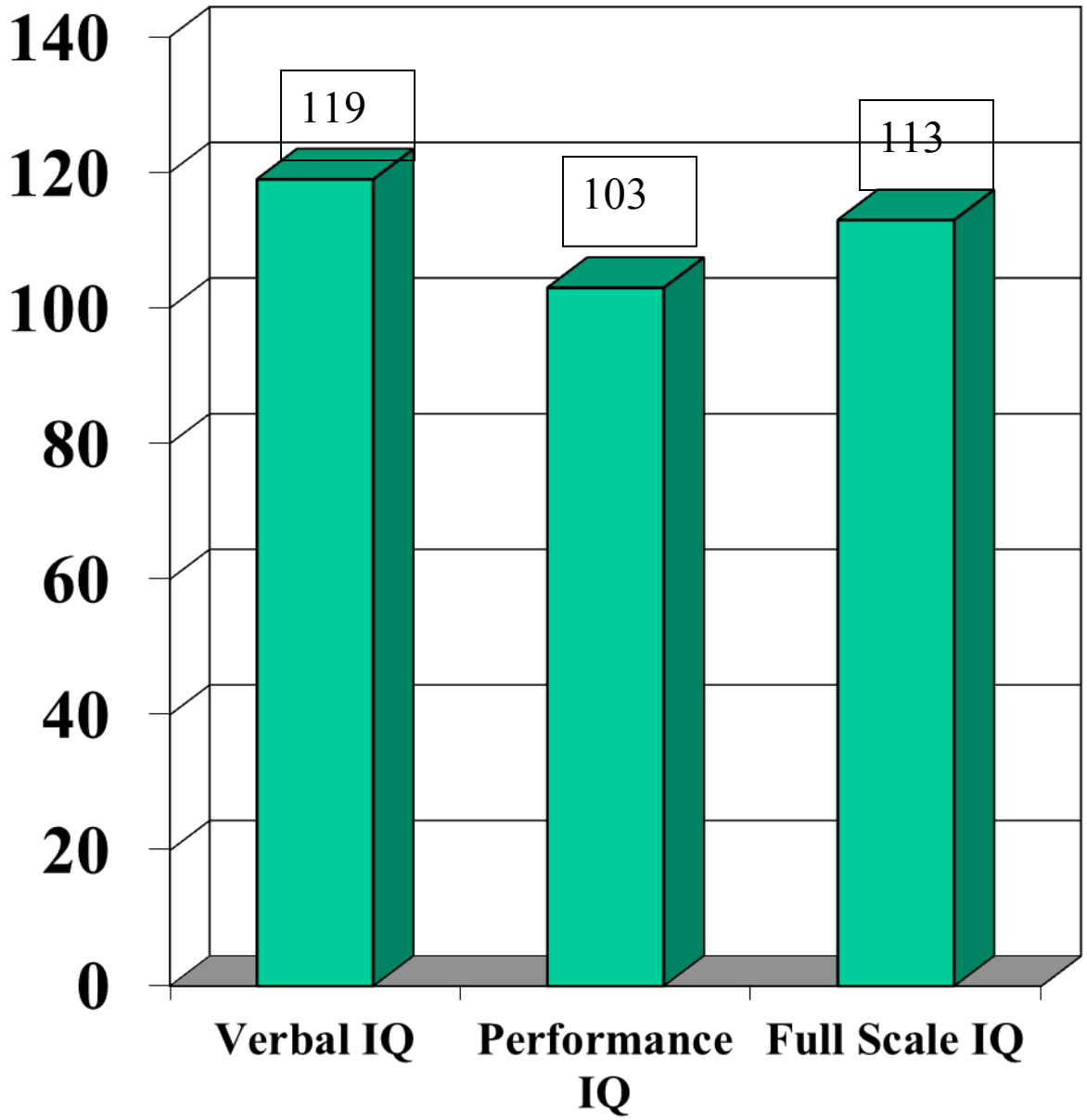
M. ALLISON CATO,[1,2] DEAN C. DELIS,[1] TRACY J. ABILDSKOV,[3] AND ERIN BIGLER[3]


A
B
C
Anterior
D
Right
Left
Posterior
Superior
E
Right
Left
Inferior
Superior
F
Posterior
Anterior
Inferior

Modern Day Phineas Gage

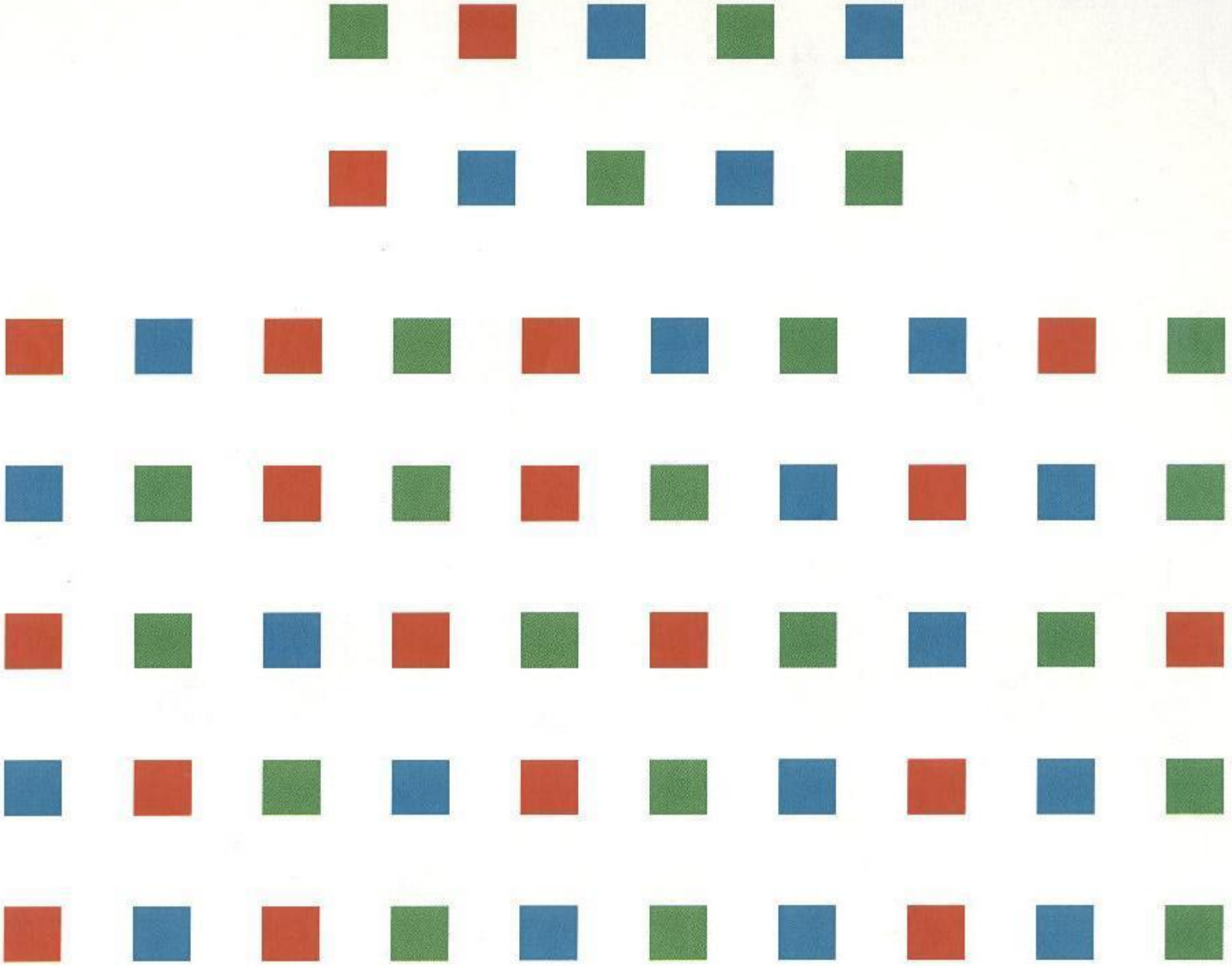
- 66-year-old male at time of testing
- Education: 14 years, skipped 6th grade, mostly A student
- Occupation: Accelerated promotions to Sergeant in Army; Infantry Instructor
- TBI at age 27 while in military

C.D.'s Current IQ Scores



Pre- and Post-Accident Work History

Phineas Gage	CD
Age at injury: 27	Age at injury: 26
Tamping iron through left frontal skull	Metal rail crushed left frontal skull
Bilateral prefrontal damage, left > right	Bilateral prefrontal damage, left > right
Railroad construction foreman	Sergeant/infantry instructor in Army
Pre-Injury: “Most efficient and capable foreman”	Pre-Injury: Accelerated promotions in military
Post-Injury: Dramatic social/occupation decline	Post-Injury: Dramatic social/occupation decline
Premorbid IQ: ?	Premorbid Verbal IQ: at least 119 (90%)
Post-Injury: Normal intellectual faculties	Post-Injury: Normal on most neuropsychological tests



red blue green red blue

green blue green red green

green red blue green blue red blue green blue green

red green blue green blue green red blue red green

red green blue green red blue green red blue red

blue green red blue green red blue green blue red

green red blue red blue green red blue red green

Rule:
Name the ink color.

red blue green blue green

red blue red green red

blue green blue red blue red blue red blue red

blue green blue green red green blue red blue green

red green red blue green red green red blue green

blue green blue red green blue red green red green

green blue red blue green red blue green red blue

Rules:

1. blue – Name the ink color.
2. red – Read the word.

blue red green red blue

green red green red blue

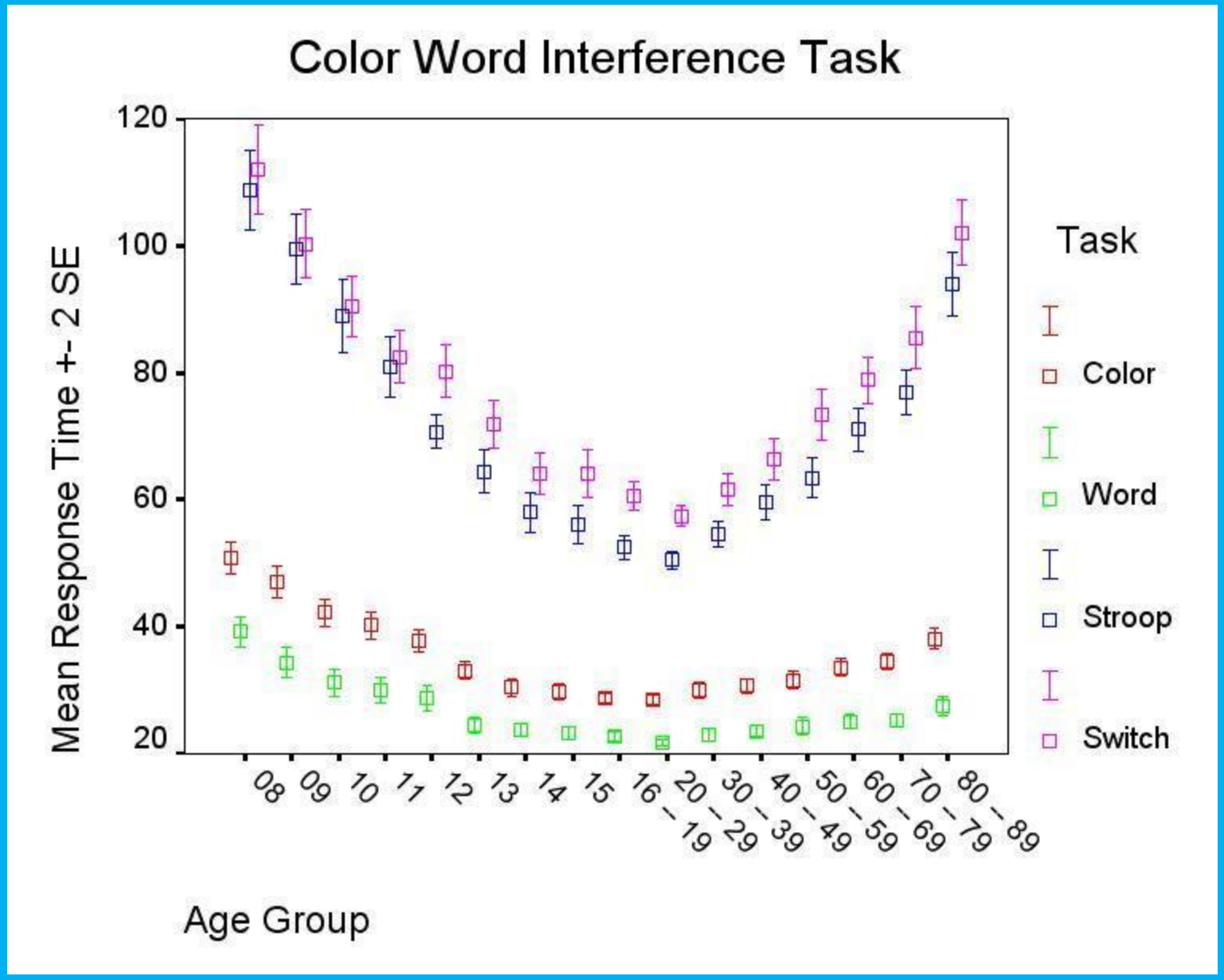
green blue green blue red green red green red blue

red blue red green blue green blue red red blue

blue red green red red green blue red blue red

blue green blue green red red green red blue green

green red red blue green blue red green green red


Color Word Interference Task
Mean Response Time +- 2 SE
120
100
80
60
40
20
08
09
10
11
12
13
14
15
16 – 19
20 – 29
30 – 39
40 – 49
50 – 59
60 – 69
70 – 79
80 – 89
Age Group
Task
Color
Word
Stroop
Switch

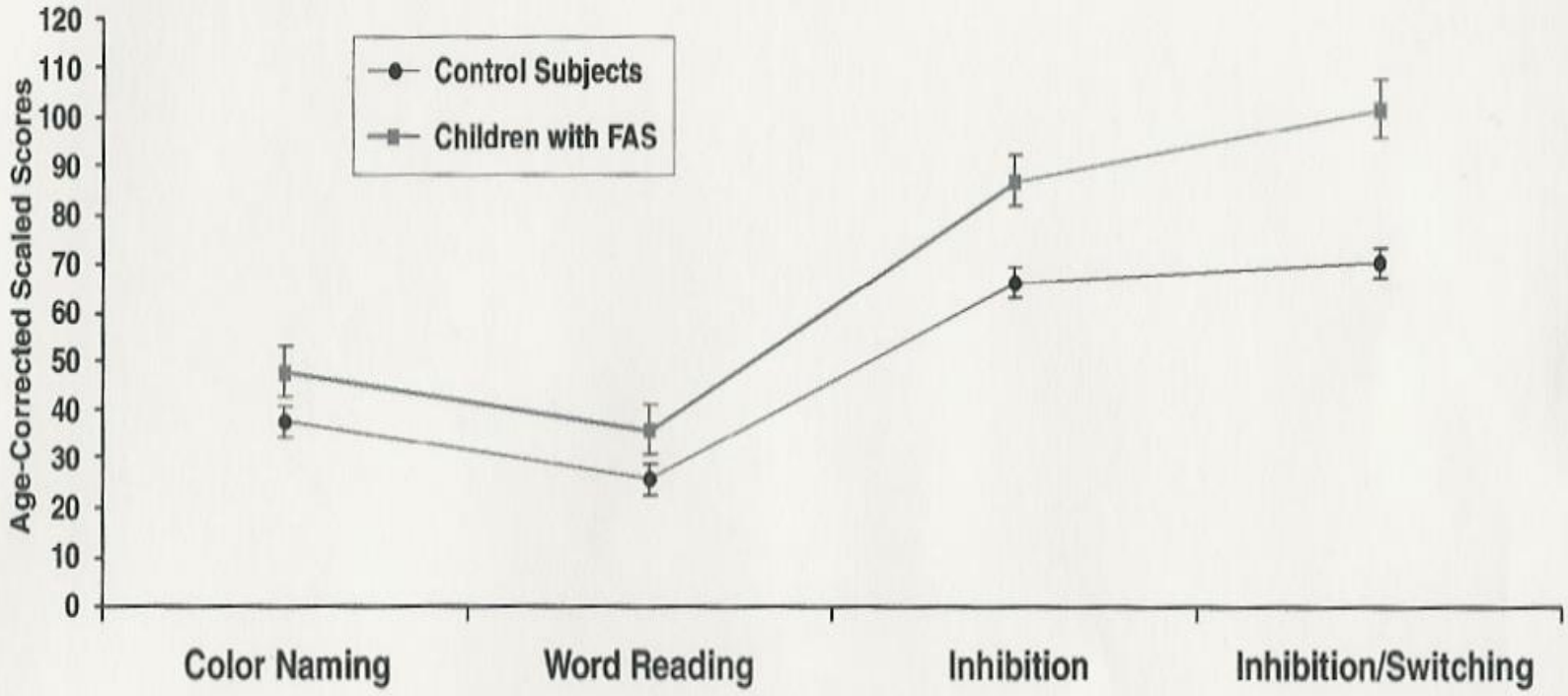
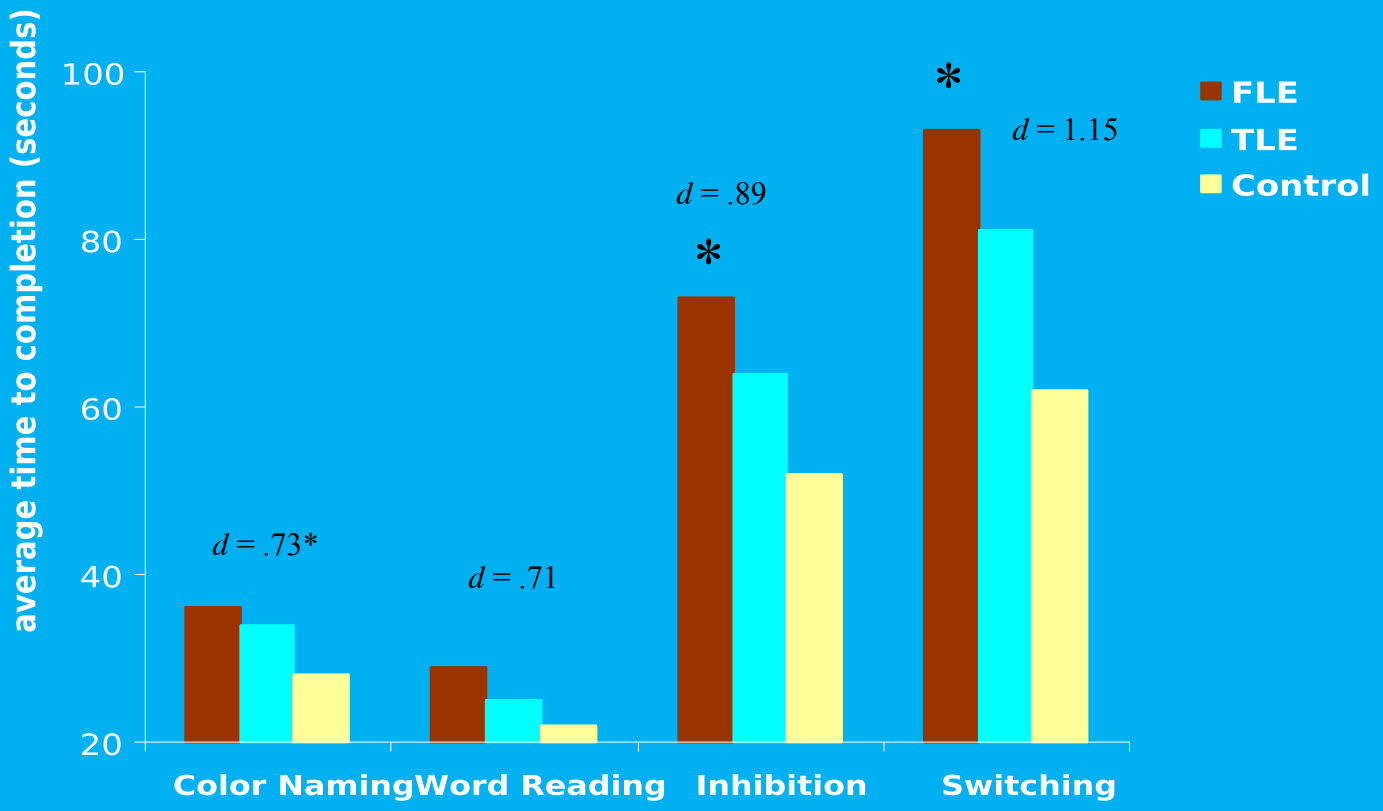


Figure 3.1. Performance of children with fetal alcohol syndrome and matched normal control subjects of the D–KEFS Color–Word Interference Test

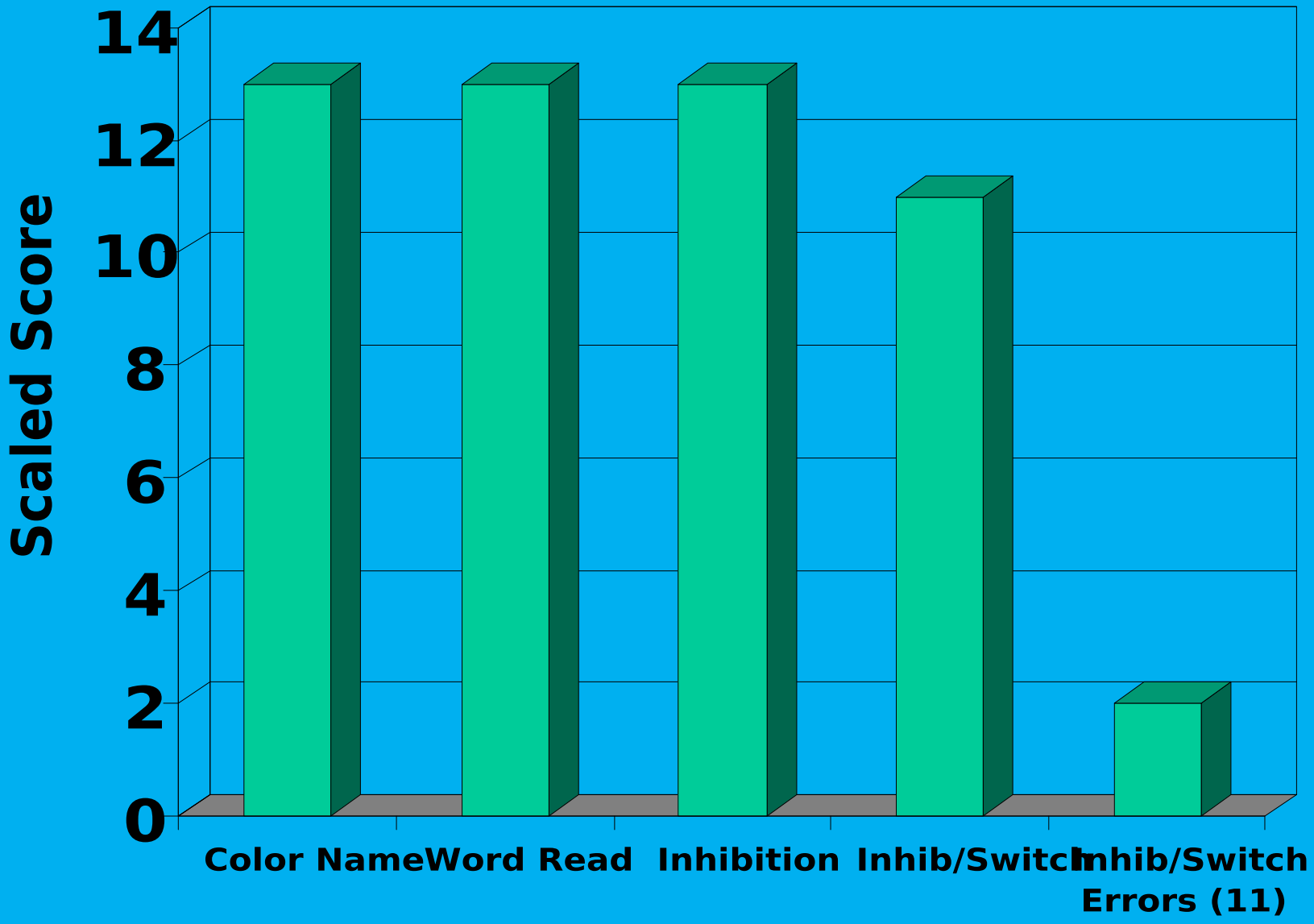
Color-Word Interference Test



Group x condition; F[6,186] = 4.3, p< .001
*Cohen's d reported as ES estimate between FLE group and controls

McDonald, **C. R**. Delis, D. C., Norman, M. A., Wetter, S. R., Tecoma, E. S., & Iragui, V. J. (in press). Epilepsy & Behavior.

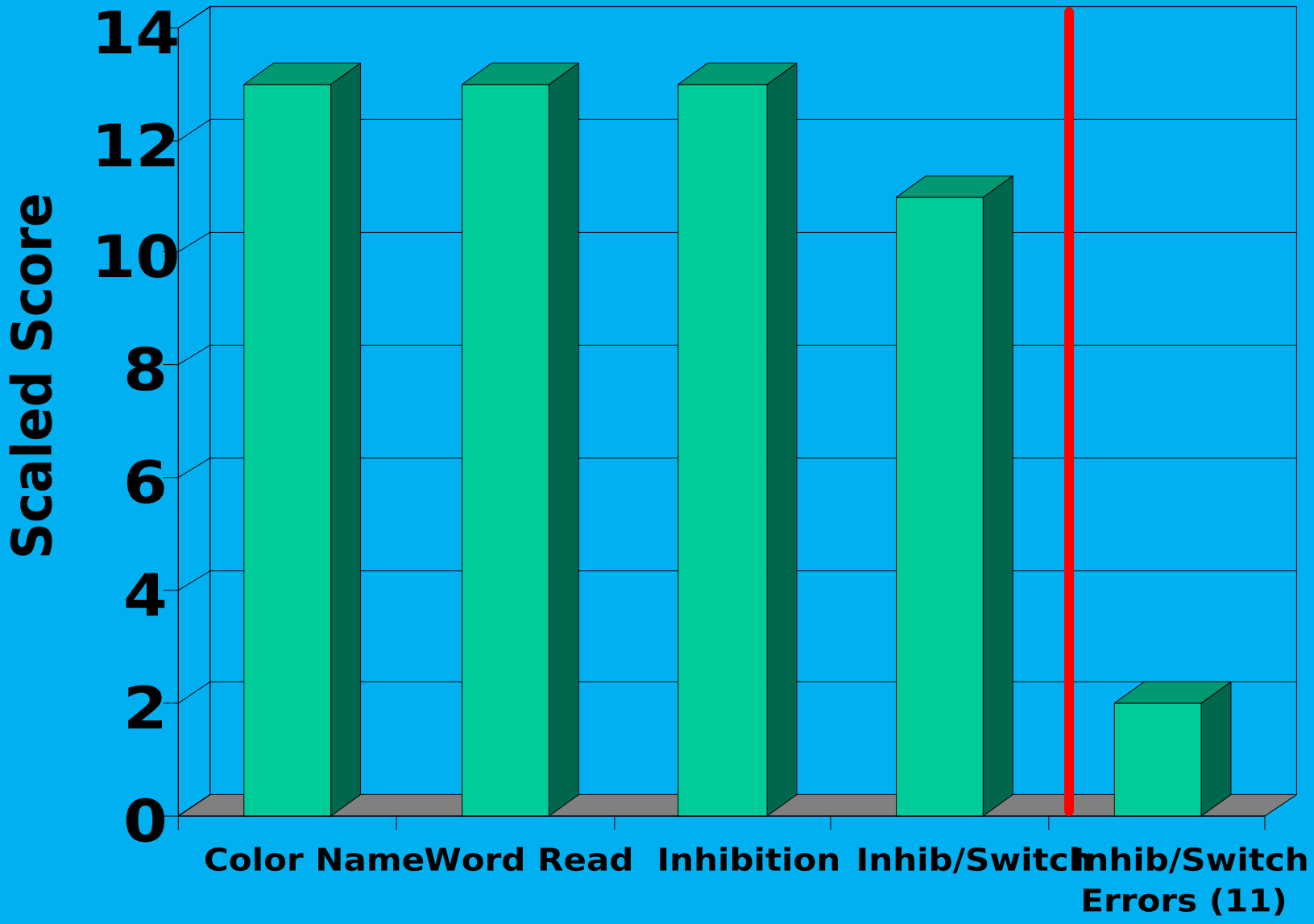
C.D.'s Scores on the DKEFS Color-Word Interference Test



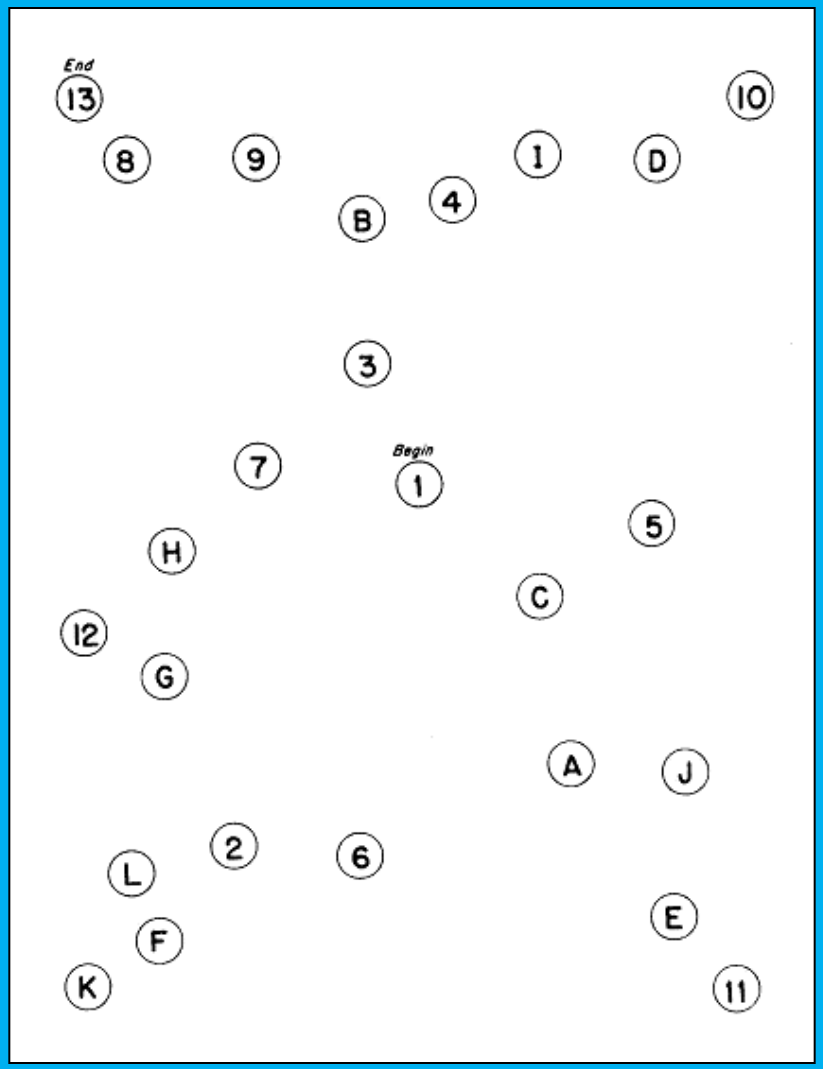
Top 3 Mistakes Made by Psychologists in Assessing Executive Functions

3. A high standardized score on the final "achievement" measure of an "Executive Function" test means that the patient does not have an executive function deficit as assessed by this test.

C.D.'s Scores on the DKEFS Color-Word Interference Test



Component Processes of Trails B



- Visual Scanning
- Motor Speed
- Number Sequencing Skills
- Letter Sequencing Skills
- Cognitive Flexibility

Traditional Trail Making Test

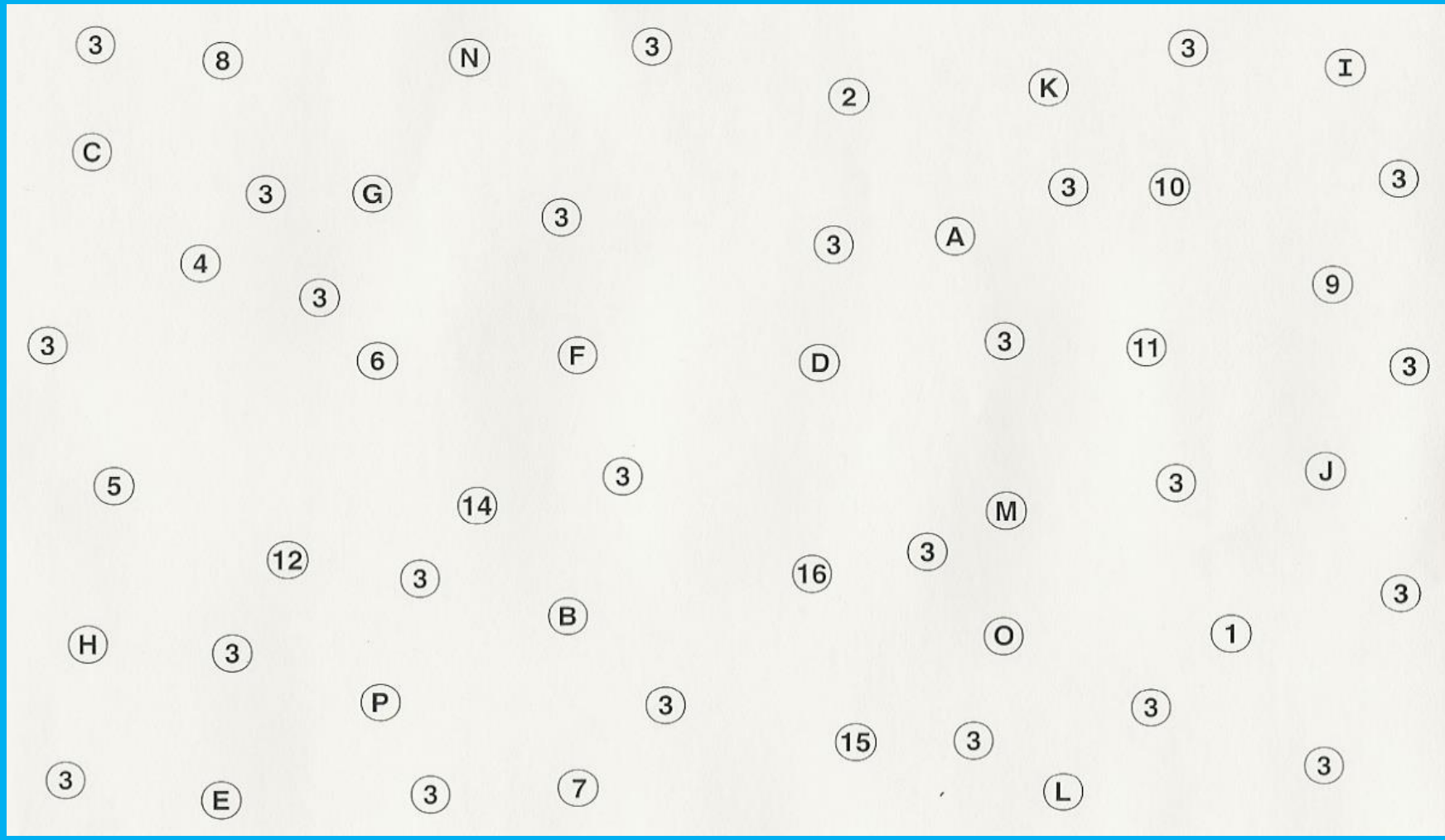
Executive Function:

Cognitive Flexibility	Trails B

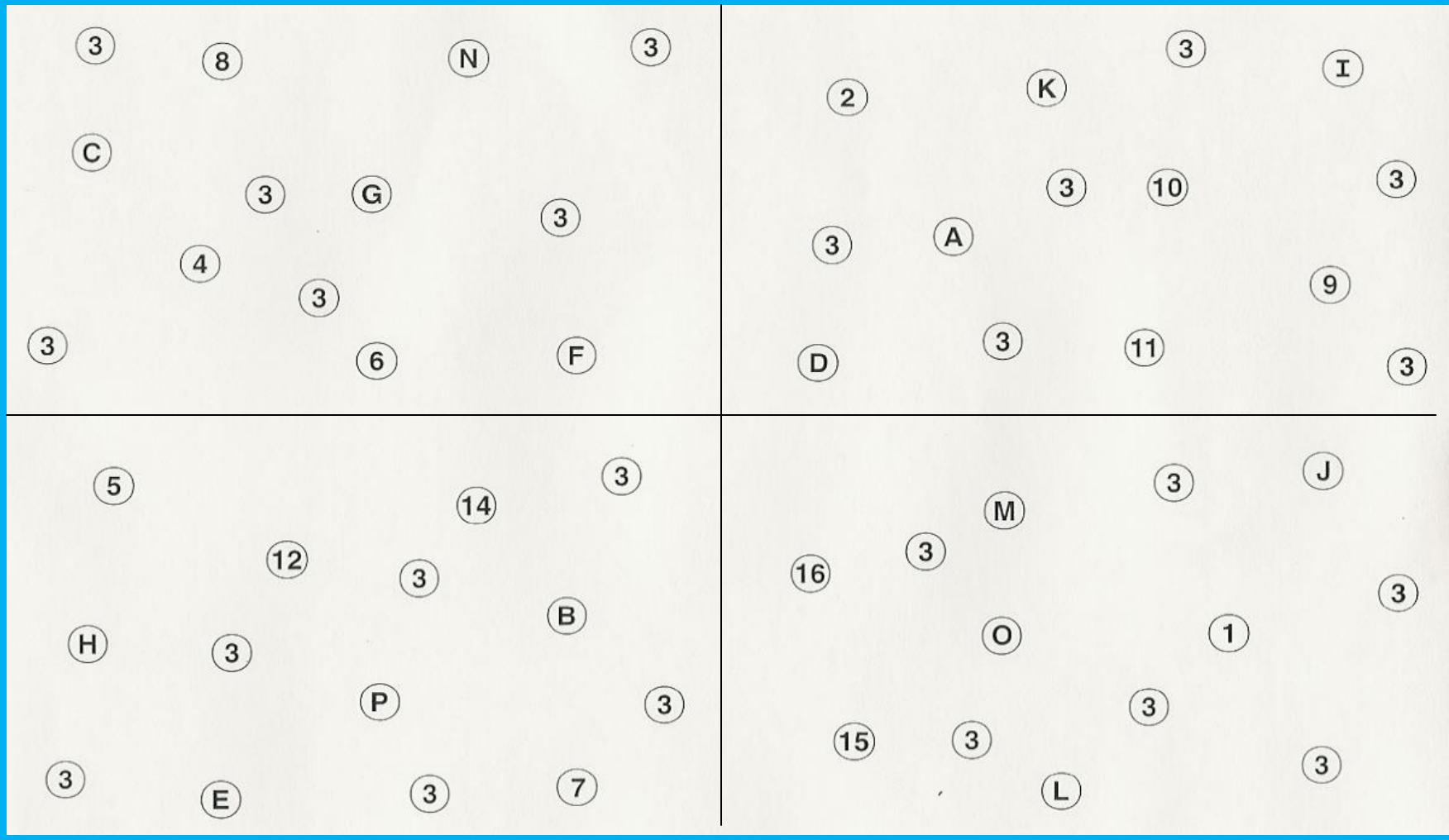
Component Skills:

Visual Scanning	No
Motor Speed	No
Number Sequencing Skills	Trails A
Letter Sequencing Skills	No

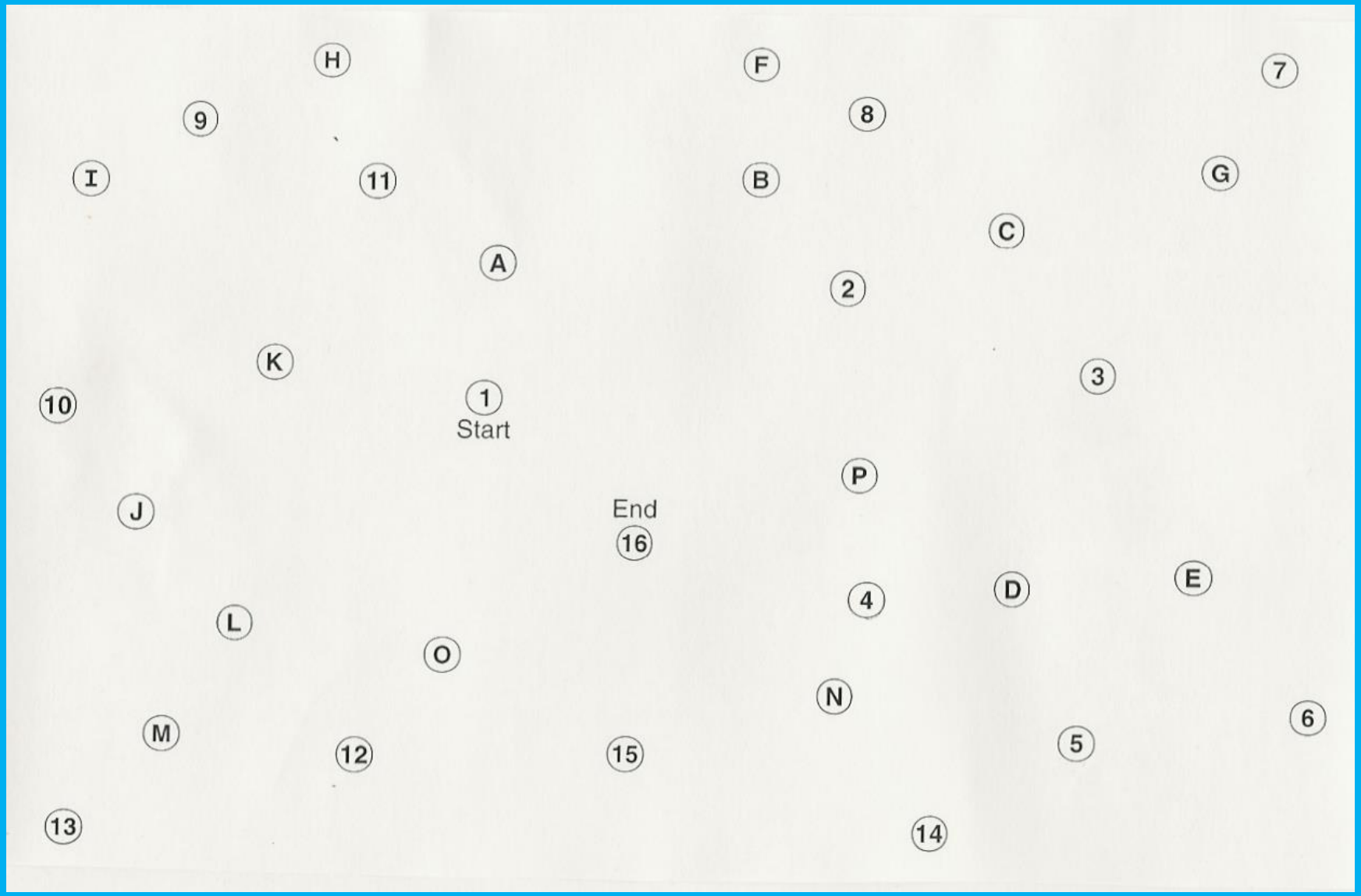
D-KEFS Trail Making Test. Condition 1: Visual Scanning



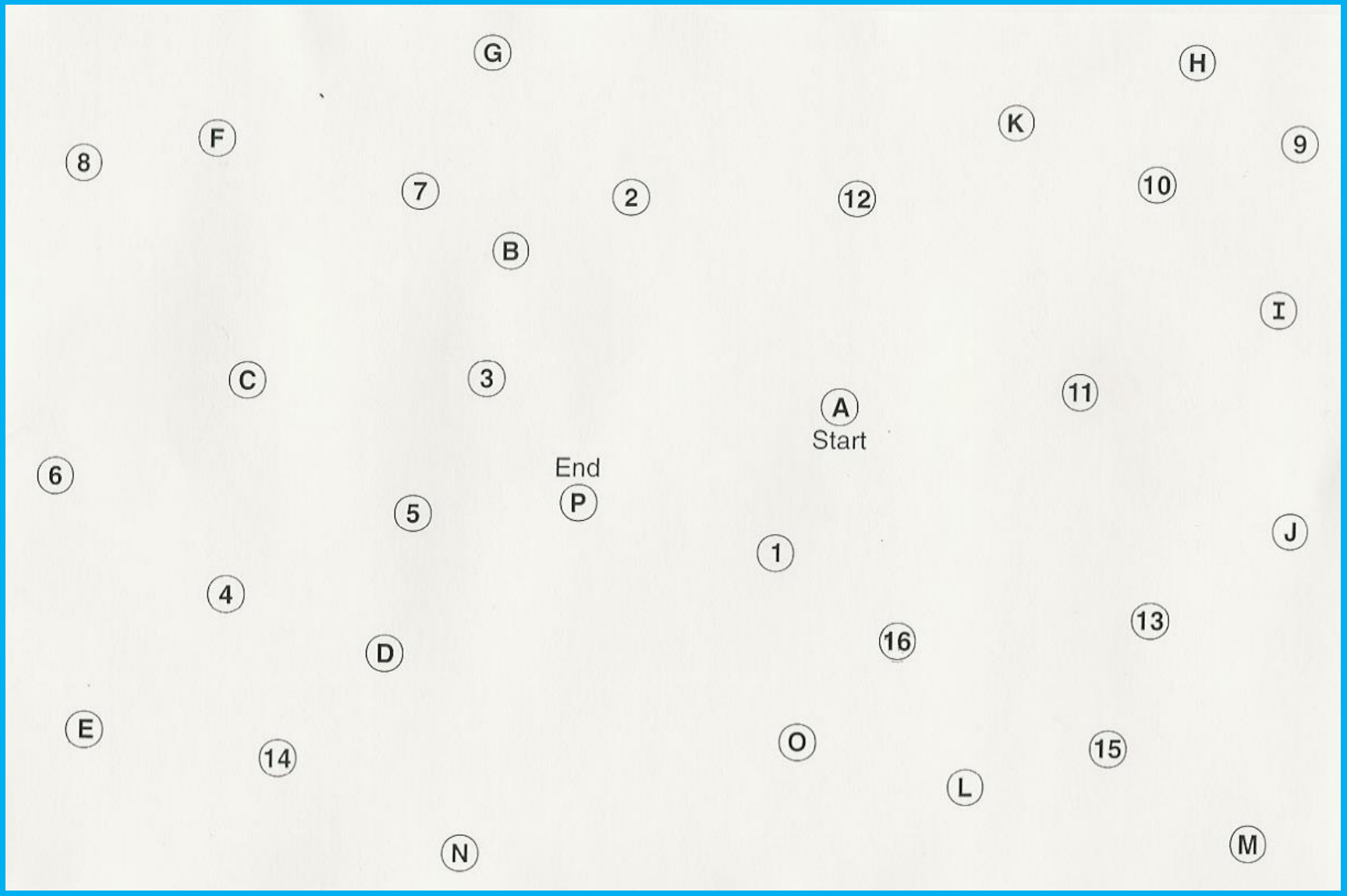
D-KEFS Trail Making Test. Condition 1: Visual Scanning



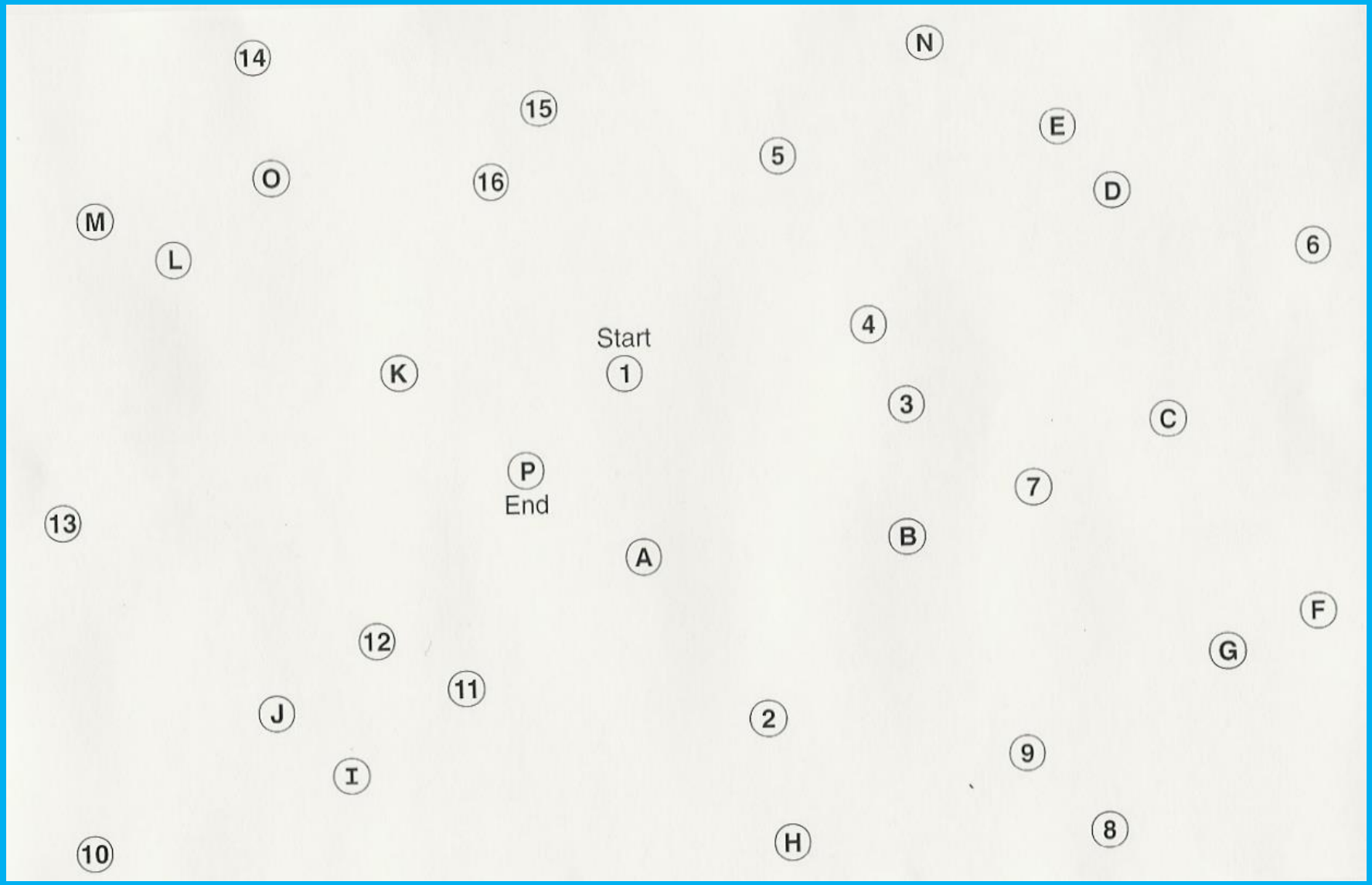
D-KEFS Trail Making Test. Condition 2: Number Sequencing



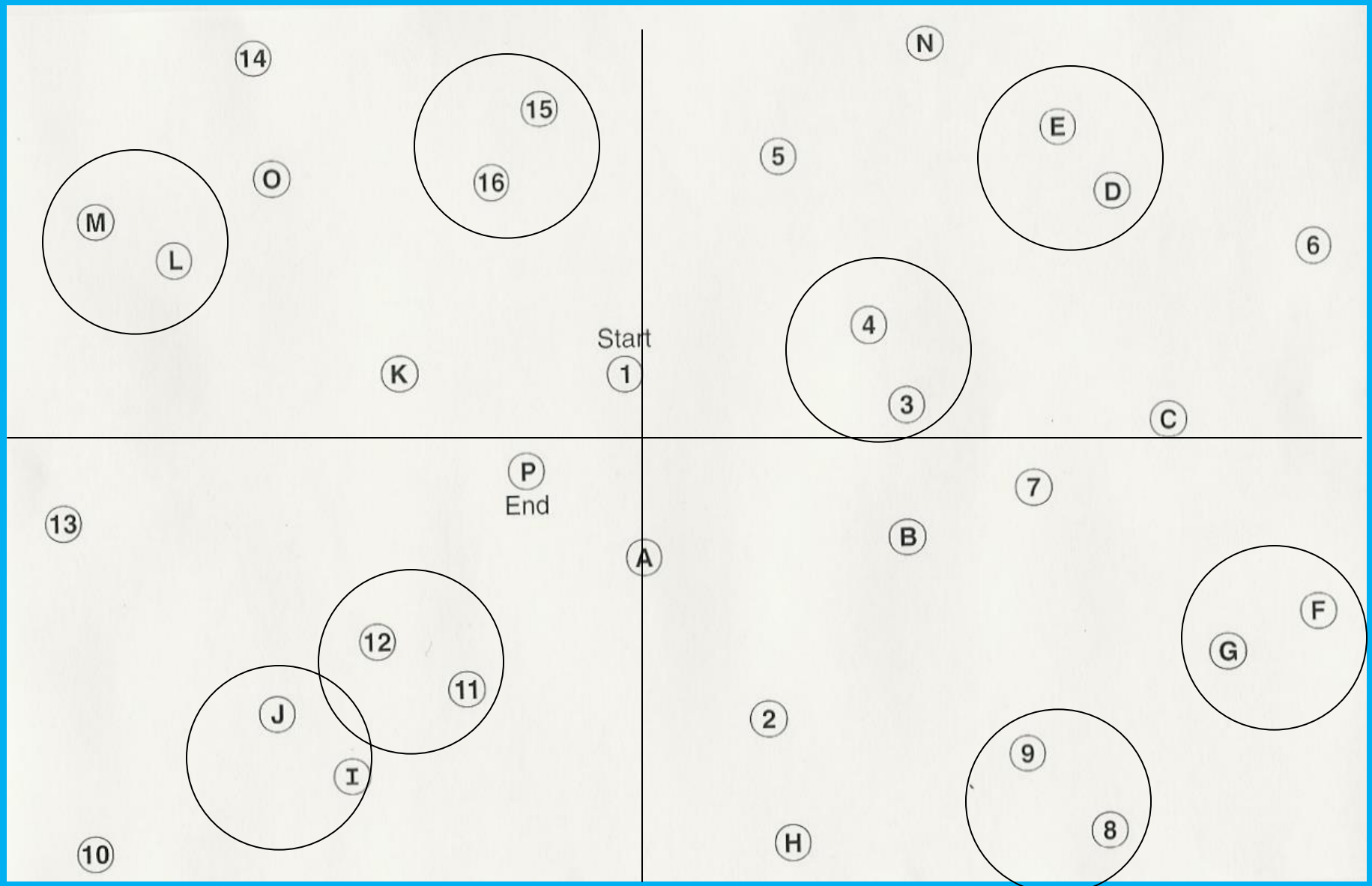
D-KEFS Trail Making Test. Condition 3: Letter Sequencing



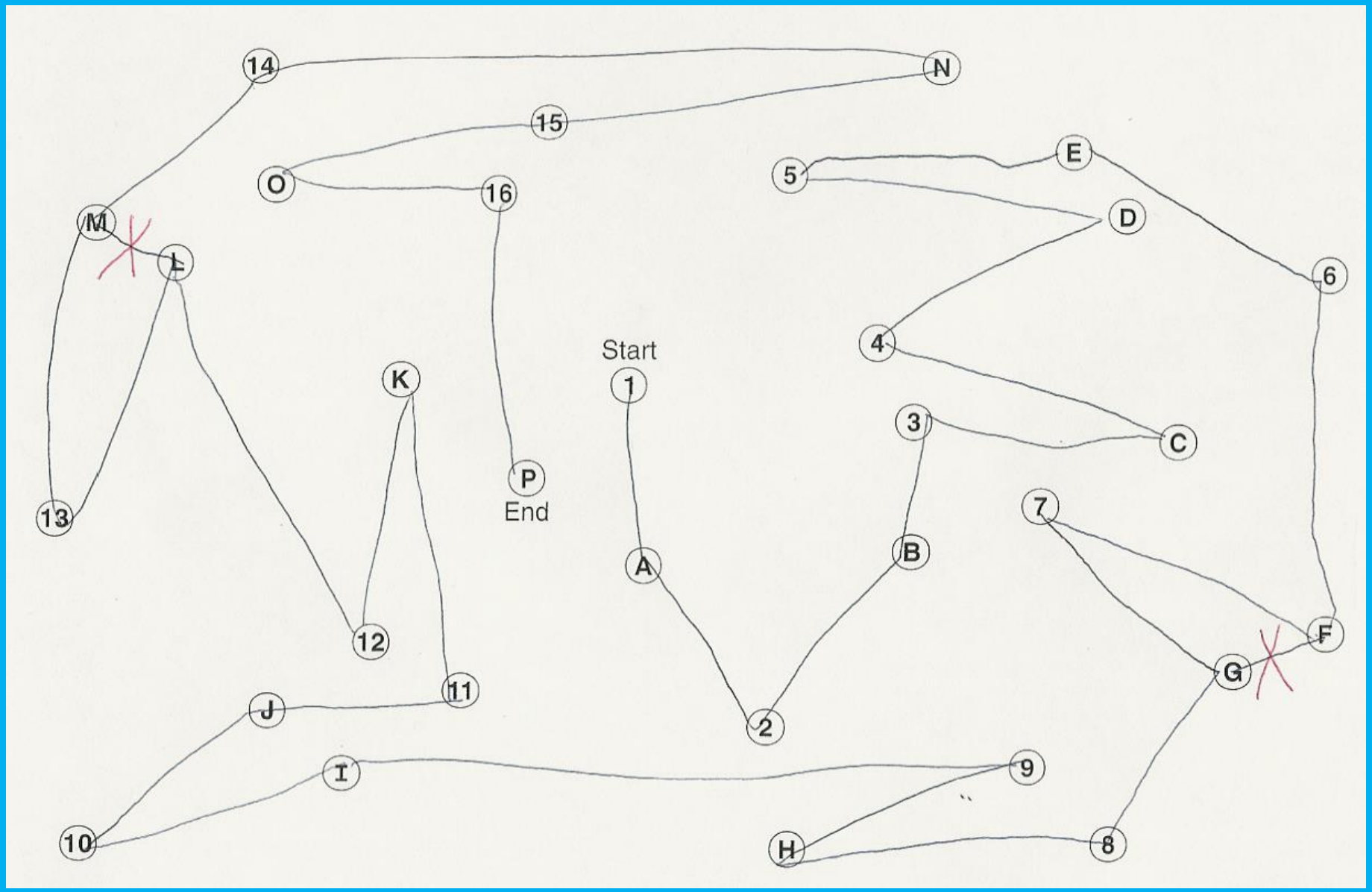
D-KEFS Trail Making Test. Condition 4: Number-Letter Switching



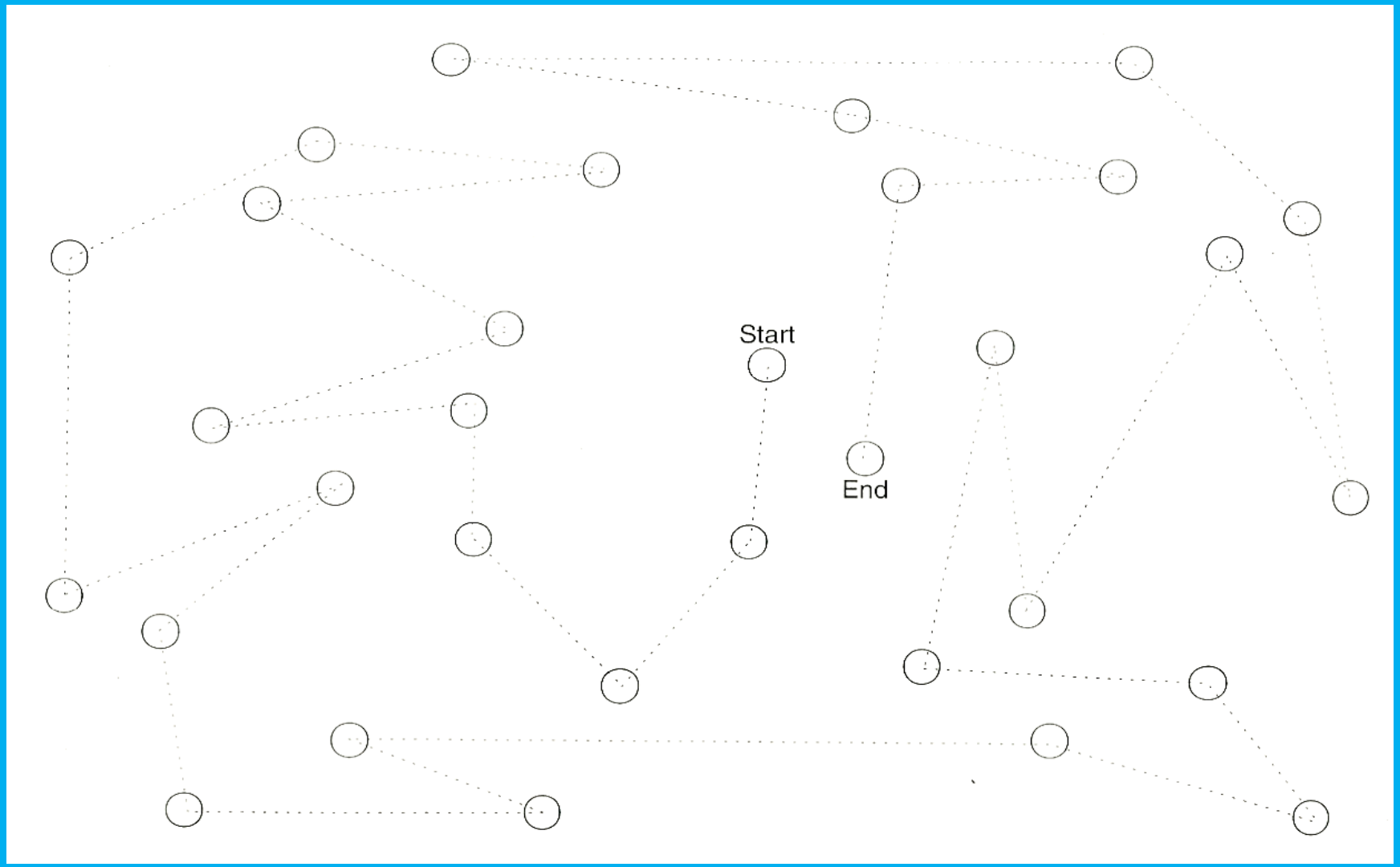
D-KEFS Trail Making Test. Condition 4: Number-Letter Switching



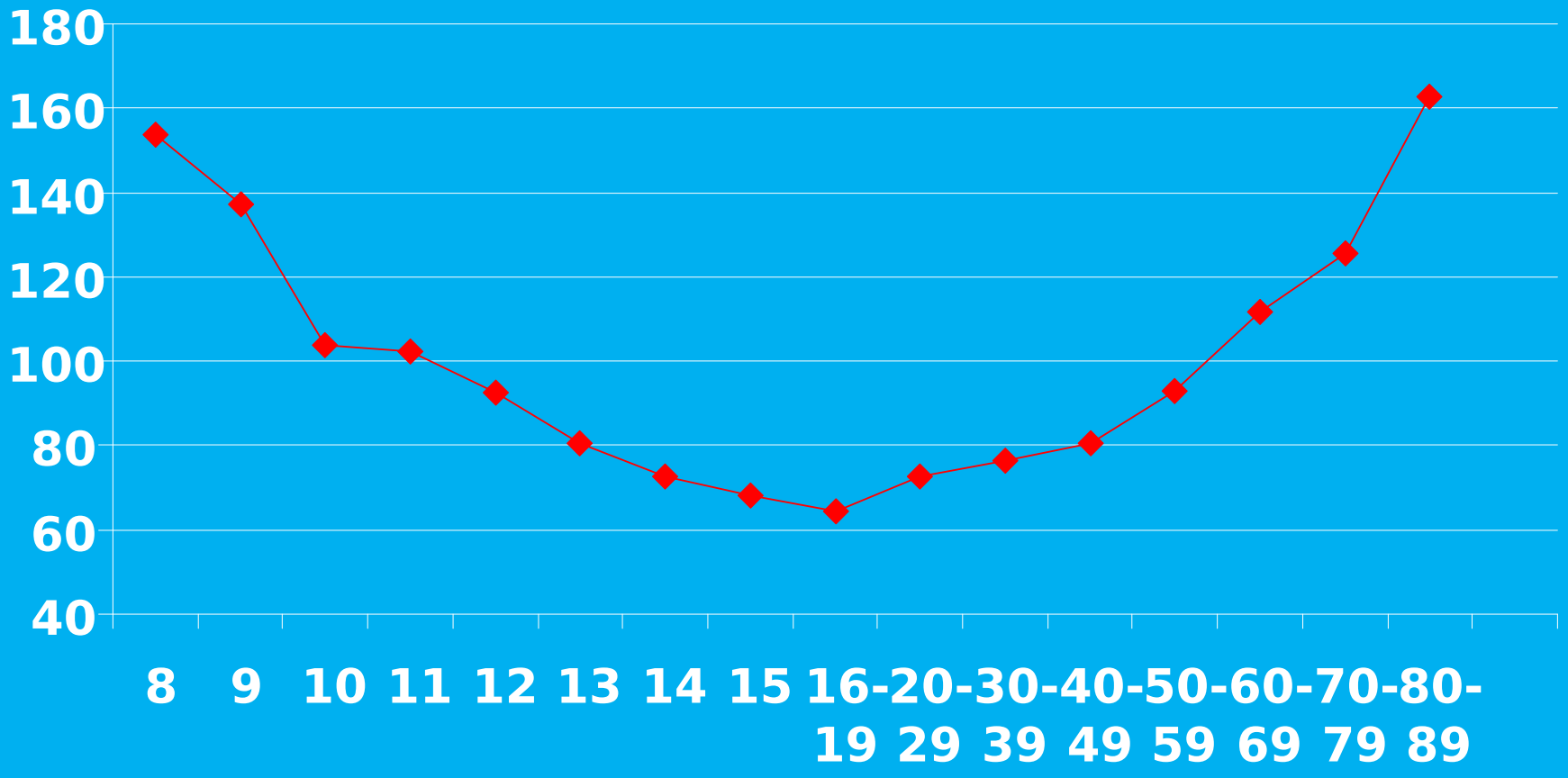
D-KEFS Trail Making Test. Condition 4: Number-Letter Switching



D-KEFS Trail Making Test. Condition 5: Motor Speed



Trails: Shifting Condition



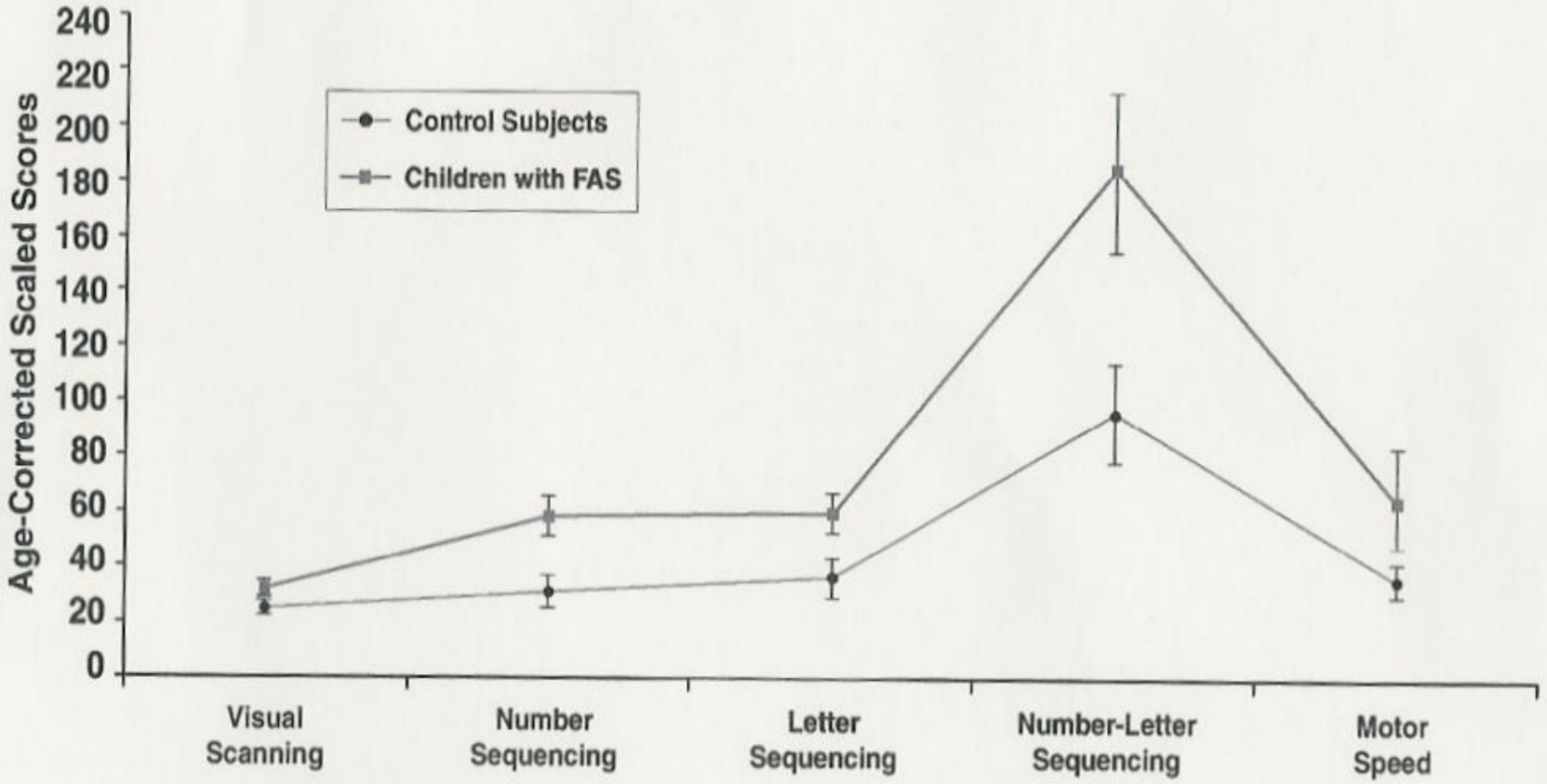
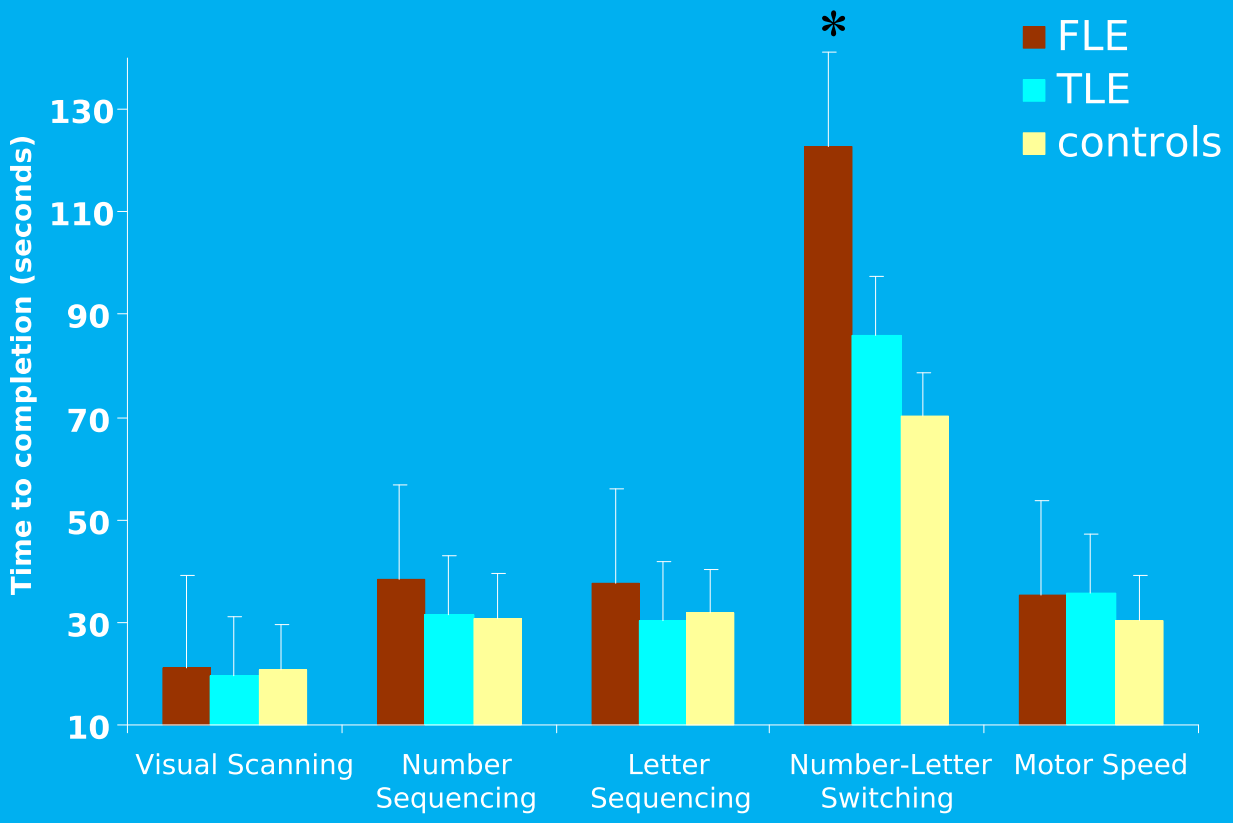


Figure 3.2. Performance of children with Fetal Alcohol Syndrome and matched normal control subjects of the D–KEFS Trail Making Test

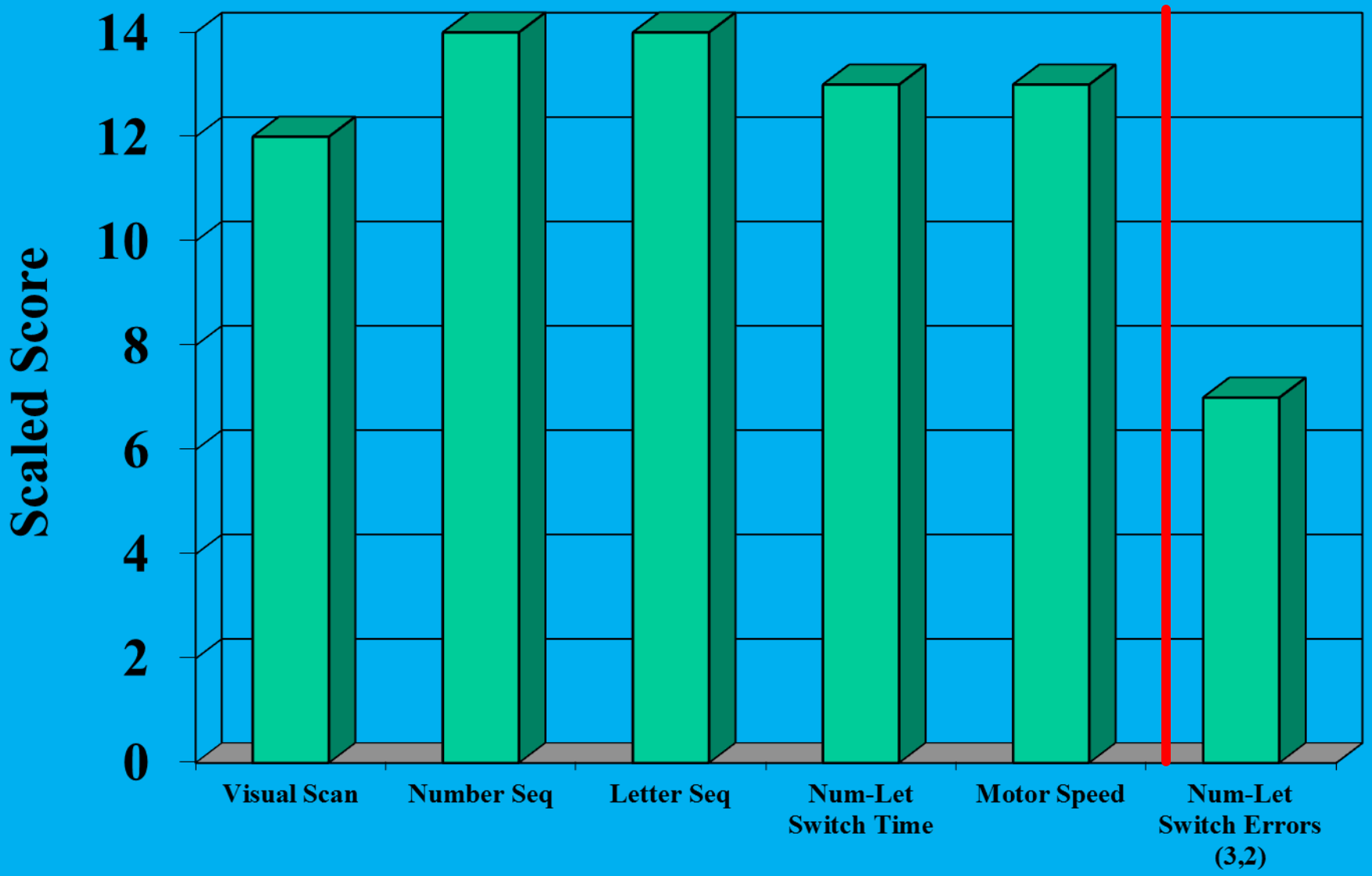
Trail Making Test



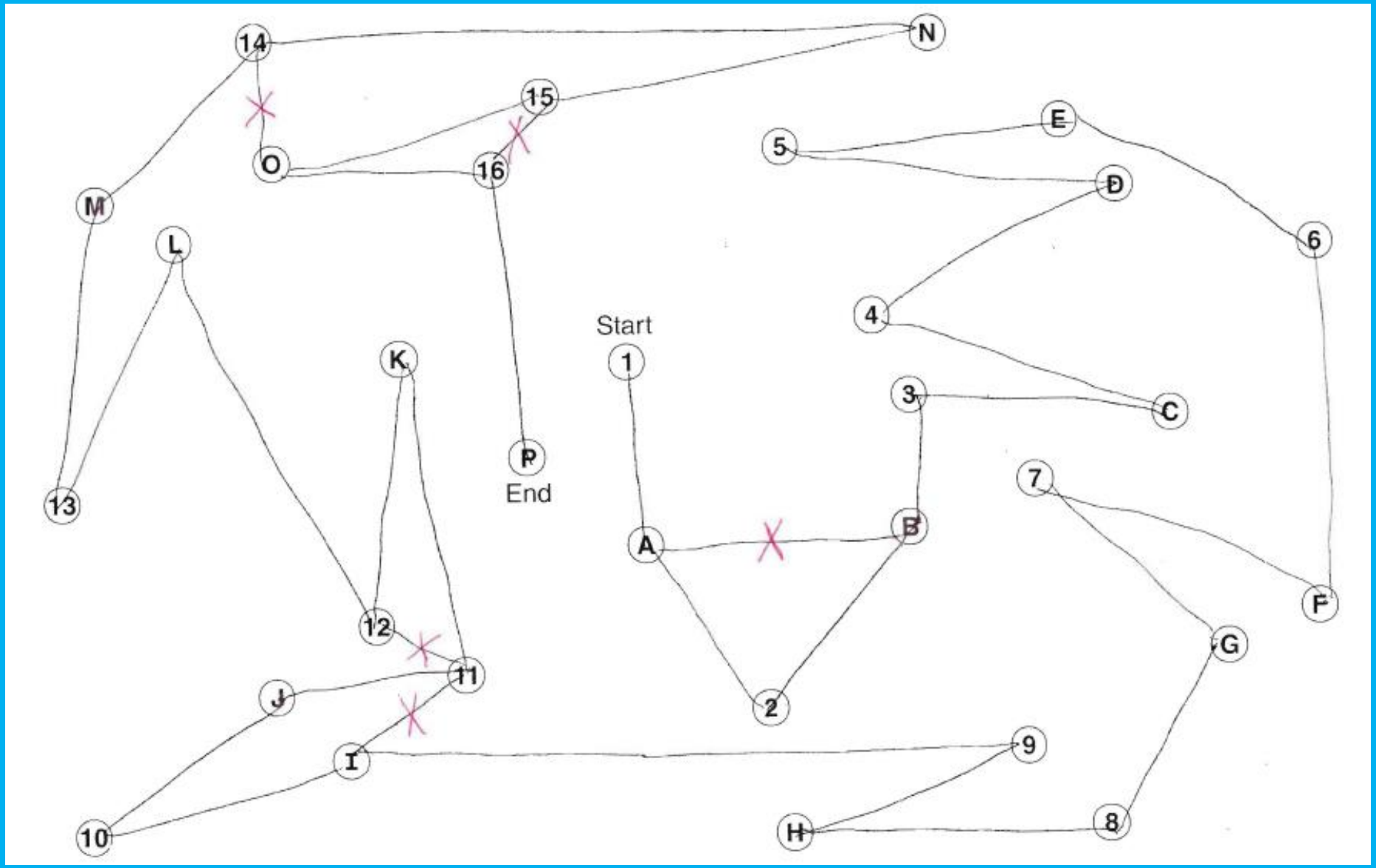
Group x condition; $F[8,248] = 9.0$, $p < .01$, $\eta^2 = .23$

McDonald, C. R., Delis, D. C., Norman, M. A., Tecoma, E. S., & Iragui, V. J. (in press). Is impairment in set-shifting specific to frontal-lobe dysfunction? Evidence from patients with frontal-lobe or temporal-lobe epilepsy. Journal of the International Neuropsychological Society.

C.D.'s Scores on the DKEFS Trail Making Test

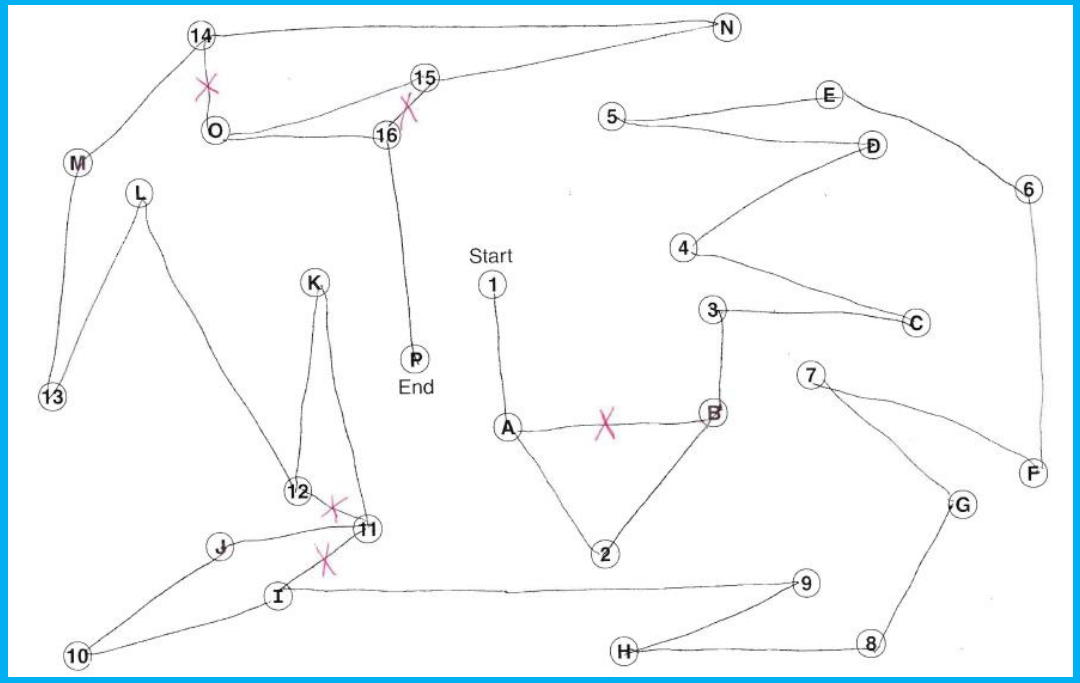


C.D.'s Number-Letter Switching Condition



Top 3 Mistakes Made by Psychologists in Assessing Executive Functions

2. If a patient makes a classic error on an "Executive Function" test, this means that the patient has an executive function deficit as assessed by this test.

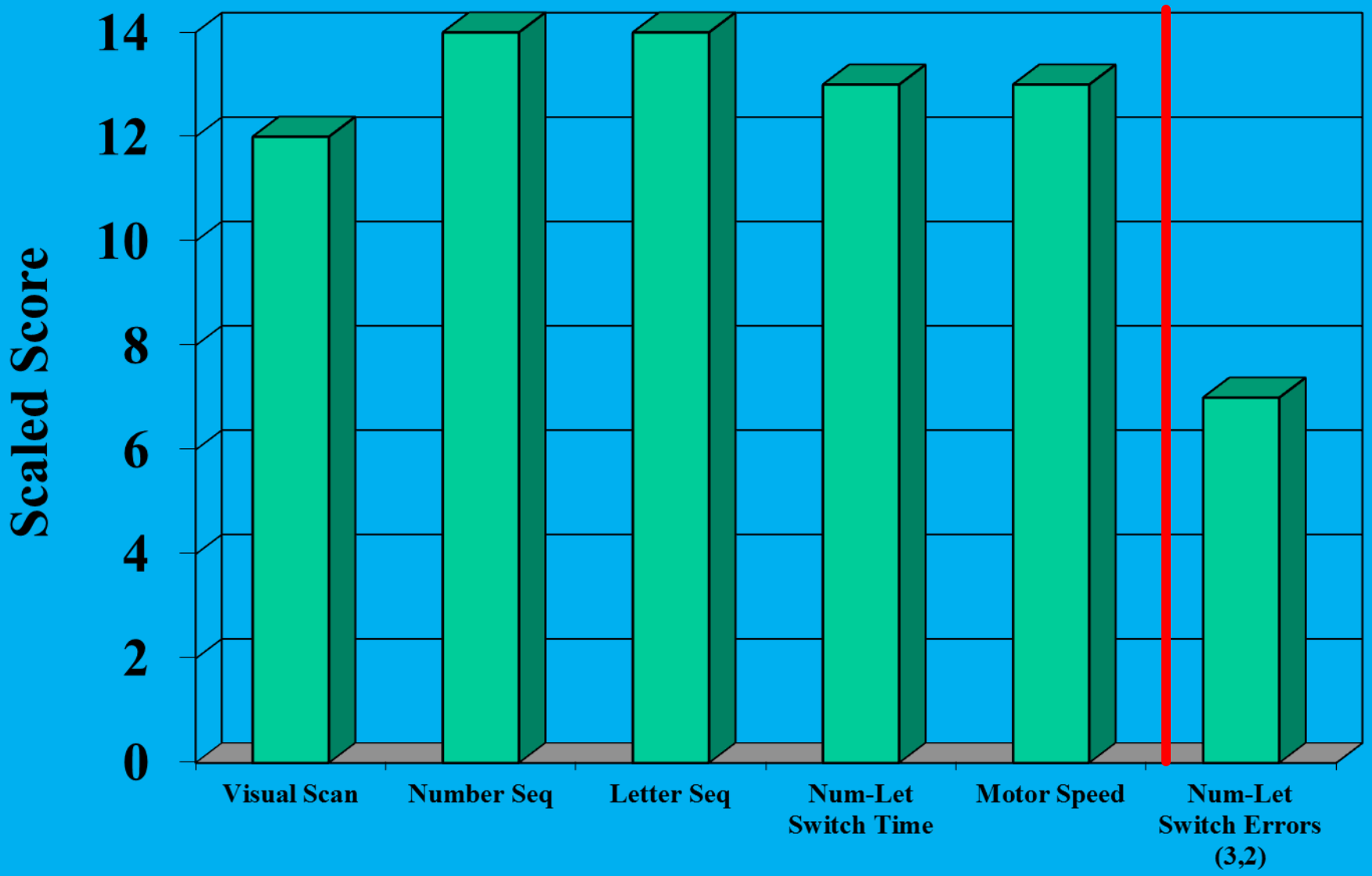


A.25% of 50-59 year olds make 3 errors on Trails Switching

B.25% of 60-69 year olds make 4 errors on Trails Switching

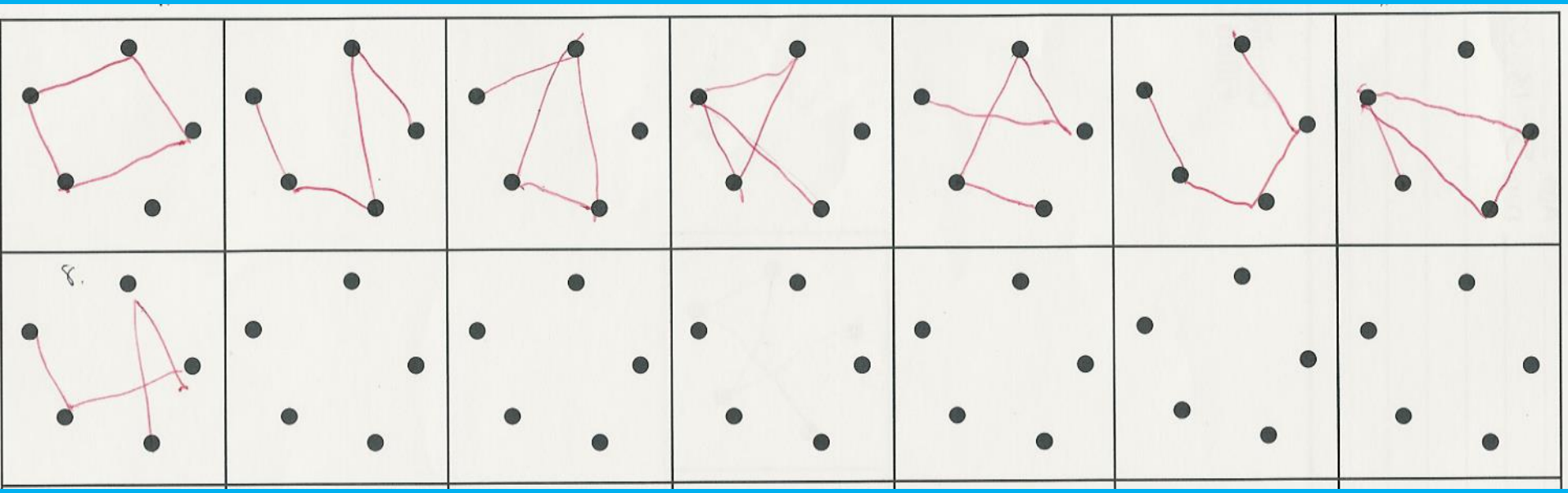
C.37% of 10 year olds make 3 errors on Trails Switching

C.D.'s Scores on the DKEFS Trail Making Test



Design Fluency: Condition 1

Filled Dots



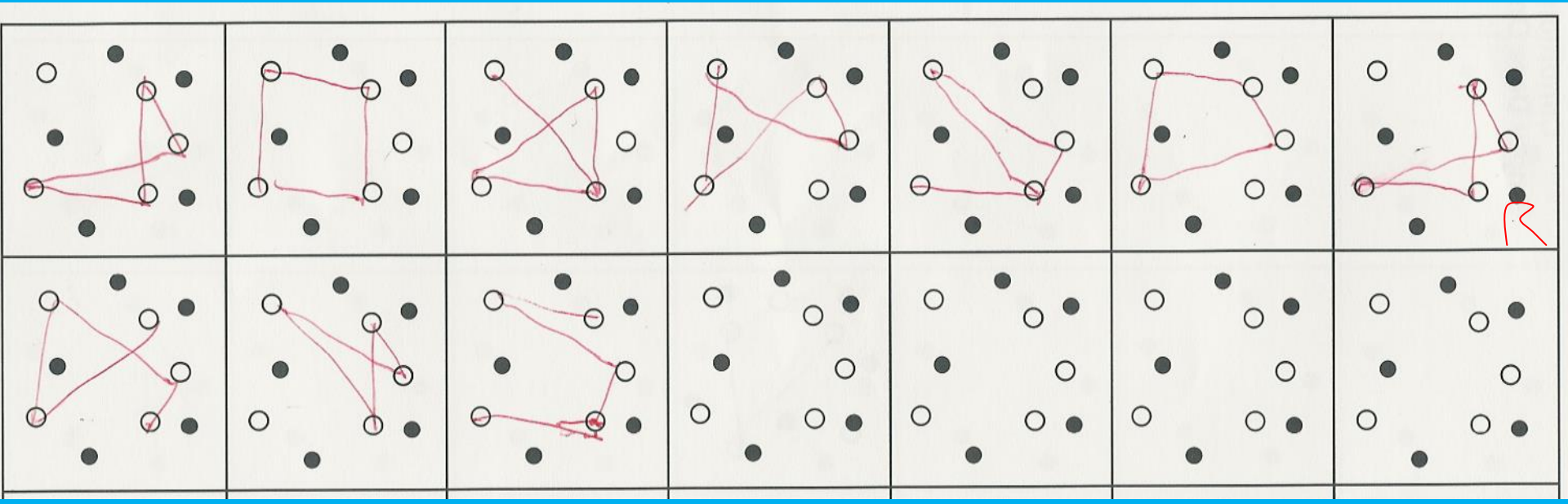
Correct Raw Score = 8

Errors = 0

Aged Scale Score = 10

Design Fluency: Condition 2

Empty Dots Only



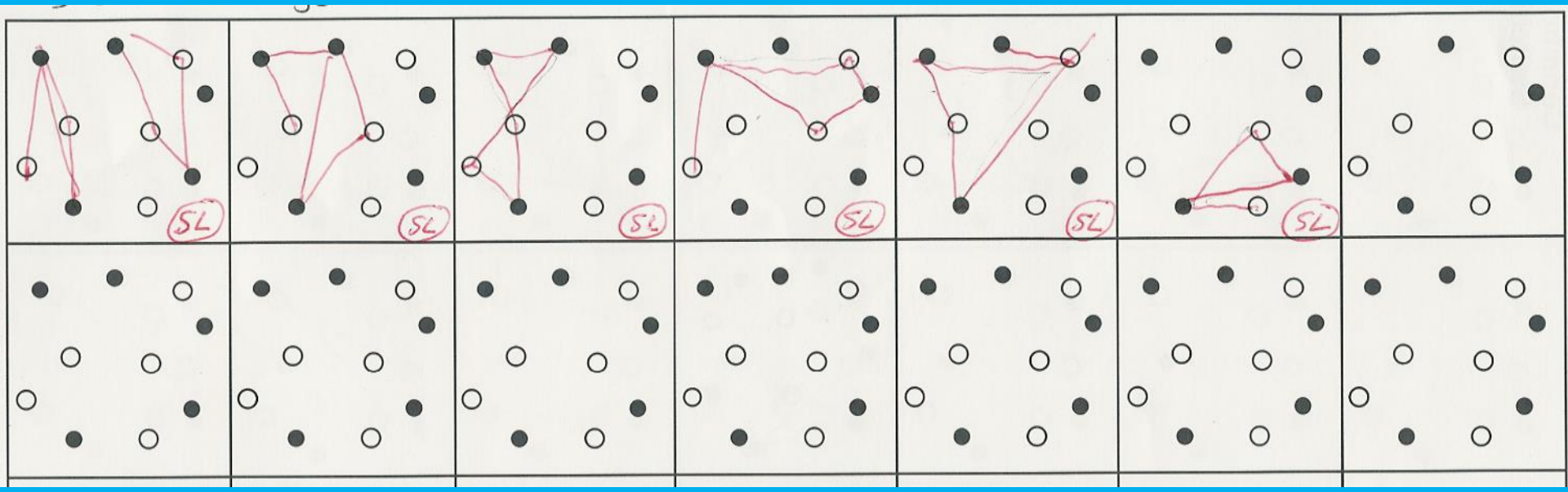
Correct Raw Score = 9

Errors = 1

Aged Scale Score = 10

Design Fluency: Condition 3

Switching

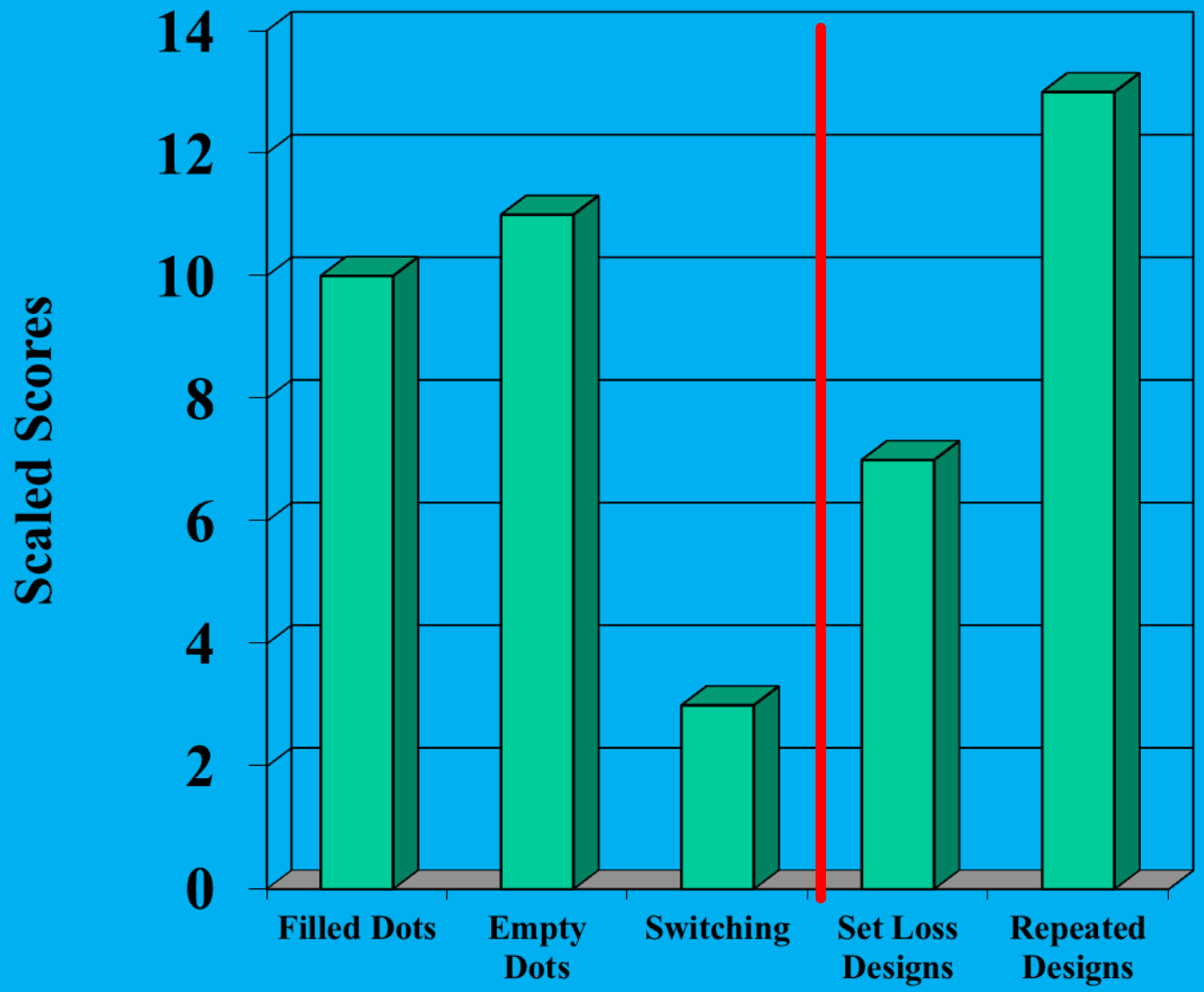


Correct Raw Score = 0

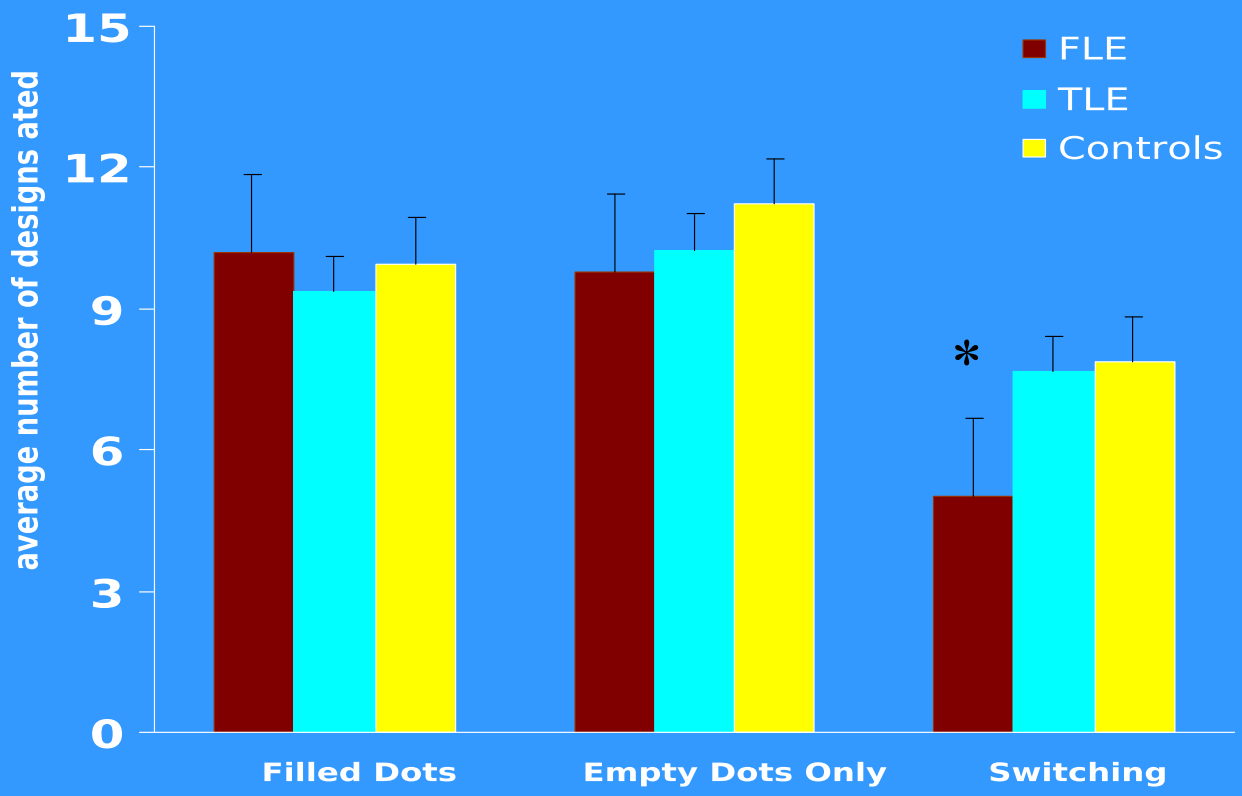
Set Loss Errors = 6

Aged Scale Score = 3

C.D.'s Scores on the DKEFS Design Fluency Test



Design Fluency Test



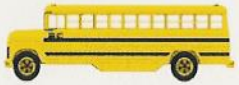
$F(4,126) = 2.5$, $p < .05$; $\eta^2 = .07$

McDonald, C. R. Delis, D. C., Norman, M. A., Tecoma, E. S., & Iragui, V. J. (in press). Discriminating patients with frontal lobe epilepsy and temporal lobe epilepsy: Utility of a new measure of design fluency. Neuropsychology.















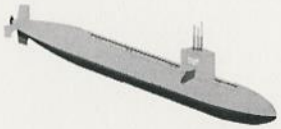












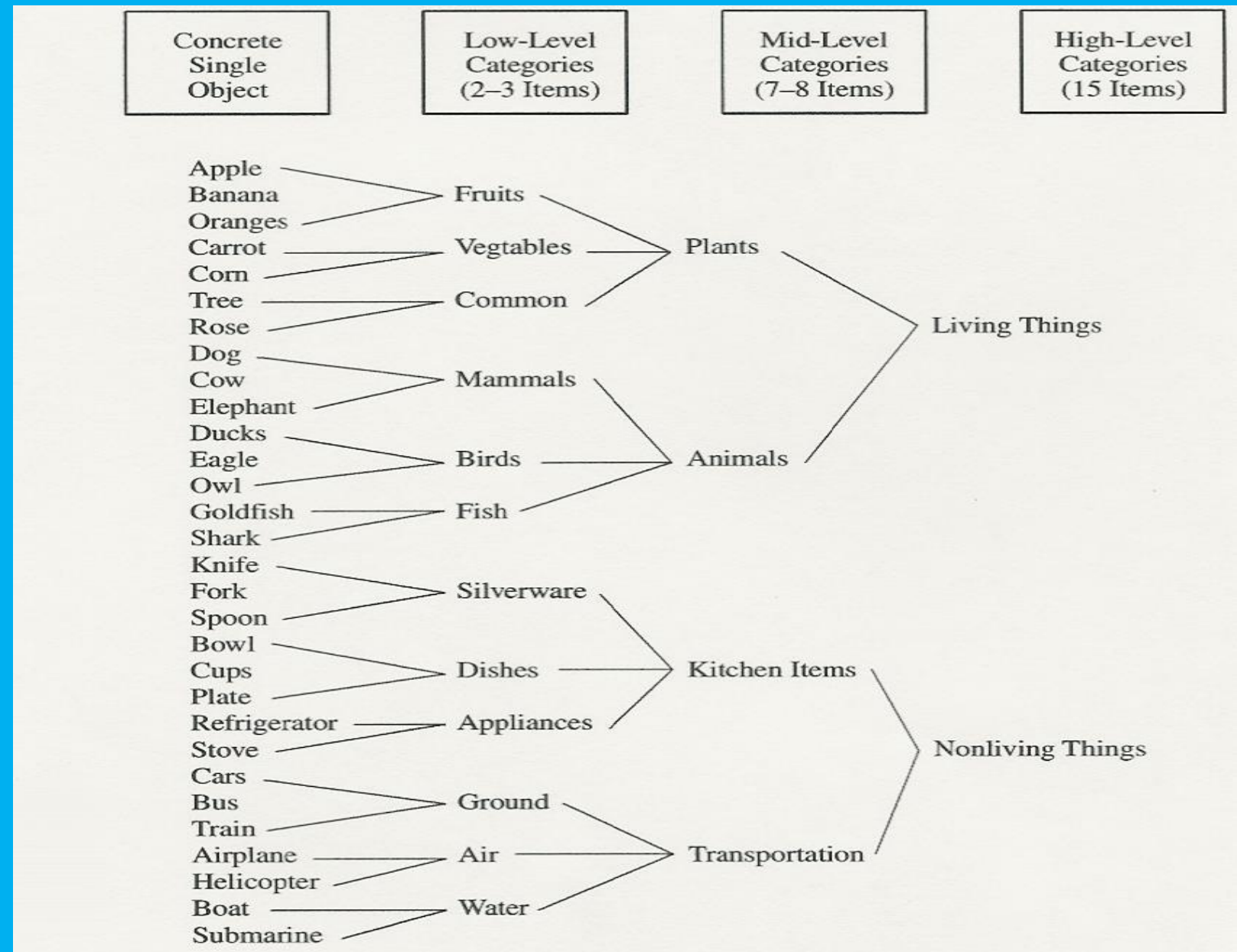
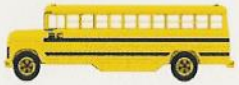


Figure 8.1. Categorical Hierarchy of the Stimulus Objects of the D–KEFS Twenty Questions Test















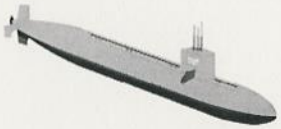












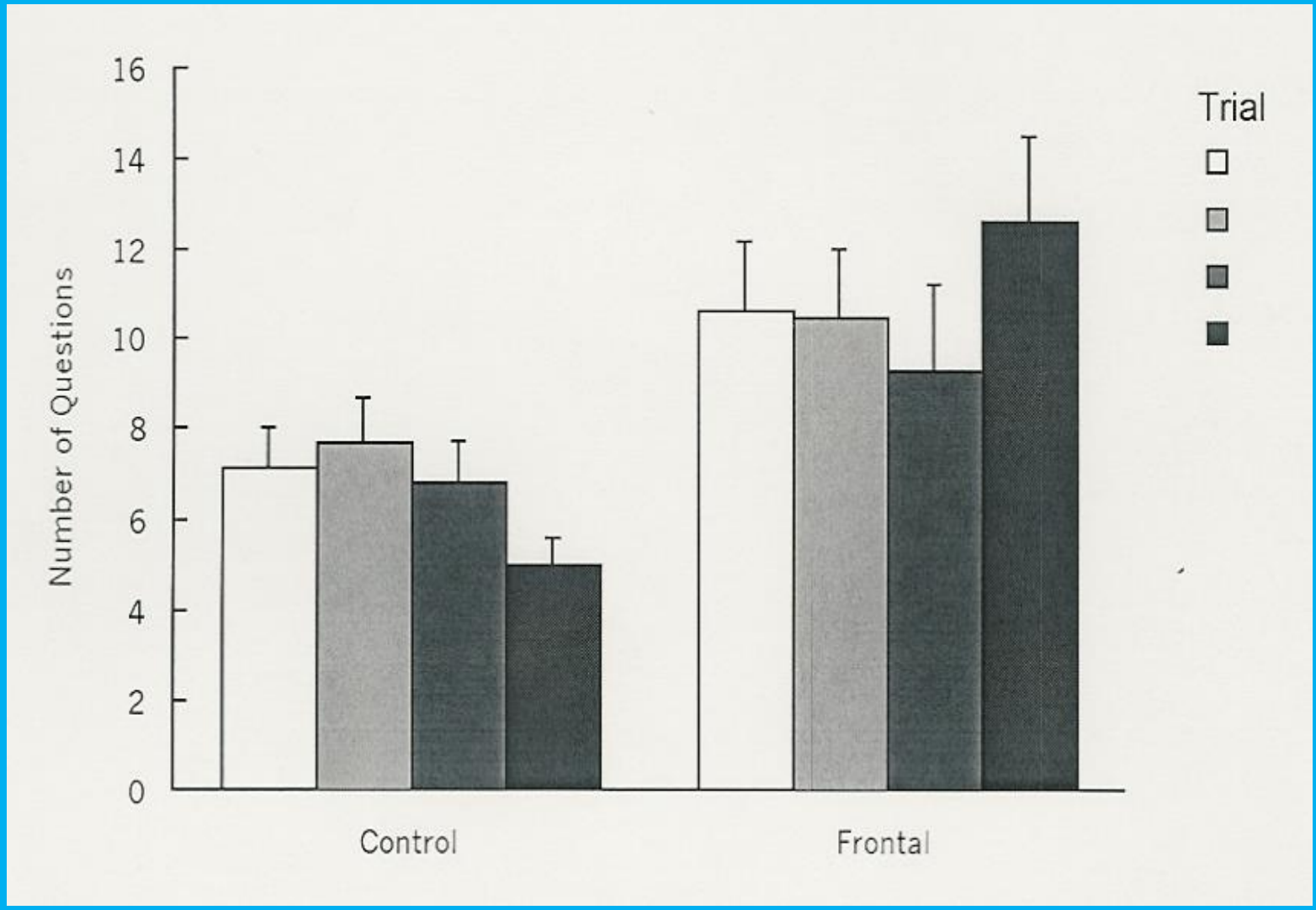
Pergamon

Archives of Clinical Neuropsychology
19 (2004) 407–419

Archives
of
CLINICAL
NEUROPSYCHOLOGY

Is it bigger than a breadbox? Performance of patients with prefrontal lesions on a new executive function test

Juliana V. Baldo [a,b,*], Dean C. Delis [c,d], David P. Wilkins [a], Arthur P. Shimamura [e]


Number of Questions
16
14
12
10
8
6
4
2
0
Control
Frontal
Trial






























Percentage of Single-Item Questions

Frontal Patients	67.6%
Control Subjects	31.0%

Patient EB's Questions for "Spoon"

- Do you drink it? (No)
- Do you smell it? (No)
- Does it go in water? (No)
- Do you cook on it? (No)
- Do you get milk from it? (No)
- Does it bark? (No)
- Does it keep food cold? (No)
- Do you get juice out of it? (No)
- Is it in the wild? (No)
- Is it yellow? (No)

11. Does it bark? (No)
12. Does it use gasoline? (No)
13. Does it fly? (No)
14. Do you eat it? (No)
15. Does it grow in the garden? (No)
16. Is it purple? (No)
17. Does it run on tracks? (No)
18. Does it hoot at night? (No)
19. Do you eat from it? (Yes)
20. Is it a plate? (No)

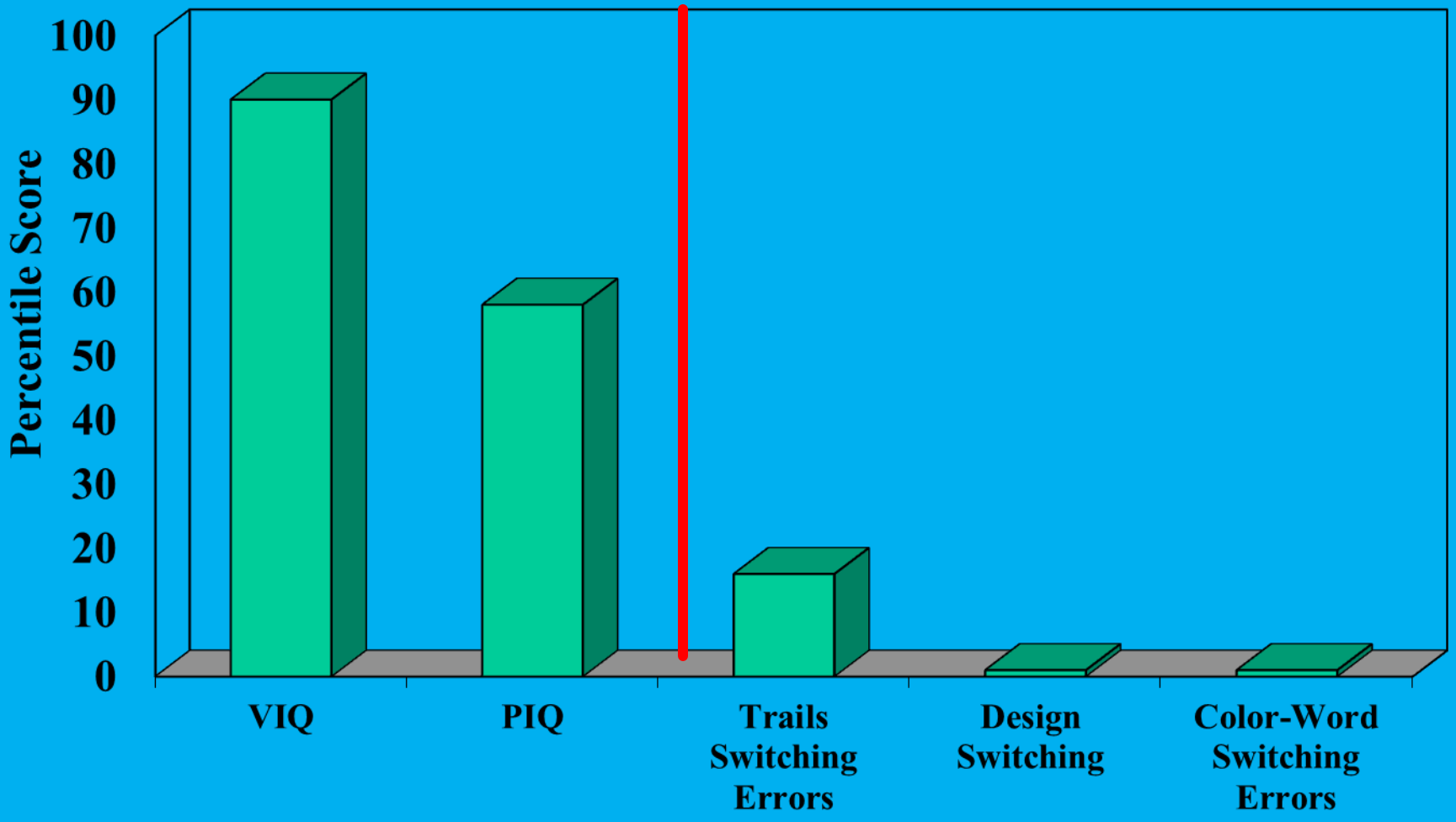
Weighted Achievement Score

Questions Asked	Weighted Score
1-2	1
3	2
4-5	5
6-7	4
8-10	3
11-14	2
15-20	1

20 Questions: Scoring

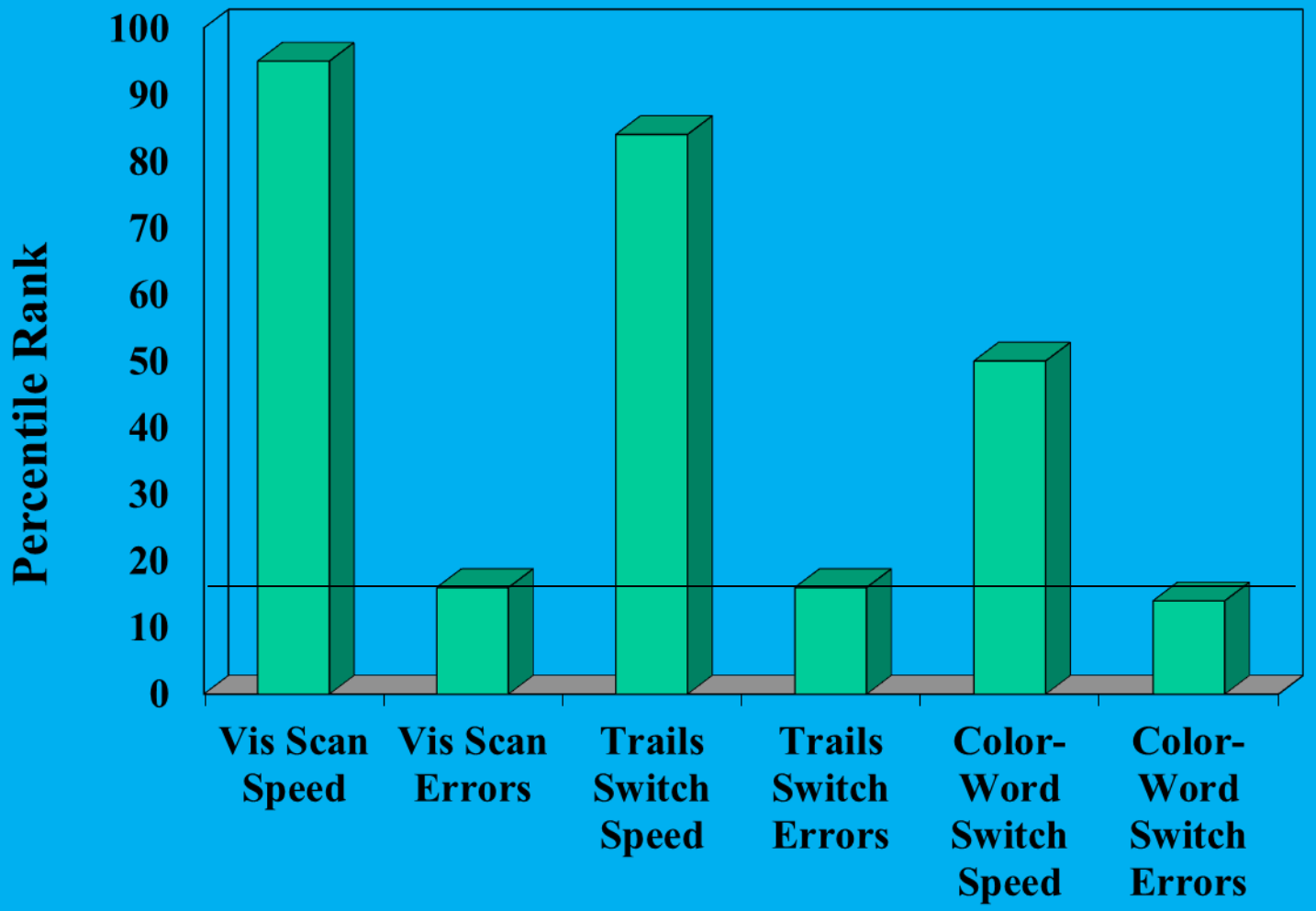
- Initial abstraction score
- Total questions
- Total weighted achievement score
- Optional
  - spatial questions (e.g., is it on the right side?)
  - repeated questions; set-loss errors

CD's Percentile Rank Scores on Selective Measures

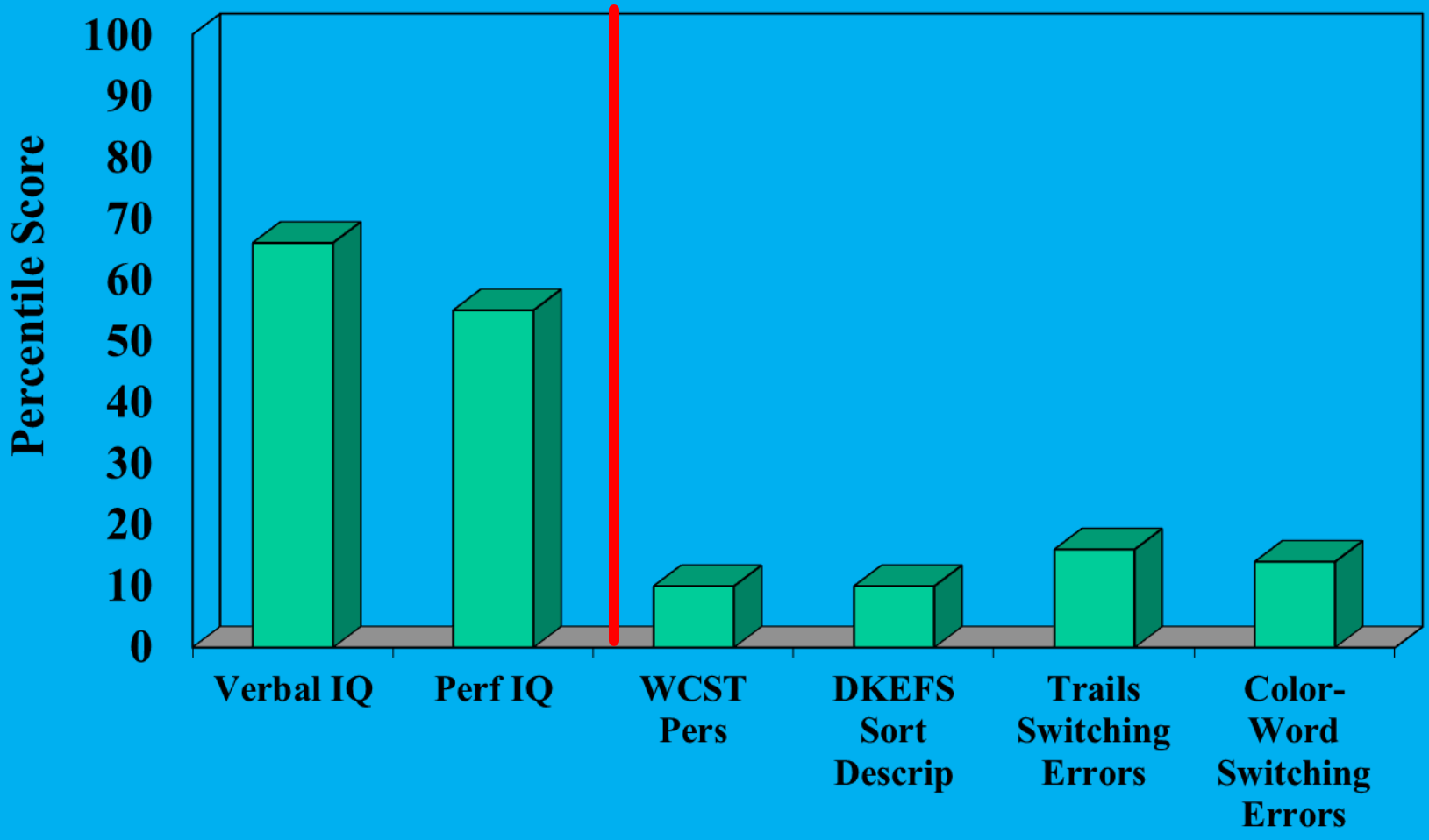


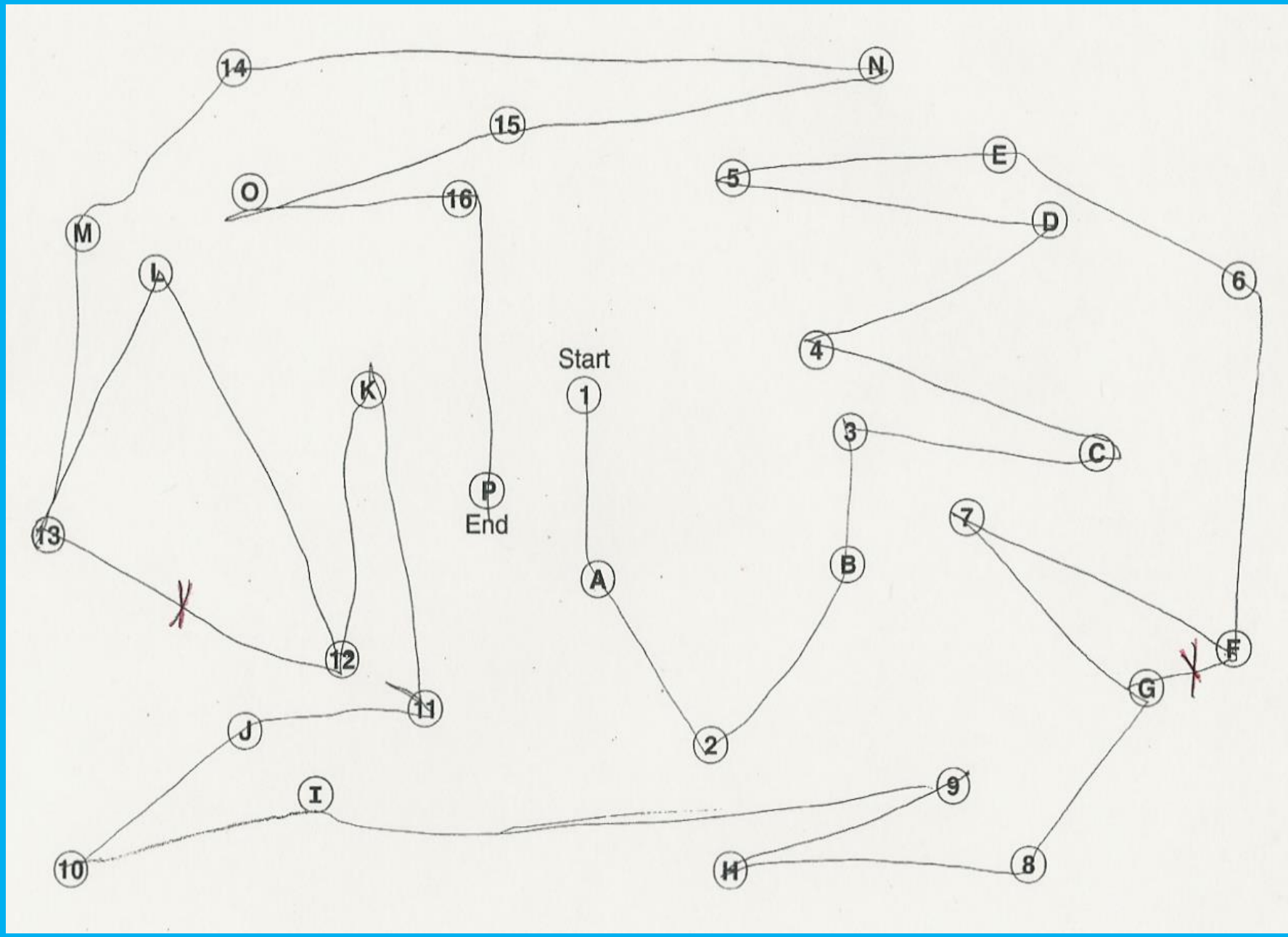
Postscript

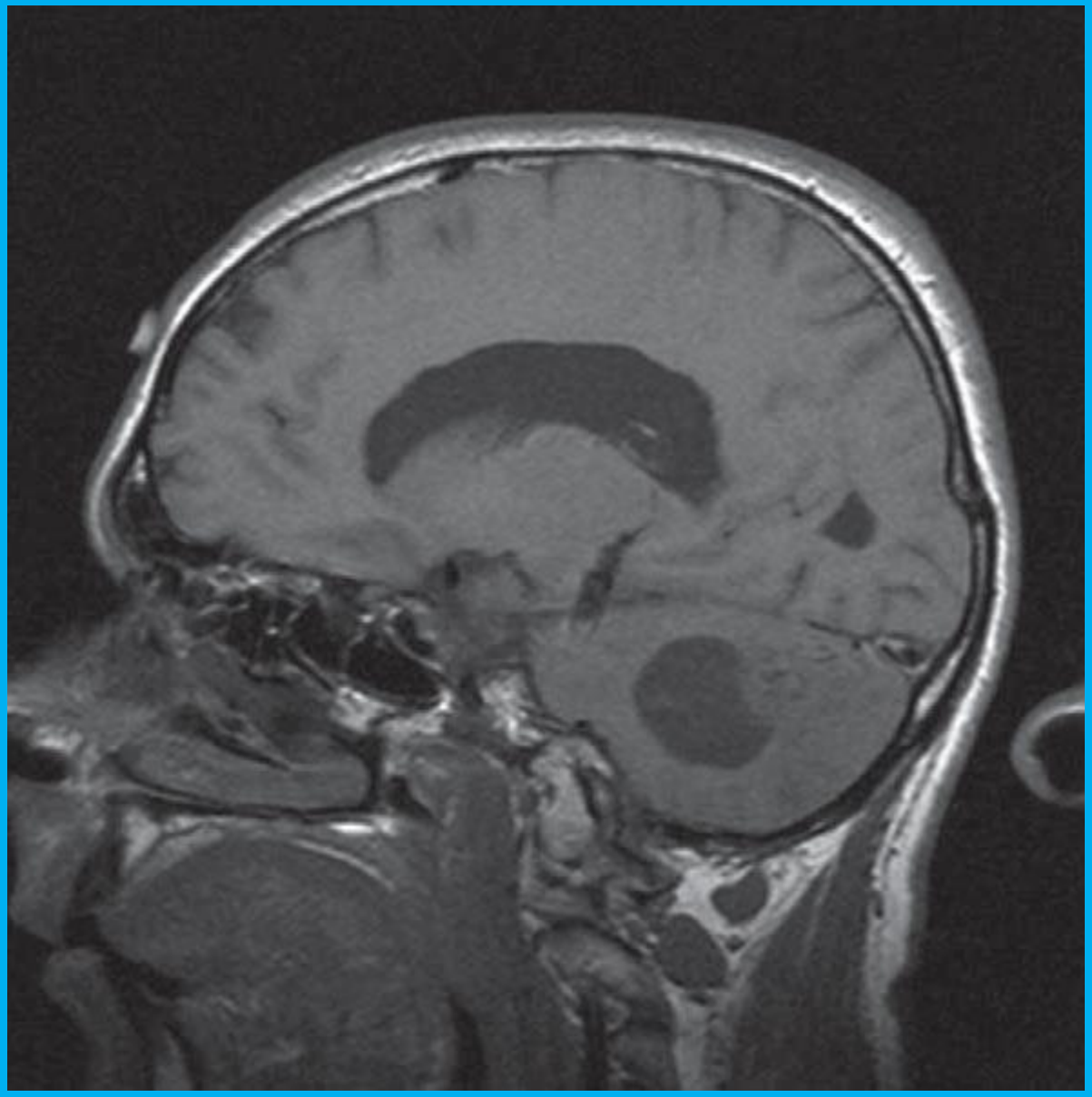
PF's Speed/Accuracy Scores on D-KEFS Tests



PF's Scores on IQ Versus Executive Function Tests




14
N
15
O
16
M
L
K
P
End
Start
1
5
E
D
6
4
3
C
13
12
A
B
7
F
G
11
J
2
I
9
10
H
8

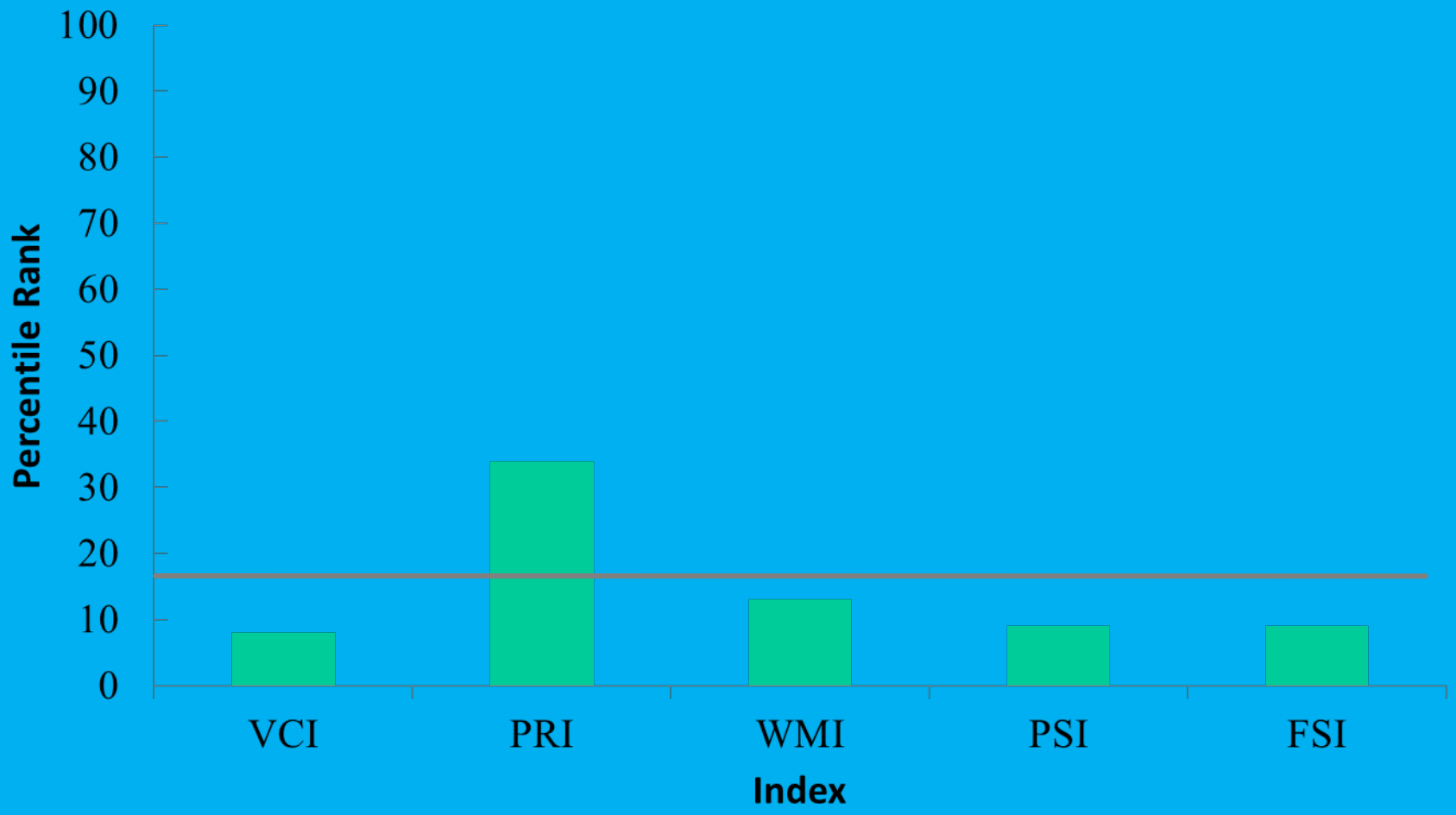


J.H.’s Scores on the Grooved Pegboard Test

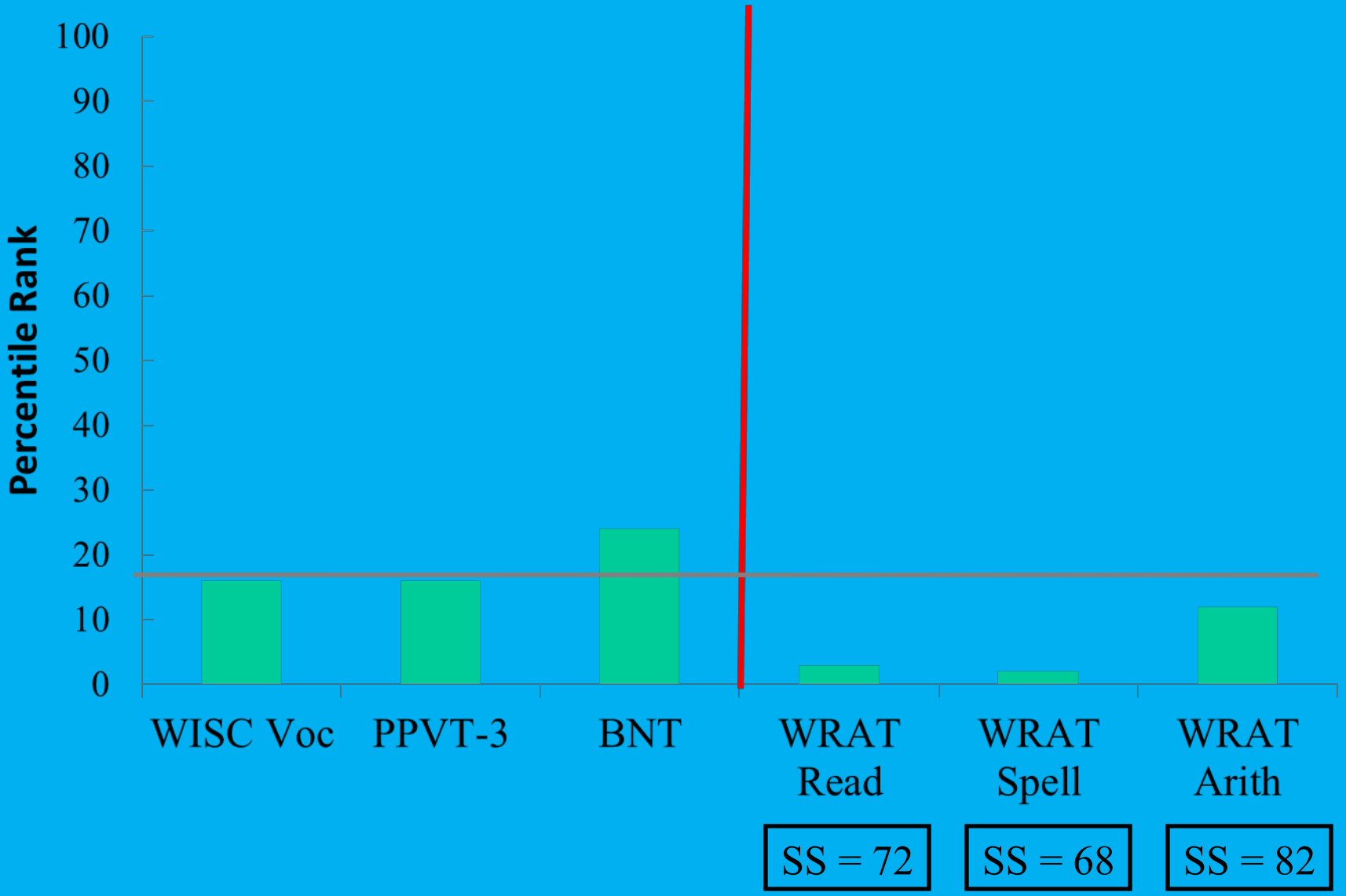
Is this consistent with Unilateral Left Hemisphere Damage?

J.H.’s WISC-IV Index Scores

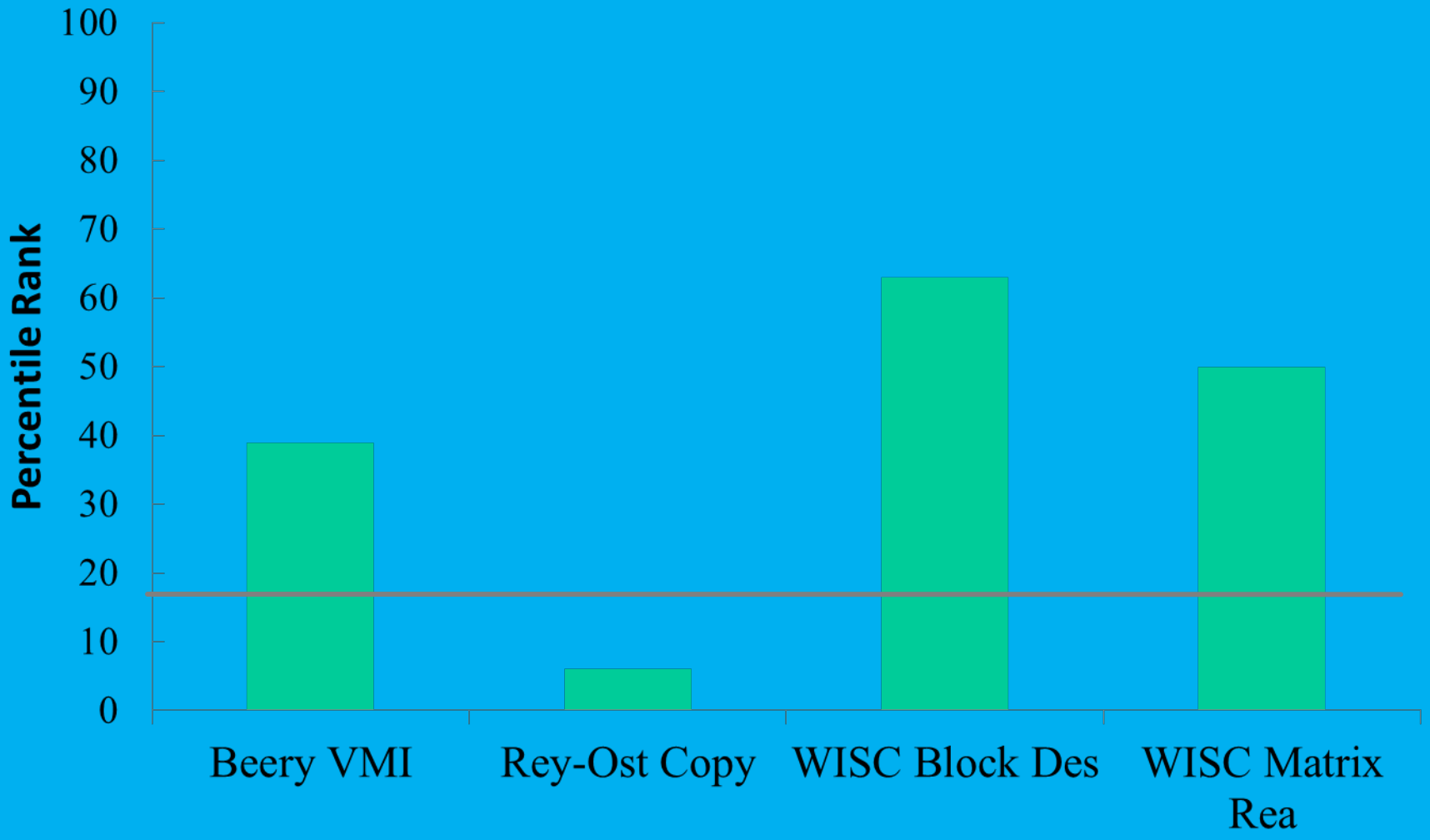
J.H.'s WISC-IV Index Scores in Percentile Ranks



J.H.’s Scores on Language Tests



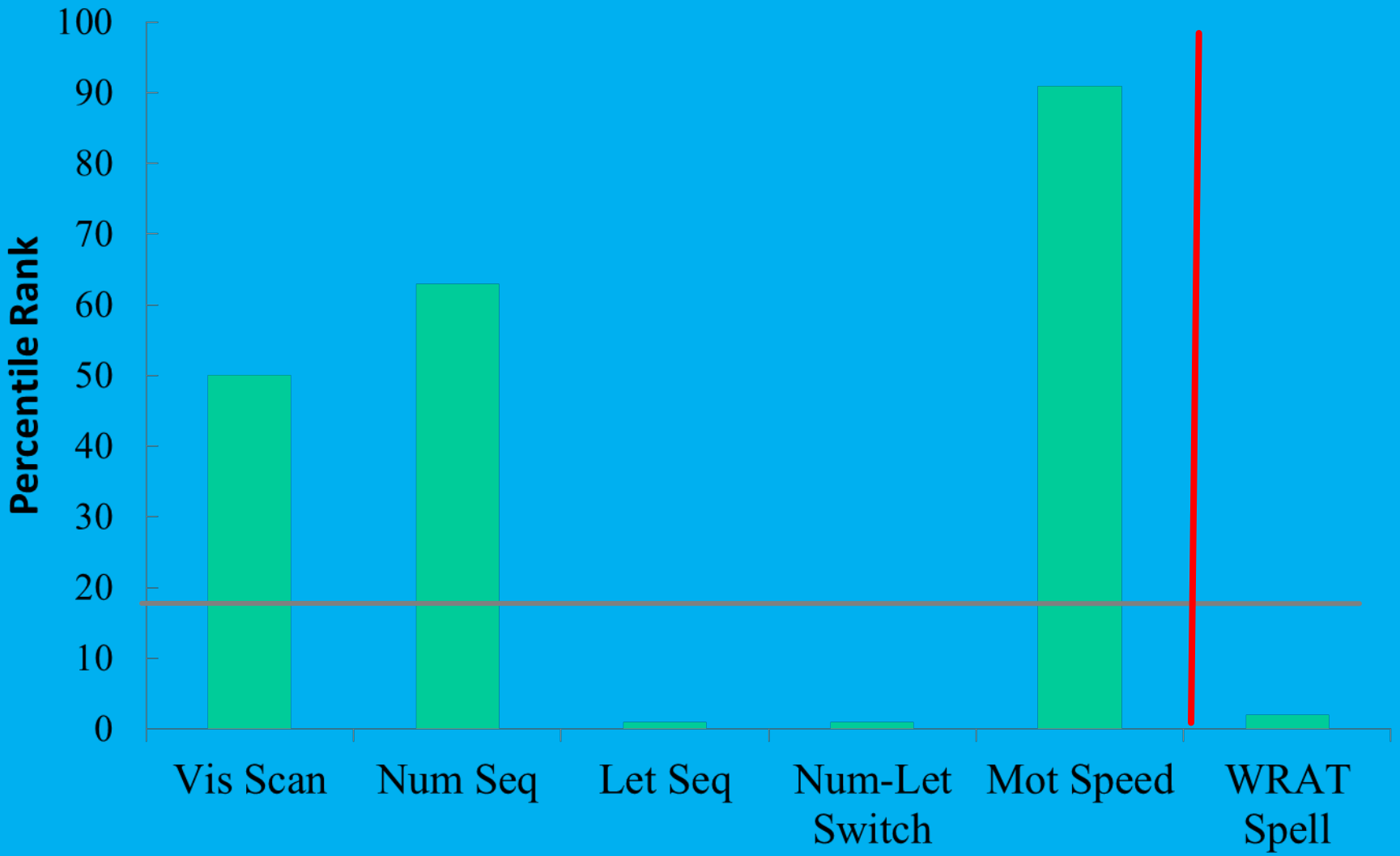
J.H.’s Scores on Visual-Spatial Tests



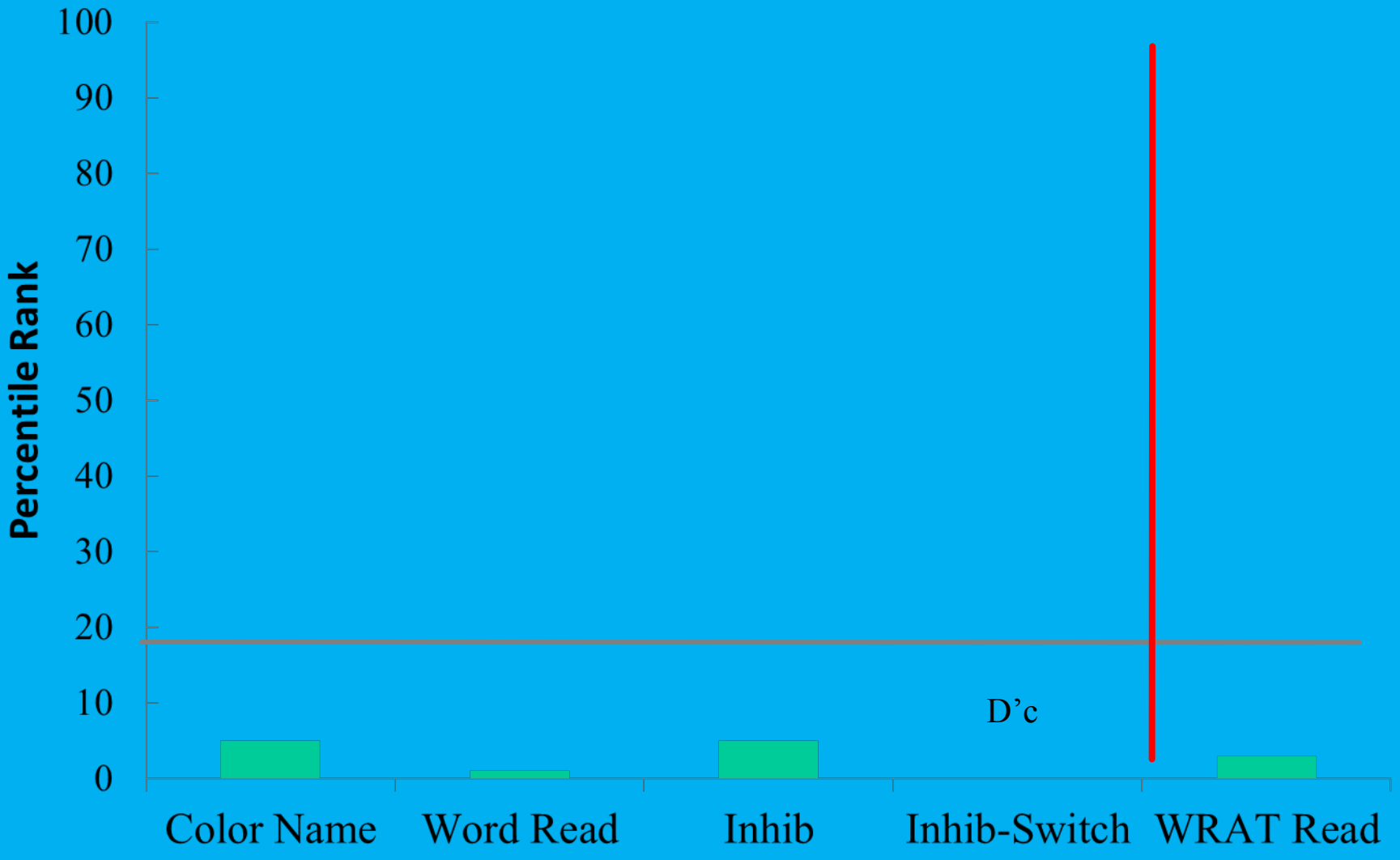
Top 3 Mistakes Made by Psychologists in Assessing Executive Functions

1. A low score on an "Executive Function" test means that the patient has an executive function deficit as assessed by this test.

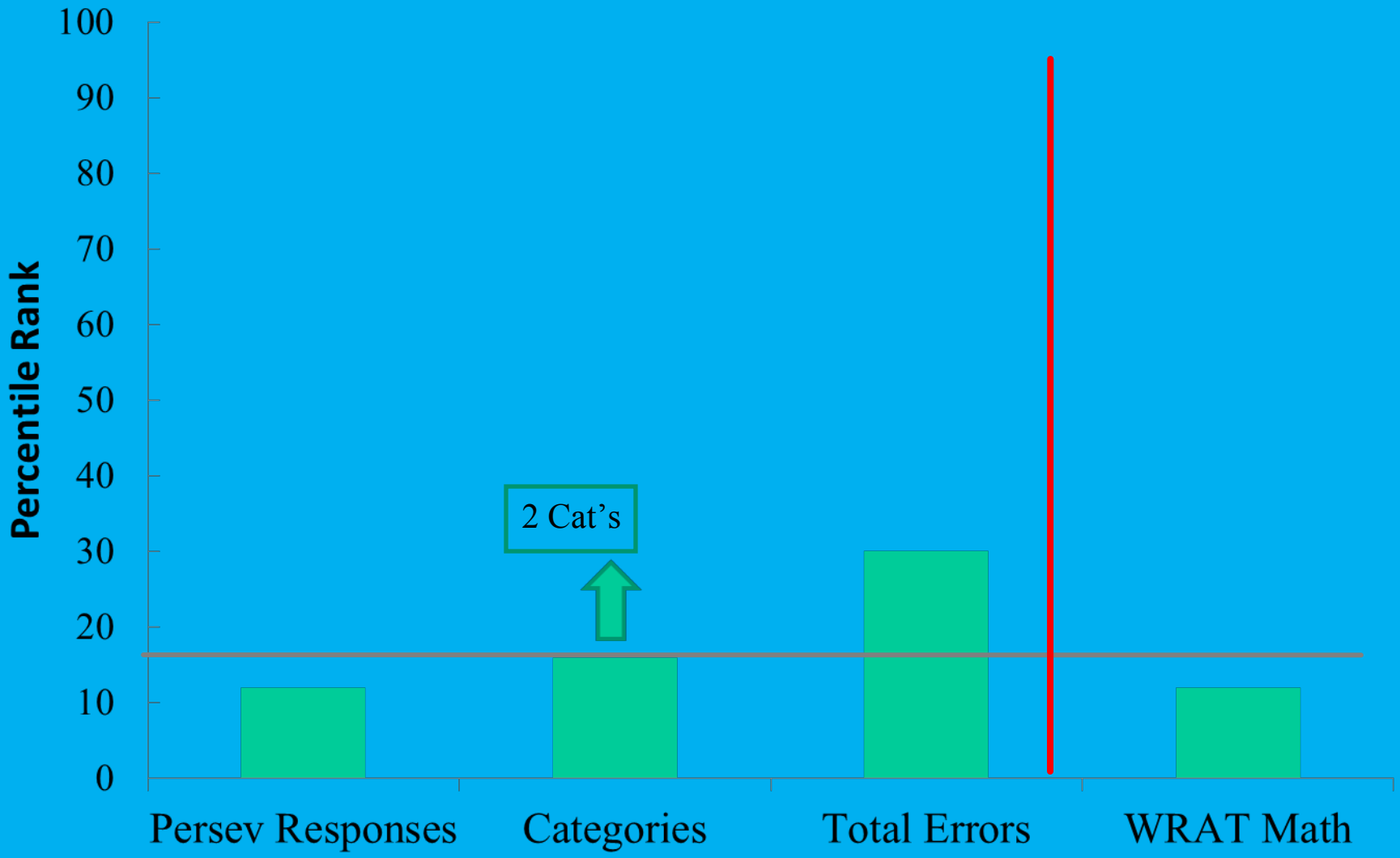
J.H.’s Scores on the D-KEFS Trail Making Test



J.H.’s Scores on the D-KEFS Color-Word Interference Test

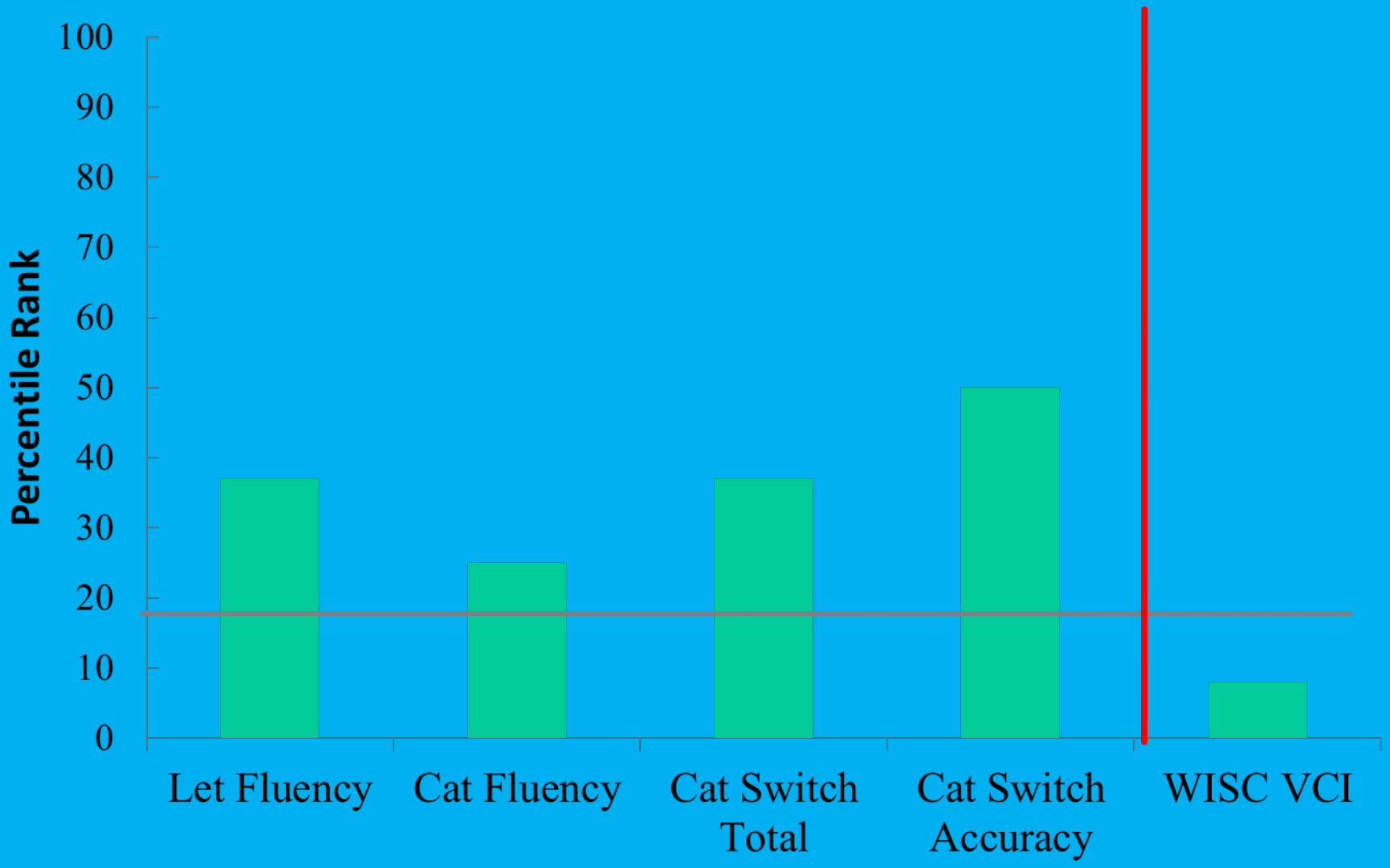


J.H.'s Scores on the WCST*

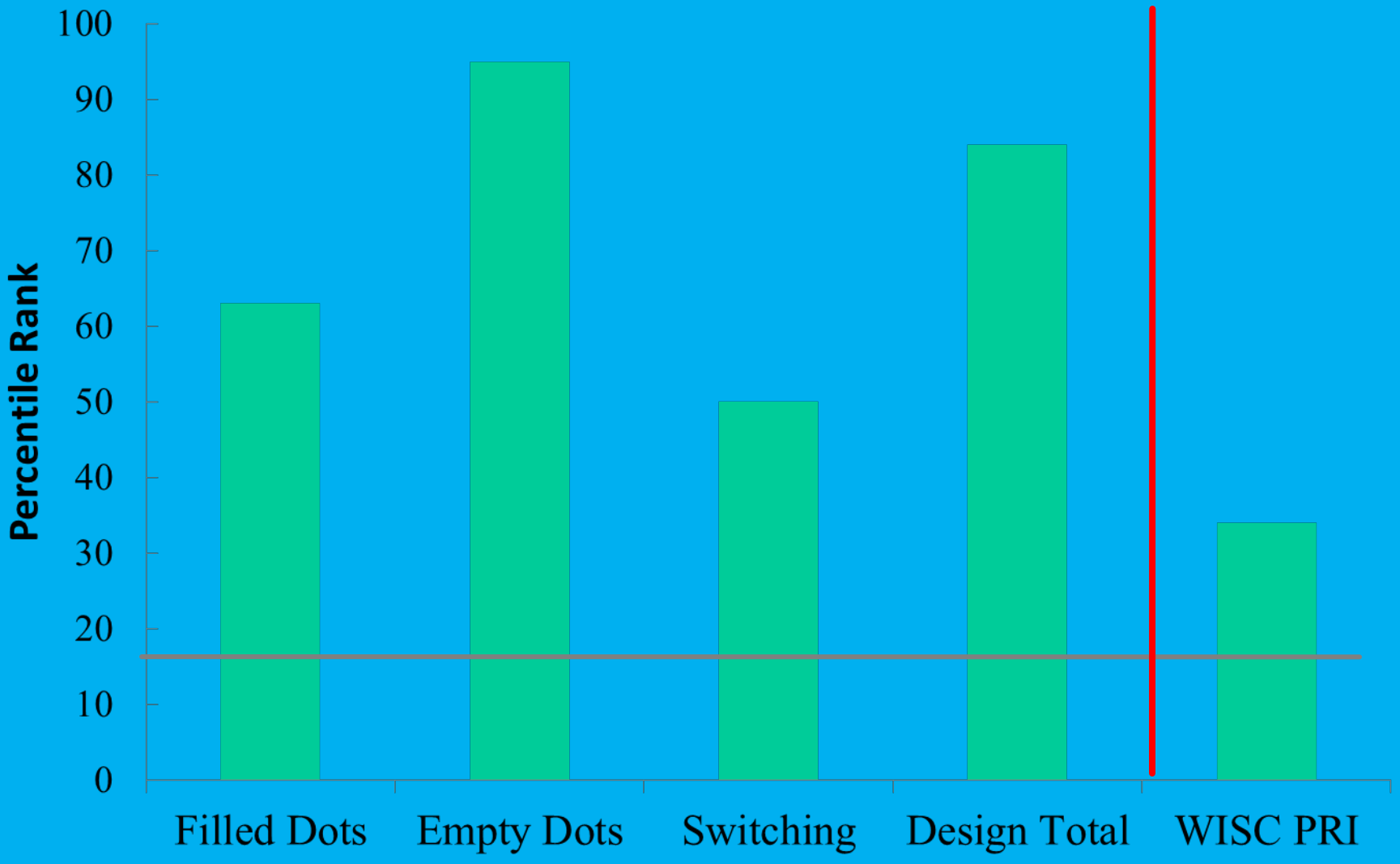


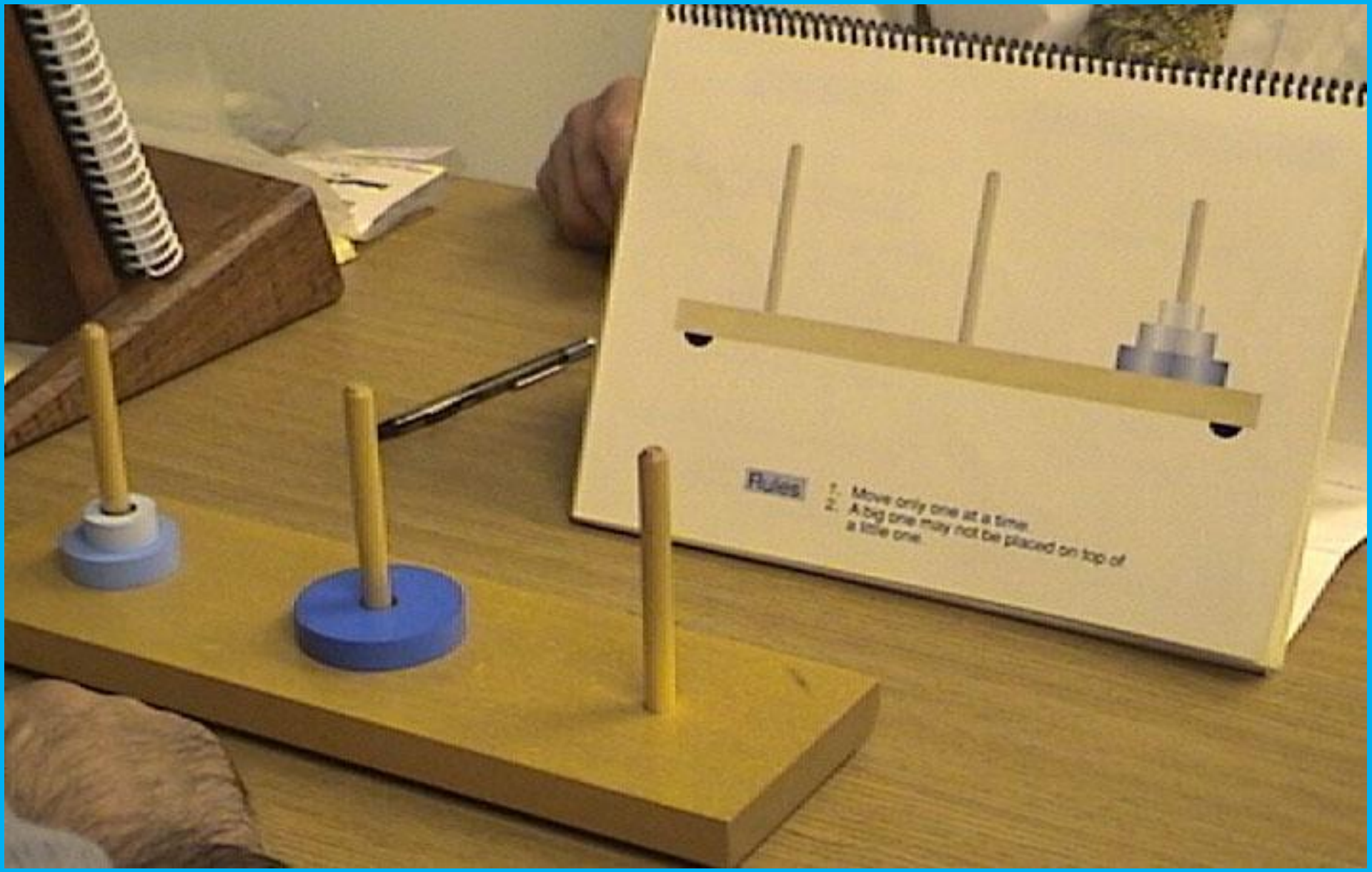
* Unable to read words on the D-KEFS Sorting Test

J.H.’s Scores on the D-KEFS Verbal Fluency Test



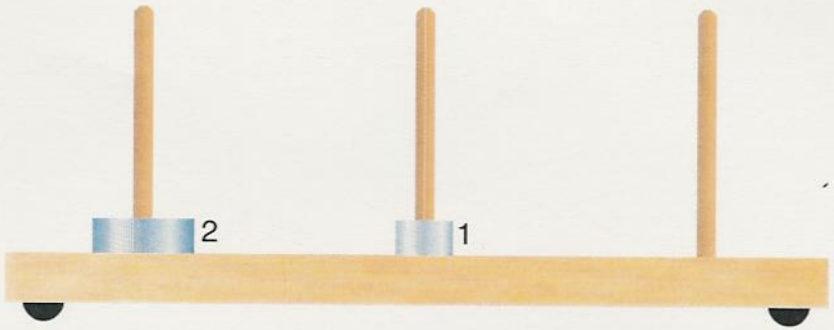
J.H.’s Scores on the D-KEFS Design Fluency Test



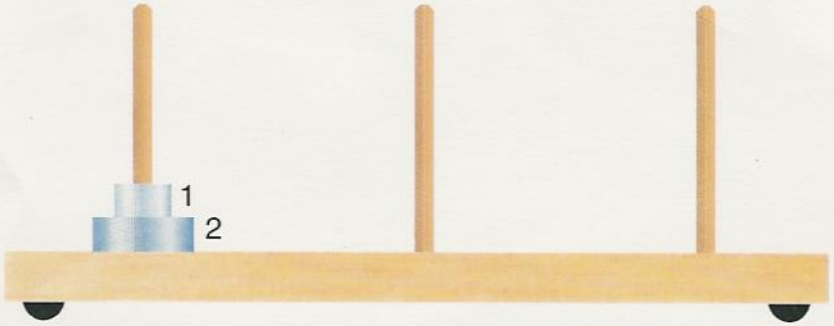

Rules
1. Move only one at a time.
2. A big one may not be placed on top of a little one.

Examiner's Perspective

Item 1 Starting Position

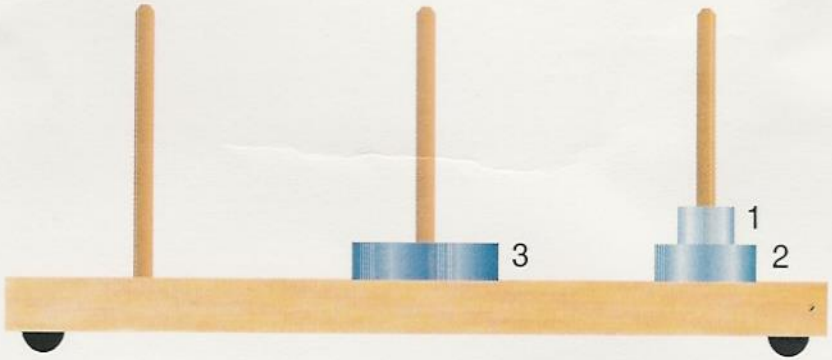


Item 1 Ending Position

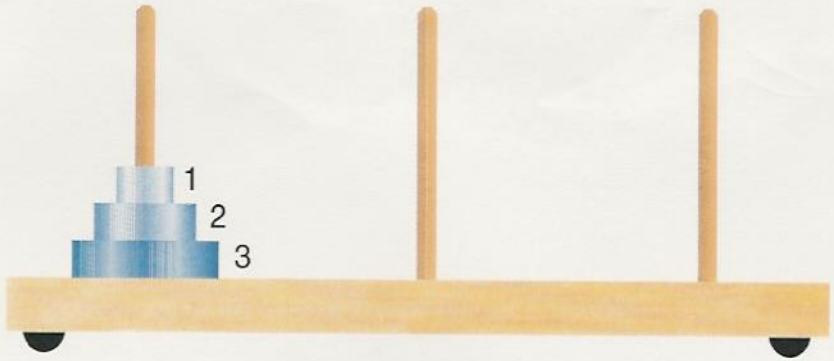


Examiner's Perspective

Item 4 Starting Position

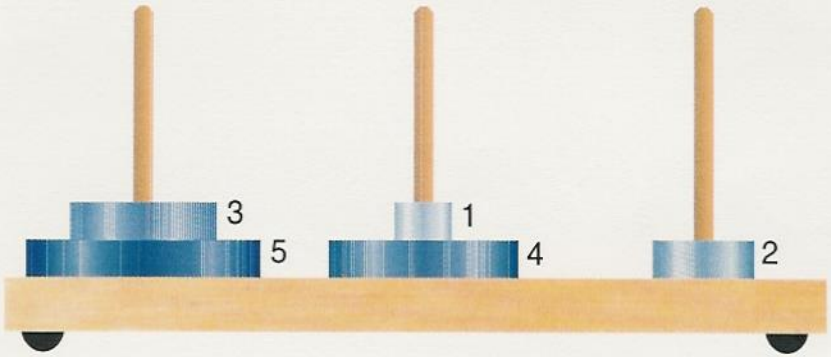


Item 4 Ending Position

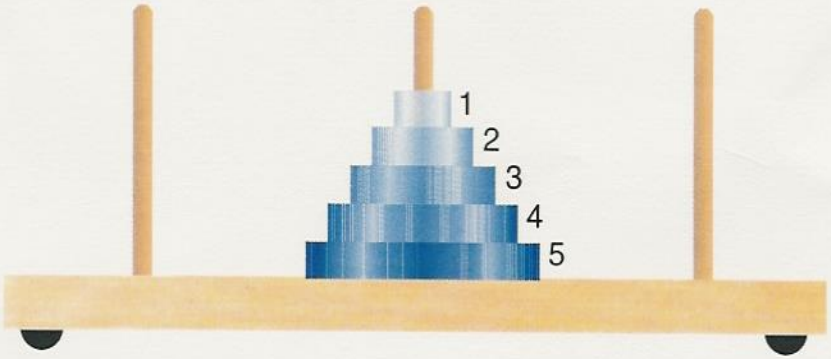


Examiner's Perspective

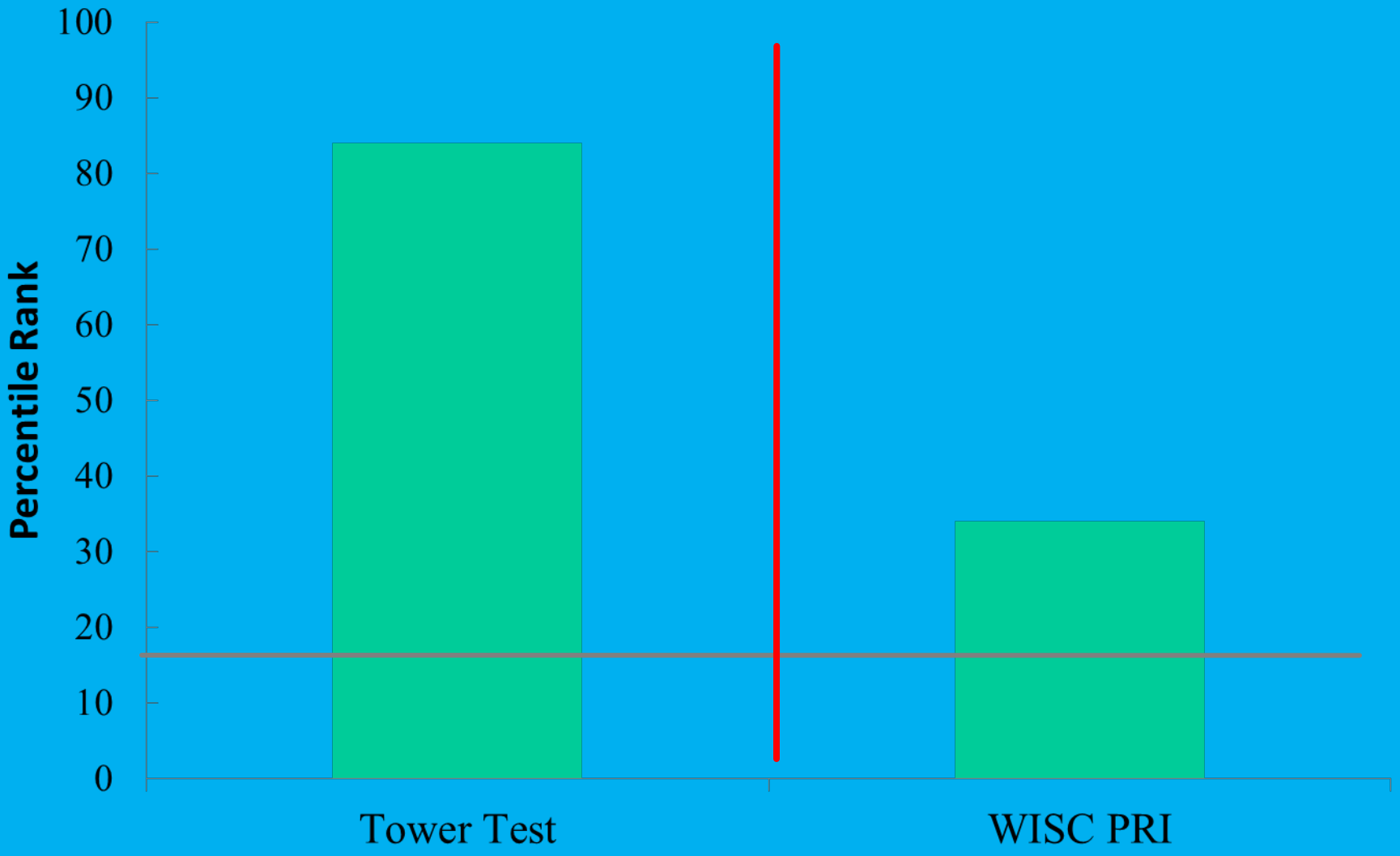
Item 9 Starting Position



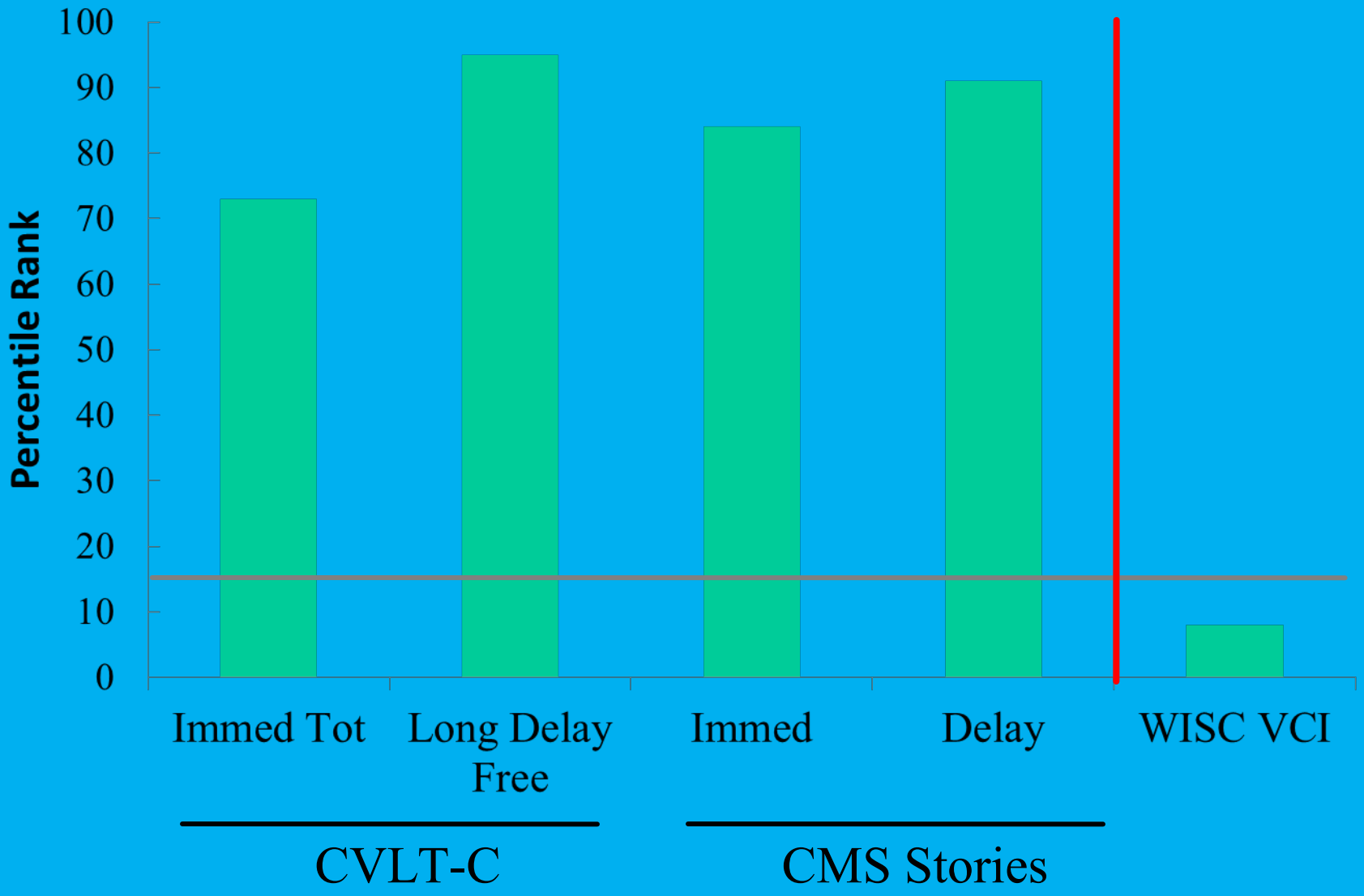
Item 9 Ending Position



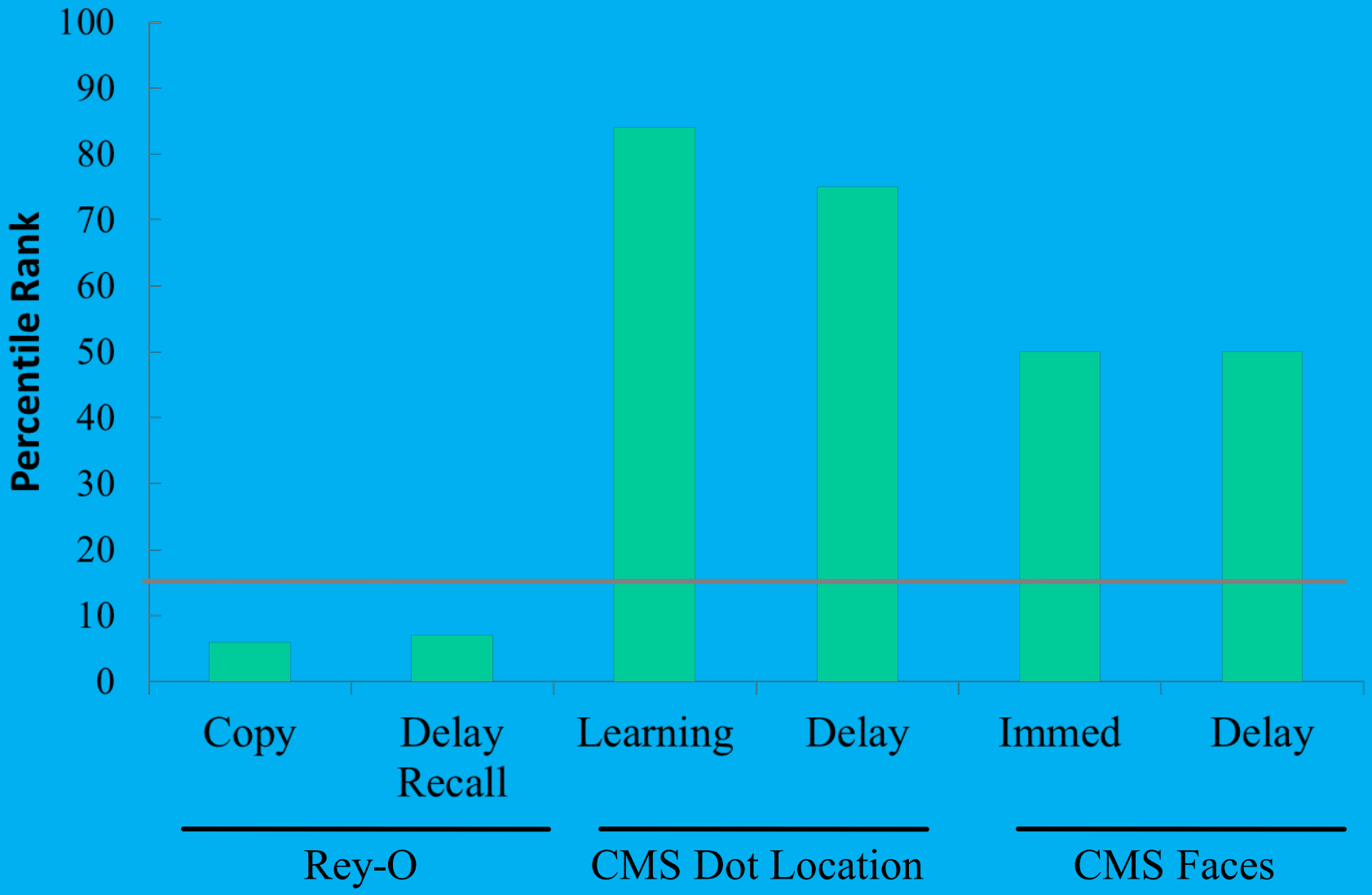
J.H.’s Scores on the D-KEFS Tower Test

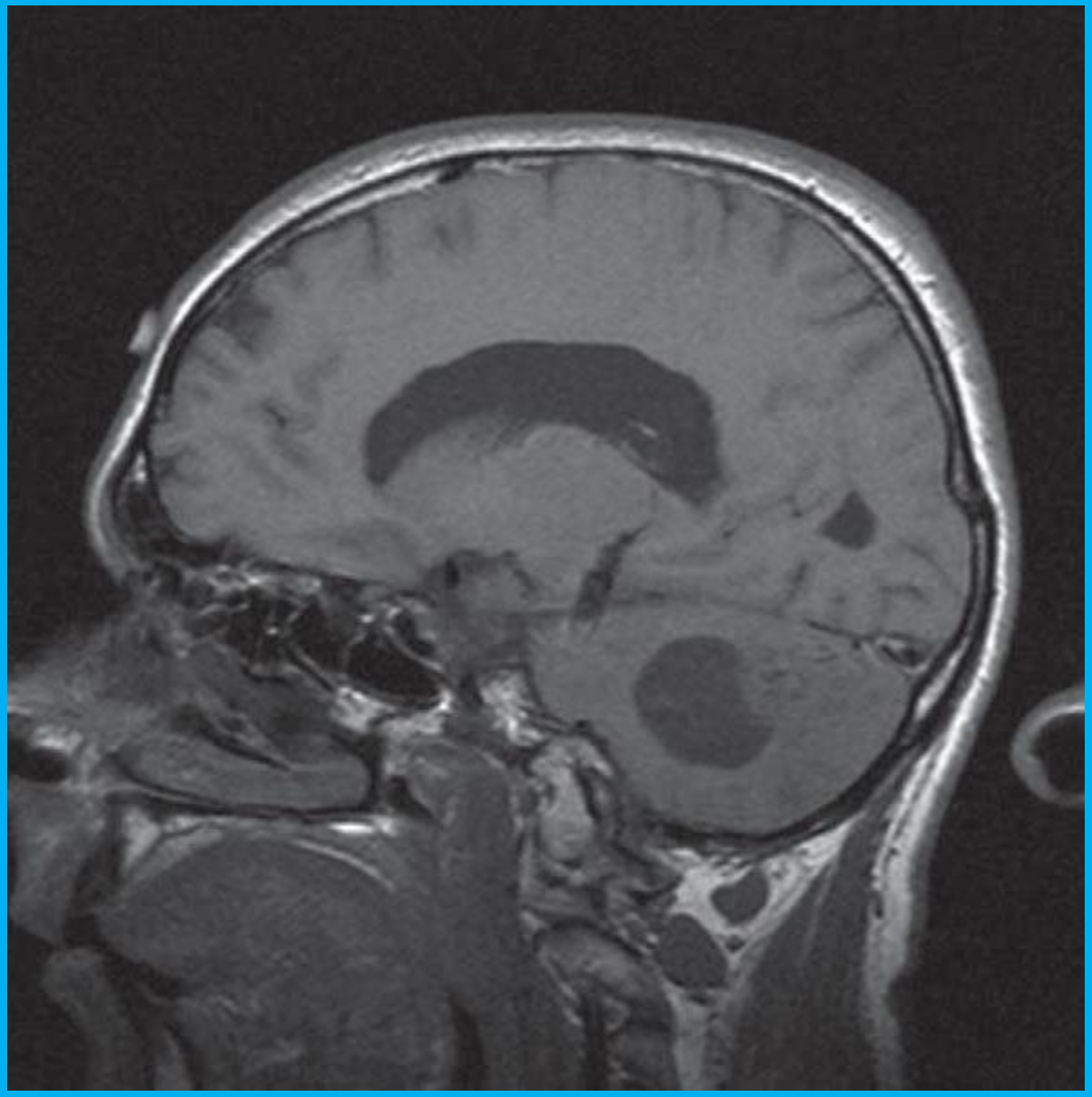


J.H.'s Scores on the Verbal Memory Tests



J.H.’s Scores on the Visual-Spatial Memory Tests





The Problems

1. **Tests of IQ, achievement, and more rote knowledge skills continue to dominate the assessment landscape in school settings.**
2. **This problem exists at all levels of education, from elementary school to graduate school.**
3. **This practice may be harmful for certain subgroups of typically developing students**

School and University Settings

- Group testing: scholastic tests (CTBS; MAT; SAT; Iowa Test)
- Individual assessment: IQ and achievement tests (WRAT-III; Woodcock-Johnson)

- College Entrance Exams (SAT)
- Graduate Entrance Exams (GRE)

Frontal Profile

Spared

- Vocabulary
- Reading
- Spelling
- Arithmetic
- Past knowledge
- **Verbal IQ**
- **G Factor**

Impaired

- Cognitive Flexibility
- Abstract thinking
- Verbal Inhibition
- Fluent production of novel responses
- Concept formation

Others Critics of School Assessment Practices

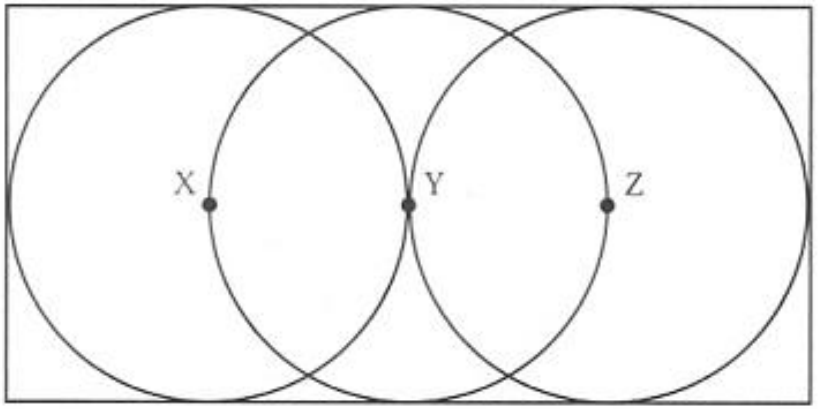
-
- Howard Gardner (1993)

- Sternberg, Lautrey & Lubart (2003)

Sample SAT Item

10. Usually ____ to criticism, Mr. Smith showed surprising ____ at his negative reviews from the critics.

(A) impervious..pique
(B) immune..volubility
(C) hostile..truculence
(D) disgruntled..dismissiveness
(E) derisive..rage



In the figure above, points X, Y, and Z are the centers of the three circles. If each circle has an area of 50, what is the area of the rectangle?

(A) $\frac{50}{\pi}$

(B) $50 - \frac{8}{\pi}$

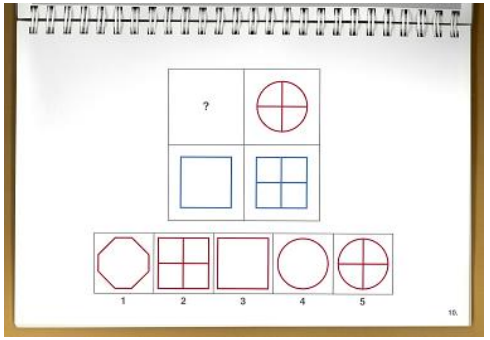
(C) 50

(D) $\frac{200}{\pi}$

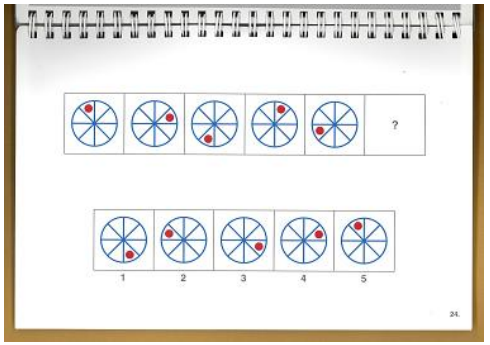
(E) $\frac{400}{\pi}$

Do IQ and Scholastic Tests Assess Executive Functions?

- Orange – Banana
- Table – Chair



- Fly – Tree
- Enemy – Friend



The Question Remains:

* How much of the variance on IQ tests are explained by executive-function tests?
* Few studies have examined correlations between EF and IQ measures.
* The studies that have been done tended to use small n's (e.g., 50) and restricted age ranges (e.g., 13-16 year olds; Ardila et al., 199; Welsh et al., 1991).

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Creativity Lost

The Importance of Testing Higher-Level Executive Functions in School-Age Children and Adolescents

Dean C. Delis
Amy Lansing
University of California, San Diego, and San Diego Veterans Affairs Healthcare System

Wes S. Houston
University of Iowa

Spencer Wetter
University of California, San Diego, and San Diego Veterans Affairs Healthcare System

S. Duke Han
Loyola University, Chicago

Mark Jacobson
University of California, San Diego, and San Diego Veterans Affairs Healthcare System

James Holdnack
University of Iowa

Joel Kramer
University of California, San Francisco

First Goal

- **The D-KEFS and WASI were co-normed on a normative sample of 470 children and adolescents, ages 8 to 19.**

- **Investigate the correlations between IQ indices (WASI) and five key subtests of the D-KEFS.**

D-KEFS Subtest

- Trail Making Test: Number-Letter Switching
- Verbal Fluency: Category Switching
- Design Fluency: Switching
- Color-Word Interference: Inhibition/Switching
- Sorting Test: Sort Recognition Description

D-KEFF Child Sample:

- 8 years (n = 75)
- 9 years (n = 75)
- 10 years (n = 75)
- 11 years (n = 75)
- 12 years (n = 100)
- 13 years (n = 100)
- 14 years (n = 100)
- 15 years (n = 100)
- 16-19 years (n = 100)

- Approximatedly 800 children and adolescents matched to U.S. Census population with respect to:
  - Race/Ethnicity
  - Education
  - Geographical Areas
- Approximately equal males and females
- 470 received both the D-KEFS and WASI

Hypotheses

- Correlations between VIQ (as measured by the WASI) and key D-KEFS measures will be relatively low.

- If so, discrepancies analyses would reveal subgroups of normal-functioning youths with either better performances on executive-function measures relative to VIQ tests or vice versa.

IQ and D-KEFS Correlations

D-KEFS Test	VIQ	PIQ
Trails Switching	**.25**	**.34**
Category Fluency/Switching	**.26**	**.15**
Design Fluency Switching	**.19**	**.34**
Color-Word Inhibition/Switching	**.16**	**.21**
Sort Recognition Description	**.40**	**.43**

All significant at $p < .01$

IQ and D-KEFS Correlations

Test	VIQ	PIQ
Trails Switching	**.25**	**.34**
Category Fluency/Switching	**.26**	**.15**
Design Fluency Switching	**.19**	**.34**
Color-Word Inhibition/Switching	**.16**	**.21**
Sort Recognition Description	**.40**	**.43**
Vocabulary Subtest	**.78**	**.56**
Similarities Subtest	**.75**	**.55**

All significant at $p < .01$

VIQ Variance Accounted for by D-KEFS Subtests

Test	VIQ
Trails Switching	**6%**
Category Fluency/Switching	**6%**
Design Fluency Switching	**4%**
Color-Word Inhibition/Switching	**3%**
Sort Recognition Description	**16%**
Vocabulary Subtest	**61%**
Similarities Subtest	**56%**

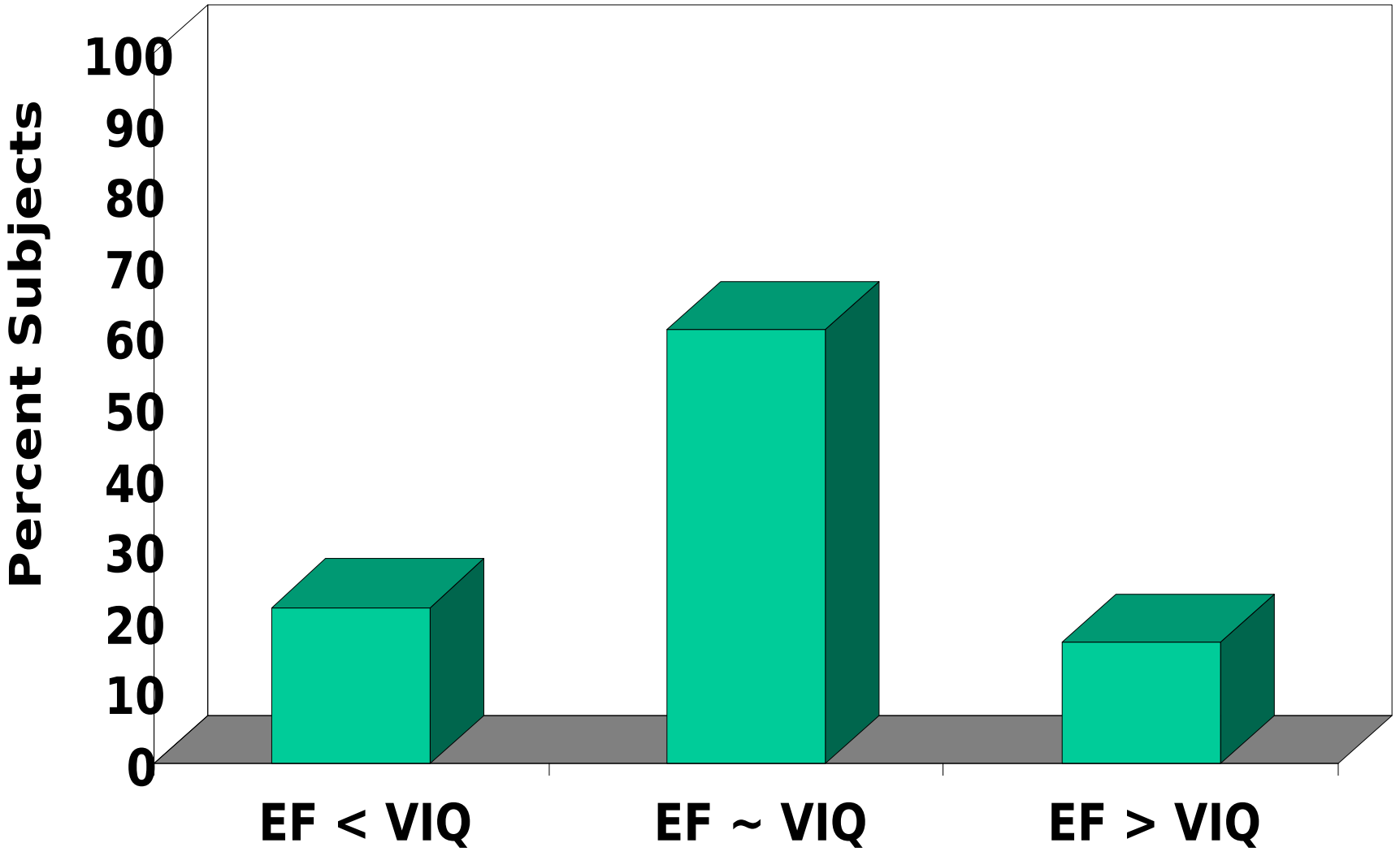
Some Implications of These Findings

- Even though some of the more difficult items on the IQ subtests may tap into executive functions, overall very little overlap between the cognitive skills assessed by IQ subtests versus EF tests.
- Must use caution in using scores on IQ measures to predict scores on EF tests.

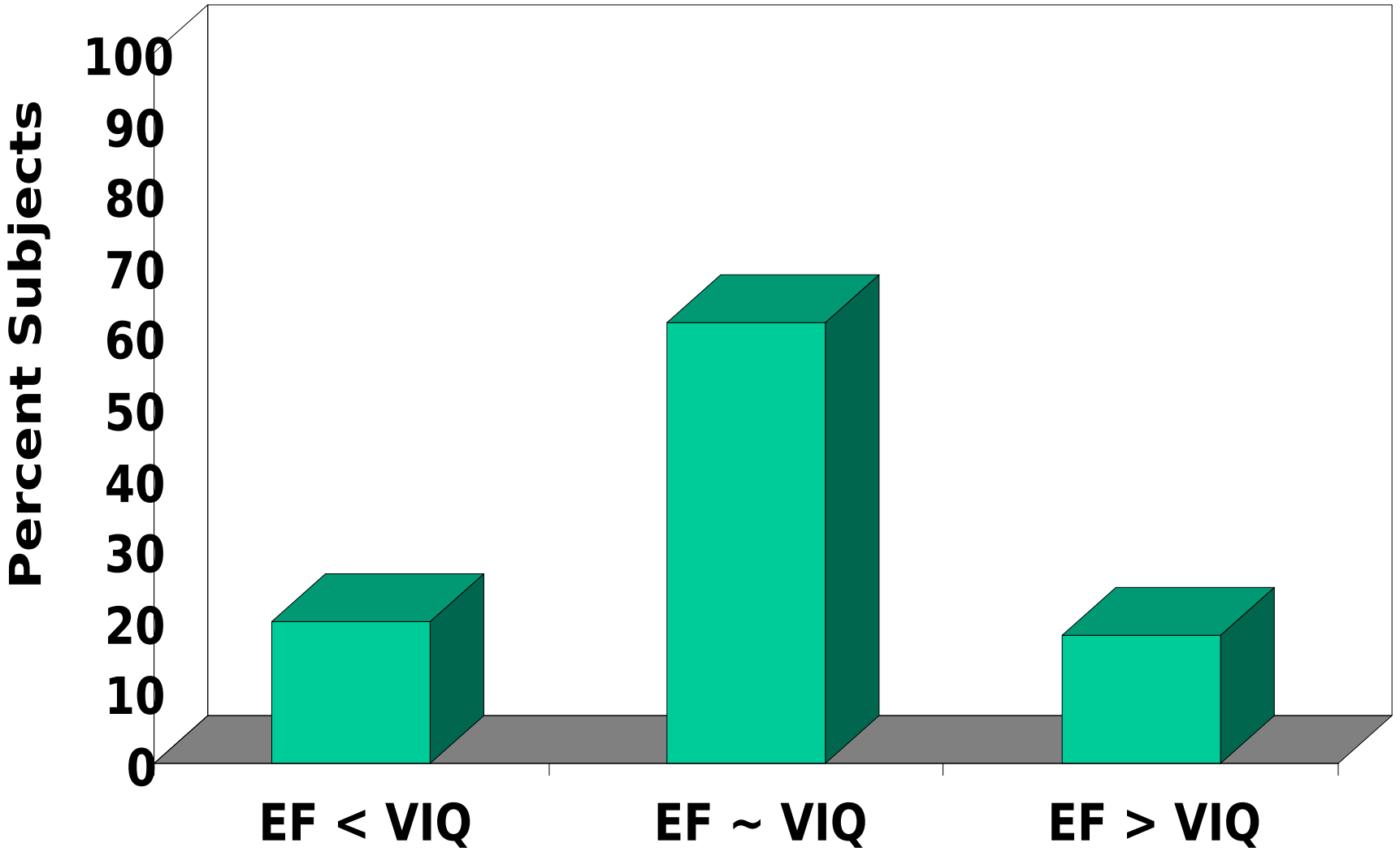
Second Hypothesis

Discrepancies analyses would reveal subgroups of youths with better performances on executive-function measures relative to VIQ tests or vice versa.

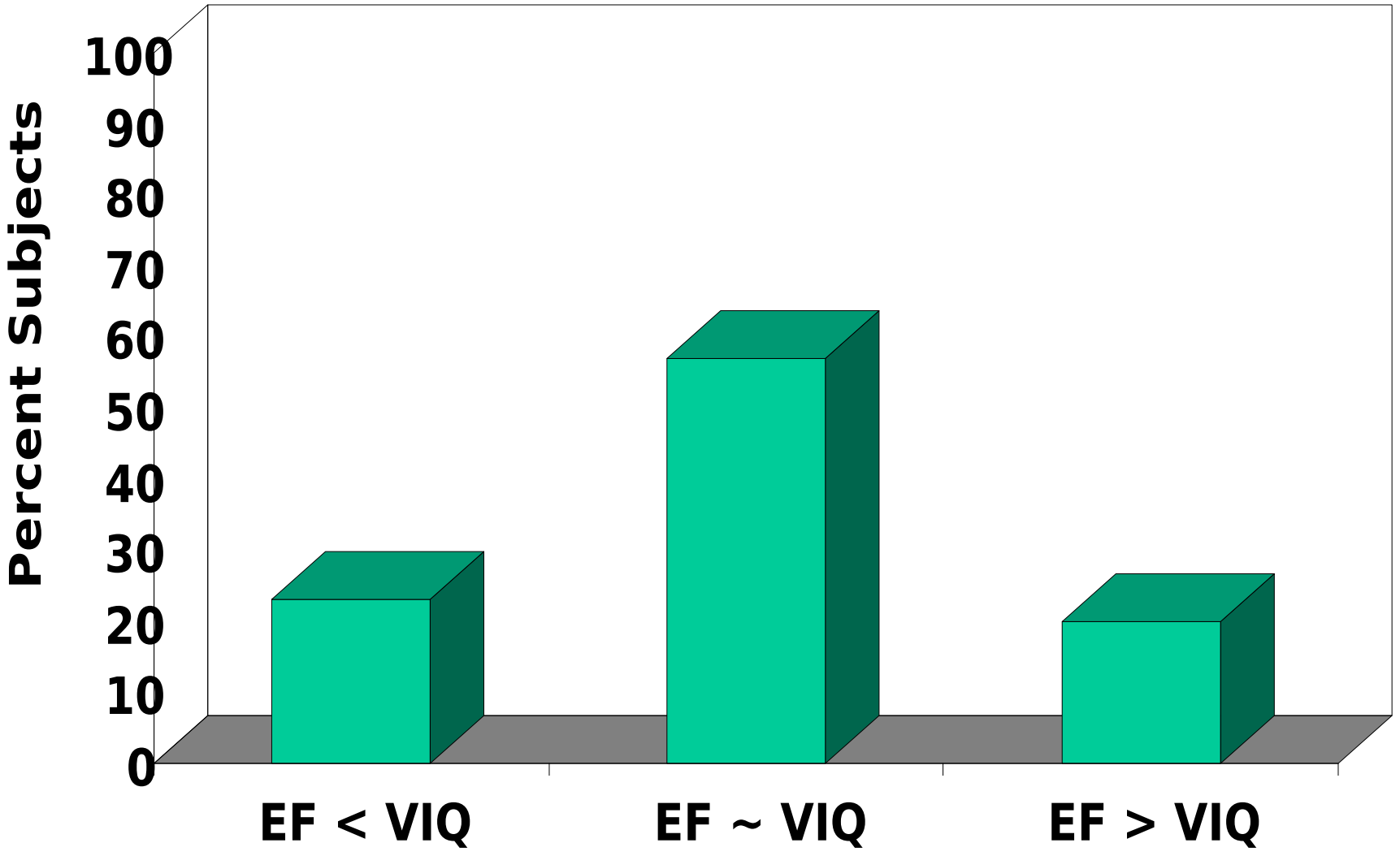
Percentage of Subjects with Significant VIQ - Trails Switching Discrepancies



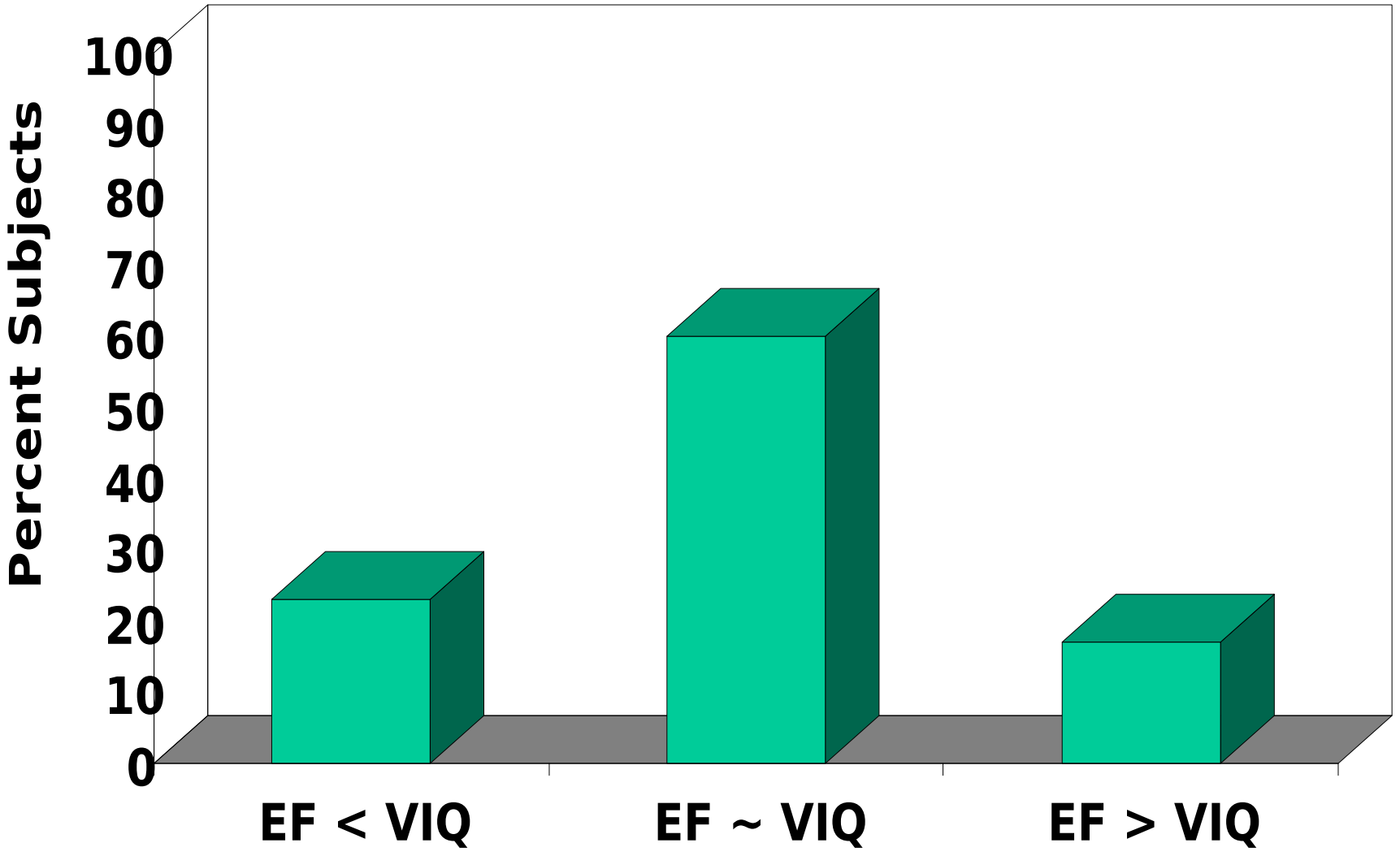
Percentage of Subjects with Significant VIQ – Category Fluency Switching Discrepancies



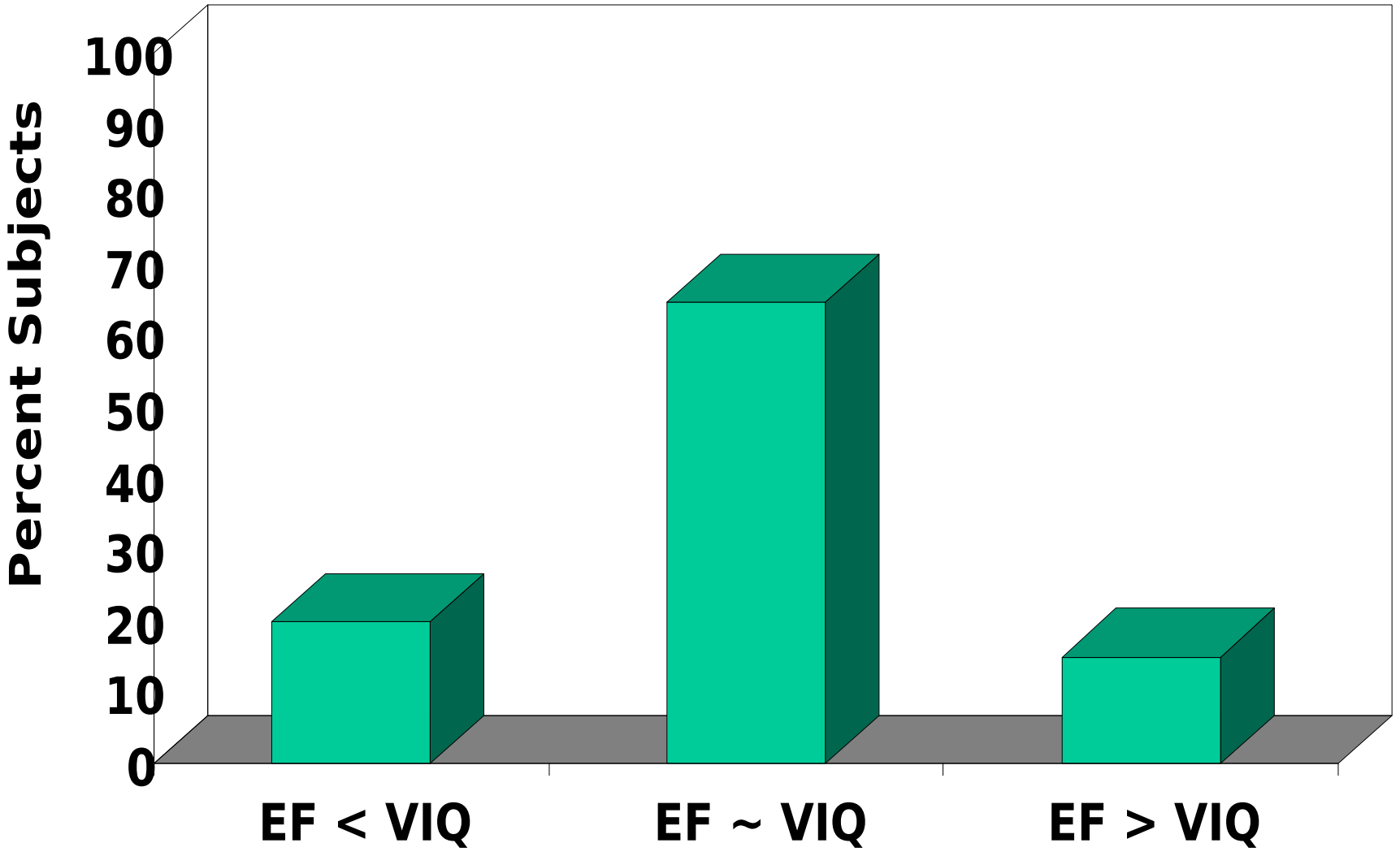
Percentage of Subjects with Significant VIQ - Design Fluency Switching Discrepancies



Percentage of Subjects with Significant VIQ – Color-Word Interference/Switching Discrepancies



Percentage of Subjects with Significant VIQ – Sort Recognition Discrepancies



Two Subgroups of Special Interest:

- **High EF / Lower VIQ**: **Mean EF score falls above average range (≥ 110) and VIQ is average or lower VIQ (< 110).**

- **Low EF / Higher VIQ**: **Mean EF score falls below average range (< 90) and VIQ is average or higher VIQ (>100).**

Two Subgroups of Special Interest:

- **Above average EF / Average or lower VIQ**:

  13% of the entire sample

- **Below average EF / Average or higher VIQ**:

  7% of the entire sample

Implications of Subgroup with Below Average EF and Average or Higher VIQ in School Settings

- The dominance of tests of primarily rote verbal skills likely to promote these children without identifying their executive-function deficits.
- May be why relatively few students are diagnosed with Developmental Executive Dysfunction Disorder.
- DSM-IV has only four Learning Disorders:

  Reading Disorder, Mathematics Disorder, Disorder of Written Expression, and Learning Disorder NOS

Implications of Subgroup with Above Average EF and Average or Lower VIQ in School Settings

- Because of the dominance of tests of primarily rote verbal skills, these students are considered to be only average or lower, and their above-average strengths in abstract, creative thinking are not identified.
- Tests such as college entrance exams create unfair roadblocks in their pursuit of higher education.
- Develop low self-esteems

Real World Accounts

One scientist's most significant "blow" as a student trying to be admitted to graduate school:

- "At that time, the most famous technical school in central Europe outside of Germany was the Swiss Federal Polytechnic School in Zurich. Einstein went there and took the ***entrance examination***. He showed that his knowledge of mathematics was far ahead of that of most of the other candidates, but his knowledge of ***modern language*** and the ***descriptive*** nature sciences (zoology and botany) was inadequate, and he was not admitted." (Frank et al., 1947).

Kenneth M. Heilman, M.D.

"The Making of a Behavioral Neurologist - Neuropsychologist."

Pathways to Prominence in Neuropsychology, 2002.

Dr. Ken Heilman's Chapter in *Pathways to Prominence in Neuropsychology* (2002)

- "When my friends were taking placement tests for college preparatory high schools in New York, I was not allowed to even attempt the tests. I had scored too low on standardized tests back in the third grade, and I was steered toward trade school. I knew, however, that if I went to trade school I could not be a scientist."

Dr. Ken Heilman (2002):

- “I did not do well in my academic courses. For example, my Spanish teacher, Mrs. X, failed to understand why I could not spell in Spanish, since Spanish has complete sound-letter correspondence. Mrs. X told me that I was not “college material” and repeatedly failed me, I suspect, to prevent me from getting my college preparatory degree.”

Dr. Ken Heilman (2002):

- “I think that my third-grade teacher, my junior high advisors, and Mrs. X would be surprised that I graduated from high school, got into college, attended medical school, and contributed to the growth of scientific knowledge. When they predicted failure for me, they could not have known that I would be fortunate to have wonderful mentors, friends, and colleagues. It is the support, guidance, and knowledge of these people that allowed me to make contributions to our understanding of the brain.”

L.L. Thurstone (1950). "Creative Talent" :

- "It is a common observation in the universities that those students who have high intelligence, judged by available criteria, are not necessarily the ones who produce the most original ideas. All of us probably know a few individuals who are both creative and highly intelligent, ***but this combination is not the rule***."

Executive Functions: Cognitive Versus Emotional/Behavioral Components

- Abstract Thinking
- Concept Formation
- Novel Problem Solving
- Creativity
- Fluent Novel Thinking
- Multi-Tasking
- Planning and Organization

- Disinhibition
- Inappropriate Behavior
- Jocularity/Child-Like Behavior
- Impulsivity
- Emotional Lability
- Apathy
- Flat affect

Advantages and disadvantages of behavioral rating scales.

D-REF

Journal of the International Neuropsychological Society (2010), Page 1 of 11.

doi:10.1017/S1355617710000093

Is the behavior rating inventory of executive function more strongly associated with measures of impairment or executive function?

TARA MCAULEY, SHIRLEY CHEN, LISA GOOS, RUSSELL SCHACHAR, AND JENNIFER CROSBIE

Department of Psychiatry Research, The Hospital for Sick Children, Toronto, Ontario, Canada

Abstract

The Behavior Rating Inventory of Executive Function (BRIEF) is commonly used in the assessment of children and adolescents presenting with a wide range of concerns. It is unclear, however, whether the questionnaire is more closely related to general measures of behavioral disruption and impairment or to specific measures of executive function. In the present study, associations between the Behavioral Regulation Index and Metacognition Index of the BRIEF and cognitive, behavioral, and academic measures were examined in a sample of clinic-referred youth ($n = 60$) and healthy youth ($n = 37$) 6–15 years of age. Measures included ratings of inattentive and hyperactive-impulsive symptoms in youth, ratings of how well youth functioned in their everyday environments, youth's scores on measures of reading and math, and youth's scores on measures of inhibition, performance monitoring, and working memory. Although both BRIEF indices were strongly related to parent and teacher ratings of behavioral disruption and impairment, neither was associated with youth's scores on the performance-based tasks of executive function. These findings support the use of the BRIEF as a clinical tool for assessing a broad range of concerns, but raise questions about the relation of the BRIEF to performance-based tasks that are commonly used to assess executive function. (*JINS*, 2010, 1–11.)

JOURNAL OF CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY
2011, 33 (6), 704–714

Are self-reported symptoms of executive dysfunction associated with objective executive function performance following mild to moderate traumatic brain injury?

Dawn M. Schiehser[1,2], Dean C. Delis[1,2,3], J. Vincent Filoteo[1,2], Lisa Delano-Wood[1,2], S. Duke Han[4], Amy J. Jak[1,2], Angela I. Drake[5], and Mark W. Bondi[1,2]

Background and objective: We examined the relationship between self-reported pre- and post-injury changes in executive dysfunction, apathy, disinhibition, and depression, and performance on neuropsychological tests of executive function, attention/processing speed, and memory in relation to mood levels and effort test performance in individuals in the early stages of recovery from mild to moderate traumatic brain injury (TBI). *Method:* Participants were 71 noncombat military personnel who were in a semiacute stage of recovery (<3 months post injury) from mild to moderate TBI. Pre- and post-TBI behaviors were assessed with the Frontal Systems Behavior Scale (FrSBe; Grace & Malloy, 2001) and correlated with levels of depressive symptoms, effort test performance, and performance on objective measures of attention, executive function, and memory. *Results:* Self-reported symptoms of executive dysfunction generally failed to predict performance on objective measures of executive function and memory, although they predicted poorer performance on measures of attention/processing speed. Instead, higher levels of depressive symptomatology best predicted poorer performance on measures of executive function and memory. However, the relationship between memory performance and TBI symptoms was no longer significant when effort performance was controlled. *Conclusions:* Our findings suggest that, among individuals in early recovery from mild to moderate TBI, self-reported depressive symptoms, rather than patients' cognitive complaints, are associated with objective executive function. However, self-reported cognitive complaints may be associated with objectively measured inattention and slow processing speed.

Advantages of Behavioral Rating Scales

- All neuropsychologists conduct clinical interviews
- Rating scales: An interview but with normative and clinical data
- Neuropsychologists are always striving for empirical methods
- Rating scales provide means for statistical comparisons of reported symptoms (e.g., across exams or raters)
- While ratings of cognitive skills have limitations, ratings of behavioral or emotional problems have greater validity
- And even self-reports and other-reports of cognitive problems can provide valuable hypotheses about the patient's functioning

	Behavior Rating Inventory of Executive Function (BRIEF)	Barkley Deficits in Executive Functioning Scale (BARKLEY)	Delis Rating of Executive Functions (D-REF)
Ages	5–18	6–17	5–18
Total Number of Items	80 - 86	70	36
Total Number of Indices	12	7	8
Parent & Teacher Forms	Yes	Yes	Yes
Self Form (Age Range)	Yes (13–18)	No	Yes (11–18)

D-REF

	BRIEF	BARKLEY	D-REF
Normative Data Stratified by US Census	No (not regional)	Yes (Year Unknown)	Yes - 2010
Age and Gender Based Norms	Yes	Yes	Yes
Clinical Group Comparison Data	Yes	Yes	Yes

D-REF

	BRIEF	BARKLEY	D-REF
Test-Retest Comparison Statistics/Base Rates	No	No	Yes
Multi-Rater Comparison Statistics/Base Rates	No	No	Yes
Index Level Comparison Statistics/Base Rates	Yes	Unknown	Yes
Top Five Stressors	No	No	Yes

D-REF Structure

	Parent	Teacher	Self
Behavior Index	11 items	11 items	11 items
Emotion Index	8 Items	8 Items	8 Items
Executive Functioning Index	17 items	17 items	17 items
Total Index	Sum of 3 Index T-scores	Sum of 3 Index T-scores	Sum of 3 Index T-scores
Attention/Working Memory Index	6 Items	6 Items	6 Items
Activity/Impulse Control Index	6 Items	6 Items	6 Items
Compliance/Anger Control Index	6 items	6 items	6 items
Abstract/Conceptual Reasoning Index	6 items	6 items	n/a

D-REF Features

- On-line administration and scoring
  - –Send a link to the parent or teacher and they can fill out the form on-line
- Paper and pencil administration
  - –Print out a copy of the questionnaire and give it to the parent/teacher/child
  - –Score it on line later
- Multiple reporting options
  - –Single rater reports (e.g. parent, teacher, or child only)
  - –Multiple rater reports with comparative statistics
    - Teacher vs parent, parent vs child, teacher vs parent up to 3 in one report

D-REF Features

- Text-speech function enables items to be read to the examinee (set by the examiner)
- Dynamic evaluation of critical items
  - –Each rater list top 5 most stressful behaviors
  - –Great for identifying behaviors for immediate intervention
  - –Most frequently occur behavior may not always be the most stressful

D-REF Parent/Teacher Forms

Item		Rating**(circle one)**			
		Seldom/ Never	Monthly	Weekly	Daily
1.	Acts too silly or childish.	S/N	M	W	D
2.	Is off-task when he/she is supposed to do homework or chores.	S/N	M	W	D
3.	Little setbacks make him/her very upset.	S/N	M	W	D

D-REF Self Form

- Ages 11-18 years
- Item Text (All Items) Flesch-Kincaid Grade Level Readability estimate: 3.6
- Average reliabilities for core indexes in mid .8s to .9s, clinical scales in the .7 to .8 range.

Parent Form ADHD-Combined Versus Matched Controls

	ADHD-C		Matched Controls			
Index	Mean	SD	Mean	SD	Sig	Effect Size
Behavioral Functioning	64.9	8.2	49.5	9.6	< .01	-1.72
Emotional Functioning	63.5	11.3	50.2	9.9	< .01	-1.26
Executive Functioning	65.5	8.6	50.7	9.7	< .01	-1.61
Total Composite	65.9	9.5	50.4	9.4	< .01	-1.64
Attention/Working Memory	64.2	7.4	50.1	10.3	< .01	-1.57
Activity/Impulse Control	65.8	7.8	49.1	9.7	< .01	-1.9
Compliance/Anger Control	64.5	11	49.7	9.8	< .01	-1.42
Abstract/Conceptual Reasoning	64.1	11	49.7	9.8	< .01	-1.38

Parent Form ADHD-Inattentive Versus Matched Controls

	ADHD-I		Matched Controls			
Index	Mean	SD	Mean	SD	Sig	Effect Size
Behavioral Functioning	56.2	9.5	48.5	9.2	<.01	-0.81
Emotional Functioning	53.8	7.7	49.0	9.3	0.08	-0.57
Executive Functioning	61.8	8.4	50.2	10.5	<.01	-1.22
Total Composite	57.8	7.2	49.0	11.6	<.01	-0.91
Attention/Working Memory	63.9	9.6	49.8	11.4	<.01	-1.34
Activity/Impulse Control	56.8	9.3	49.3	9.7	<.01	-0.79
Compliance/Anger Control	53.0	7.3	48.7	9.0	0.07	-0.52
Abstract/Conceptual Reasoning	58.9	9.8	49.1	10	<.01	-0.99

Parent Form Autism Versus Matched Controls

	Autism		Matched Controls			
Index	Mean	SD	Mean	SD	Sig	Effect Size
Behavioral Functioning	61.3	6.2	49.9	9.8	<.01	-1.39
Emotional Functioning	61.7	9.9	50.8	7	<.01	-1.28
Executive Functioning	66.3	9.3	49.8	10.6	<.01	-1.65
Total Composite	64.1	7.2	50.4	8.3	<.01	-1.75
Attention/Working Memory	61.9	8.2	48.9	12	<.01	-1.26
Activity/Impulse Control	61.6	6.3	48.5	8.4	<.01	-1.77
Compliance/Anger Control	60.1	8.2	49.9	6.9	<.01	-1.34
Abstract/Conceptual Reasoning	67.8	12.3	48.8	9.5	<.01	-1.73

Parent Form Asperger's Syndrome Versus Matched Controls

	Asperger's Syndrome		Matched Controls			
Index	Mean	SD	Mean	SD	Sig	Effect Size
Behavioral Functioning	65.4	13.2	48.1	9.7	<.01	-1.50
Emotional Functioning	66.8	9.9	50.1	9.4	<.01	-1.73
Executive Functioning	67.2	9.5	49.1	9.5	<.01	-1.90
Total Composite	68.8	12.2	49.4	9.1	<.01	-1.80
Attention/Working Memory	65.6	9.7	49.1	9.0	<.01	-1.77
Activity/Impulse Control	65.6	12.3	49.1	10.9	<.01	-1.42
Compliance/Anger Control	65.2	11.3	49.2	10.1	<.01	-1.50
Abstract/Conceptual Reasoning	67.4	9.5	47.9	10.7	<.01	-1.93

Parent Form Concurrent Validity with BRIEF

	General Executive	Behavioral Regulation	Inhibit	Shift	Emotional Control
Behavioral Functioning	**0.78**	**0.73**	**0.74**	0.45	0.60
Emotional Functioning	**0.70**	**0.79**	0.62	0.60	**0.81**
Executive Functioning	**0.70**	0.58	0.55	0.49	0.45
Total Composite	**0.73**	0.70	0.65	0.48	0.61
Attention/Working Memory	0.68	0.57	0.57	0.43	0.42
Activity/Impulse Control	**0.77**	0.65	**0.63**	0.45	0.55
Compliance/Anger Control	0.67	**0.69**	0.63	0.47	0.63
Abstract/Conceptual Reasoning	**0.63**	0.55	0.48	0.52	0.43

Parent Form ADHD Combined

5 Items with largest effect sizes in terms of frequency of occurrence:

- –Let's mind wander if an adult does not keep him/her on track
- –Cannot do two or more tasks at the same time
- –Forgets what he/she is supposed to do
- –Says things before thinking
- –Touches or plays with things that he/she was told not to touch or play with

Parent Form ADHD Combined

5 Items reported as top 5 stressors

- –Is off-task when he/she is supposed to do homework or chores
- –Shows outbursts of anger
- –Is very messy
- –Is quick to argue with others
- –Is easily upset when corrected by an adult

Multi-Rater Score Report; Parent-Teacher-Self Ratings

D-REF

Delis Rating of Executive Functions

Dean C. Delis, PhD

Examinee Information

Name:	case study 2
Gender:	Male
Birth Date:	01/10/1999
Age at Rating:	13 years 9 months
Grade:	8
School:	texas
Norms:	Age Adjusted
Referral Agent	school
Date of Rating:	10/10/2012

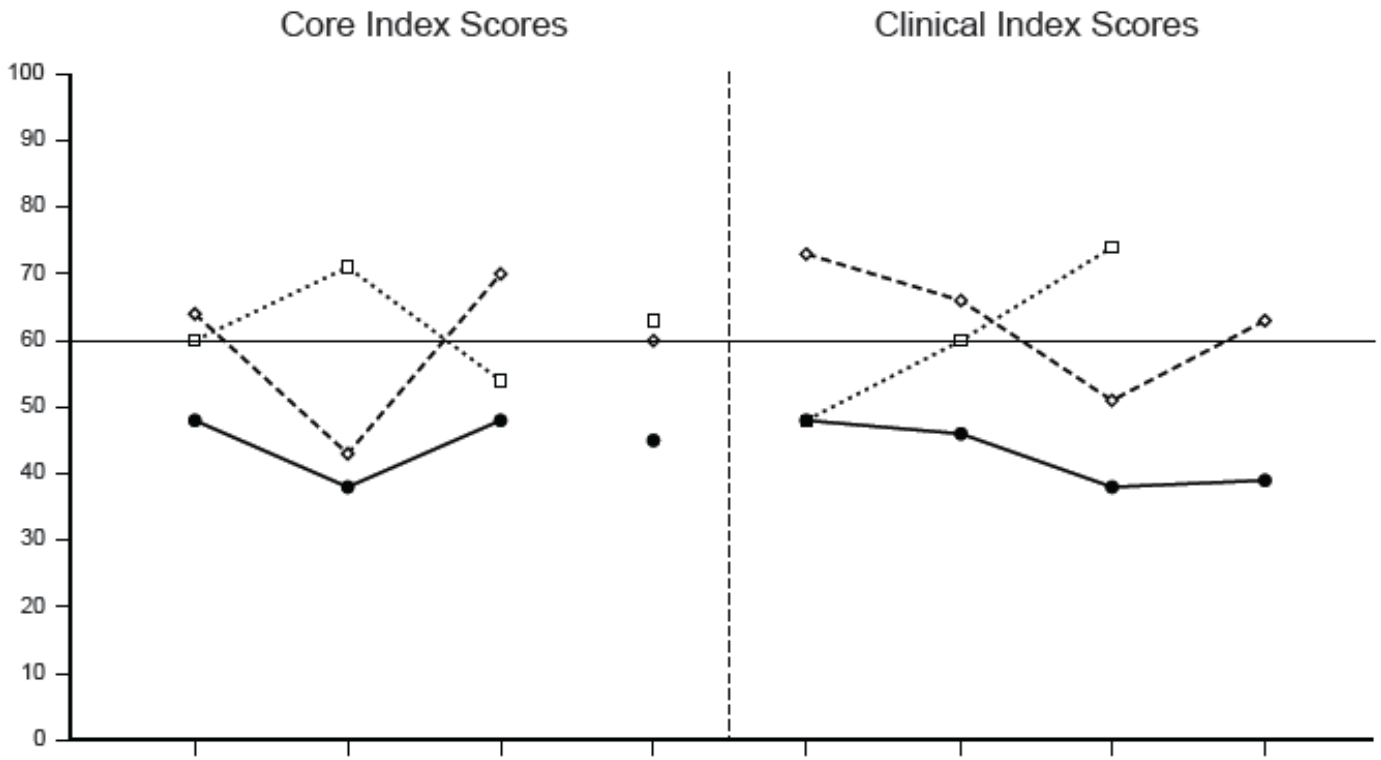
Parent Rater Information

Name:	P study 2
Relationship to Examinee:	mother
Time Known Examinee:	Since Birth
Date of Rating:	10/10/2012
Examinee Age at Rating:	13 years 9 months

Teacher Rater Information

Name:	T study 2
Class/Subject:	english
Time Known Examinee:	2 months
Date of Rating:	10/10/2012
Examinee Age at Rating:	13 years 9 months

D-REF CORE AND CLINICAL INDEX SCORE PROFILE



	BF	EMF	EXF	TC	AWM	AIC	CAM	APS
Parent (●——●):	48	38	48	45	48	46	38	39
Teacher (◇- - -◇):	64	43	70	60	73	66	51	63
Self (□····□):	60	71	54	63	48	60	74	

BF = Behavioral Functioning; EMF = Emotional Functioning; EXF = Executive Functioning; TC = Total Composite;
AWM = Attention/Working Memory; AIC = Activity Level/Impulse Control; CAM = Compliance/Anger Management; APS = Abstract Thinking/Problem Solving

CORE INDEX SCORES

Index	Raw Score	T Score	Percentile Rank	95% Confidence Interval
Parent (10/10/12)				
Behavioral Functioning	17	48	42	42 - 54
Emotional Functioning	8	38	12	34 - 44
Executive Functioning	26	48	42	44 - 52
Total Composite	134	45	31	41 - 49
Teacher (10/10/12)				
Behavioral Functioning	25	64	92	58 - 68
Emotional Functioning	8	43	24	39 - 48
Executive Functioning	54	70	98	65 - 73
Total Composite	177	60	84	57 - 63
Self (10/10/12)				
Behavioral Functioning	26	60	84	50 - 65
Emotional Functioning	27	71	98	59 - 74
Executive Functioning	37	54	66	47 - 60
Total Composite	185	63	90	58 - 67

CORE INDEX COMPARISONS (BETWEEN RATERS)

Index	Rater 1	Rater 2	Difference	Critical Value .05	Significant	Base Rate
Parent - Teacher						
Behavioral Functioning	48	64	-16	8.99	**Y**	5.5%
Emotional Functioning	38	43	-5	6.80	N	42.4%
Executive Functioning	48	70	-22	5.54	**Y**	1.4%
Total Composite	45	60	-15	4.37	**Y**	9.2%
Parent - Self						
Behavioral Functioning	48	60	-12	11.77	**Y**	11.8%
Emotional Functioning	38	71	-33	10.37	**Y**	0.0%
Executive Functioning	48	54	-6	8.09	N	24.8%
Total Composite	45	63	-18	6.79	**Y**	3.3%
Teacher - Self						
Behavioral Functioning	64	60	4	10.90	N	36.0%
Emotional Functioning	43	71	-28	9.99	**Y**	0.0%
Executive Functioning	70	54	16	8.09	**Y**	11.6%
Total Composite	60	63	-3	6.50	N	38.4%

TOP STRESSORS

Item	Rating
Parent	
10. Is very messy.	Daily
17. Touches or plays with things that he/she was told not to touch or play with.	Seldom/Never
21. Does not start homework or chores on his/her own.	Daily
22. Makes mistakes because he/she is in a hurry to complete a task.	Seldom/Never
25. Has trouble completing tasks like homework and chores.	Daily
Teacher	
2. Is off-task when he/she is supposed to do class work.	Daily
5. Loses track of what he/she is doing due to noises or other things going on.	Daily
7. Forgets what he/she is supposed to do.	Daily
21. Does not start class work without extra prompting.	Daily
32. Focuses on small details and fails to understand the main points.	Seldom/Never
Self	
1. I do things without thinking.	Daily
3. People say that I get mad easily.	Weekly
7. My teachers complain that my work is sloppy.	Monthly
8. My mood can change from happy to mad or sad very quickly.	Daily
11. If I get mad, watch out.	Daily