Neuropsychological Assessment

Ronna Fried, Ed.D
Director of Neuropsychology in the Clinical and Research Programs in Pediatric Psychopharmacology and Adult ADHD, Massachusetts General Hospital
Assistant Professor in Psychology in the Department of Psychiatry, Harvard Medical School
Disclosures

• Dr. Fried receives grant support from Lundbeck
What is a neuropsychologist?

• Doctoral training in psychology
• Specialized coursework
• Postdoctoral training (two years)
• Has probably done and can do ‘regular psychologist’ things
• Additional specialized training in assessment of cognitive functioning
• Diagnoses abnormality in cognitive functions
• Does lots of testing!
The purpose of referral is to have a person with training or experience different from your own provide additional information about the child.

Referral is typically done to answer specific questions about a child’s developmental, cognitive, or emotional status.
Typical areas of concern...

- Social reciprocity / language / behavior
  - “Is this child autistic?”
- Rate of learning
  - “Is there a learning disability?”
- Rigid, shuts down, has outbursts
  - “Is there an emotional disorder?”
- Seems to be generally slow
  - “Does this child have an Intellectual and Developmental Disabilities (formerly mentally retardation)?”
- Has trouble focusing, seems impulsive, bothers other children
  - “Does this child have ADHD?”
A neuropsychological evaluation is a comprehensive assessment of cognitive and behavioral functions using a set of standardized tests and procedures.
Neuropsychological evaluations may:

• Confirm or clarify a diagnosis (Asperger vs ADHD)
• Provide profile of strengths and weaknesses for educational, vocational, or other services
• Document changes in functioning since prior examinations, including effects of treatment
• Clarify what compensatory strategies would help
• Result in referrals to other specialists
Why all the testing?
Neuropsychological evaluations typically include:

- Intelligence (IQ)
- Attention / organization
- Fine motor
- Academic achievement
- Memory
- Mood
- Parent / teacher questionnaires (assessing mood, behavior, strengths)

Process Approach
Intelligence(s)

• Multiple definitions of intelligence:
  – Expressed in different domains
    • The absent-minded professor
  – Intelligence is functional
    • Directed at solving problems
  – Intelligence is defined and shaped by culture
  – “What intelligence tests measure...”
Frequency Distribution of IQ Scores

(Figure adapted from Anastasi & Urbina, 1997)
Validity Issues for IQ Tests

• IQ test scores predict ability to succeed in school (valid use)

• IQ tests are often criticized because of:
  – Minimal theoretical basis (no underlying construct was used to devise tests)
  – Cultural bias
    • Scores depend on language, cultural experiences
      – Immigrants from Europe were deemed mental defectives because they had poor test scores
      – Tests were administered in English to non-English-speaking immigrants.....

© 2002 John Wiley & Sons, Inc.
Approaches to Intelligence

- **Psychometric approach**: statistical techniques are used to define intellectual skills and abilities
- **Information-processing**: examine mental processes
- **Multiple intelligences**: notion that intelligence is a function of multiple systems
Fluid versus Crystallized Intelligence

- **Fluid**: Refers to mental processes rather than specific information (declines with age)
- **Crystallized**: a person's knowledge base (increases with age)

© 2002 John Wiley & Sons, Inc.

(Figure adapted from J. Horn & J. Knoll, 1997, p. 72)
What Is IQ

• The IQ and Index scores have a mean of 100 and a standard deviation of 15

• IQ score of 90-110 is considered solidly average. Scores above 120 are considered superior and those below 80 are very low

• The official IQ cutoff for intellectual disability is 70; however, there must be other measures given to conclude that this score actually reflects this diagnosis
Information-Processing Approach

- Examines the processes that underlie intelligent behavior
  - **Speed of processing**: how rapidly a person can perform a mental task
    - Is a strong correlate of IQ scores
  - **Knowledge base**: persons with a strong knowledge base in an area are better able to perform a mental task
  - **Ability to apply mental processes**: can a person acquire and use new mental strategies?
Examples of Average IQ

- Verbal: 125 (superior)
- Nonverbal: 100 (average)
- Working Memory: 91 (average)
- Processing Speed: 79 (Borderline)

**AVERAGE IQ** ...but if the school teaches at an average pace of 100, the child will be unable to be successful.
Average IQ (cont.)

- Verbal: 79 (Borderline)
- Nonverbal: 91 (average)
- WM: 115 (high average)
- PS: 115 (high average)

**Average IQ** ... works quickly; rote memory but poor verbal skills = reading comprehension deficits (history; science)
What Are Executive Functions?

- Mental operations involved in goal directed behavior and self-regulation, including
  - Inhibiting, set shifting, self-monitoring, initiating, planning/organizing, task organizing, organizing materials, emotional control, and working memory
- Originally derived from the frontal lobe syndrome in which patients with brain lesions showed disturbances in the area of self-regulation

- *Shown to have Major Effect on Full Scale IQ*
Executive Functions & Disorders

• Attention Deficit Hyperactivity Disorder (ADHD)

• Bipolar Disorder (BPD)
Impact of EFDs on Children with ADHD

- Examined psychometrically defined EFDs in children with and without ADHD and EFDs
- Included male and female (mean age=12.3-13.7 years old) probands from two longitudinal family studies of ADHD

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>ADHD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>N=125</td>
<td>N=159</td>
</tr>
<tr>
<td>Female</td>
<td>103</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>122</td>
<td>138</td>
</tr>
</tbody>
</table>

So What?

• Executive Function Disorder
  – Definition:

  1 SD below norm in ≥2 tests of any domain of executive functioning
Impact of EFDs on Children with ADHD

Percent of Subjects with ≥ 2 EFDs

Control: 12
ADHD: 33

Impact of EFDs on Children with ADHD

Impact of EFDs on Children with ADHD

Repeated School Grade

- ADHD + EFDs: 42
- ADHD: 19
- Control + EFDs: 12
- Control: 8

Impact of EFDs on Children with ADHD

Psychosocial Functioning

<table>
<thead>
<tr>
<th>Condition</th>
<th>SAICA Total Problem Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADHD + EFDs</td>
<td>22.6</td>
</tr>
<tr>
<td>ADHD</td>
<td>22.9</td>
</tr>
<tr>
<td>Control + EFDs</td>
<td>15.8</td>
</tr>
<tr>
<td>Control</td>
<td>17.8</td>
</tr>
</tbody>
</table>

Impact of EFDs on Children with ADHD

- Using the psychometrically defined method, significantly more children with ADHD had EFDs than controls
- Neuropsychological impairments in children with ADHD have implications for functional outcome above and beyond the diagnosis itself
- Children with ADHD and EFDs had an increased risk for grade retention and a decrease in academic achievement, relative to ADHD alone

- *EFDs Can and Do affect IQ scores in many cases*

---

Impact of EFDs on Adults with ADHD

- Examined psychometrically defined executive function deficits (EFDs) in adults with and without ADHD and EFDs

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Control + EFD</th>
<th>ADHD</th>
<th>ADHD + EFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>122</td>
<td>23</td>
<td>147</td>
<td>66</td>
</tr>
<tr>
<td>Age</td>
<td>29.3 ± 8.4</td>
<td>35.4 ± 8.8</td>
<td>34.6 ± 10.4</td>
<td>40.0 ± 10.3</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>55 (45%)</td>
<td>11 (48%)</td>
<td>80 (54%)</td>
<td>33 (50%)</td>
</tr>
</tbody>
</table>

Impact of EFDs on Adults with ADHD

Prevalence of EFDs in Adults

- ADHD: 31%
- Control: 16%

Impact of EFDs on Adults with ADHD

Impact of EFDs on Adults with ADHD

Impact of EFDs on Adults with ADHD

Repeated School Grade

- ADHD + EFDs: 32%
- ADHD: 17%
- Control + EFDs: 22%
- Control: 2%

Impact of EFDs on Youth with BPD

Prevalence of EFDs in Youth

BPD: 45%
Control: 17%

Impact of EFDs on Youth with BPD

Academic Functioning

- BPD + EFDs: 93, p≤0.001 vs. Control & BPD
- BPD: 106, p≤0.001 vs. Control + EFD
- Control + EFDs: 96, p≤0.001 vs. Control
- Control: 111

Full Scale IQ

Impact of EFDs on Youth with BPD

Special Classes

- BPD+EFD: 68% (p≤0.001 vs. Control & BPD, p≤0.05 vs. Control+EFD)
- BPD: 29% (p≤0.01 vs. Control)
- Control+EFD: 24% (p≤0.05 vs. Control)
- Control: 4%

Impact of EFDs on Youth with BPD

Impact of EFDs on Youth with BPD


Repeated Grade

- BPD+EFD: 18%
- BPD: 8%
- Control+EFD: 12%
- Control: 10%

www.mghcme.org
Impact of EFDs on Youth with BPD

Global Assessment of Functioning

- BPD+EFD: 38.4
- BPD: 38.9
- Control+EFD: 59.5
- Control: 61.8

p≤0.001 vs. Control & Control+EFD

Impact of EFDs on Youth with BPD

SAICA Score

- BPD+EFD: 2.7
- BPD: 2.5
- Control+EFD: 1.9
- Control: 2.0

Neuropsychology & ASD
### ASD Demographics

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th></th>
<th>Adults</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASD N=49</td>
<td>ADHD N=147</td>
<td>Controls N=32</td>
<td></td>
</tr>
<tr>
<td><strong>FS IQ</strong></td>
<td>104 ± 12</td>
<td>103 ± 11</td>
<td>106 ± 13</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>12.0</td>
<td>14.3</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td><strong>Sex (Male)</strong></td>
<td>44 (90%)</td>
<td>110 (75%)</td>
<td>18 (56%)</td>
<td></td>
</tr>
<tr>
<td><strong>SES</strong></td>
<td>1.85</td>
<td>1.97</td>
<td>1.74</td>
<td></td>
</tr>
<tr>
<td><strong>FS IQ</strong></td>
<td>109 ± 12</td>
<td>108 ± 14</td>
<td>112 ± 11</td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>27.5</td>
<td>24.6</td>
<td>24.2</td>
<td></td>
</tr>
<tr>
<td><strong>Sex (Male)</strong></td>
<td>20 (77%)</td>
<td>45 (51%)</td>
<td>53 (38%)</td>
<td></td>
</tr>
<tr>
<td><strong>SES</strong></td>
<td>2.12</td>
<td>2.07</td>
<td>1.87</td>
<td></td>
</tr>
</tbody>
</table>

Full Scale IQ

Children

Adults

a

^p<0.05 versus controls

WASI Vocab

Not significant vs. controls

WASI Matrix

WASI Matrix Score 1SD<Vocab Score

Not significant vs. controls

Set Shifting

• Ability to move from one situation, activity, or part of a problem to another as the condition demands

• Test
  - Trails Making (D-KEFS)

• Child examples
  - Tries the same approach even when it does not work (BRIEF-A)
  - Has trouble moving from activity to activity (BRIEF-A)

• Adult examples
  - Resists accepting a different solution (BRIEF-A)
  - Becomes angry, experiences anxiety, or has emotional outbursts when things change (BRIEF-A)

Shifting Deficits

• May learn a set of responses for a set situation
• May have a set of strategies, but not be aware they possess them or are unable to select a strategy for a new situation

Academic Example:

48 stamps
+ 23 more.
71

48 + 23 = 71

Tim has 48 and gets 23

How many does he have now?
Trails Making

• Switch between connecting the numbers and letters
• Begin at number 1 and draw a line from 1 to A, A to 2, 2 to B, B to 3 and so on until you reach the end

D-KEFS Trail Making Number Letter

Children

- ASD
- ADHD
- Controls

Adults

- ASD
- ADHD
- Controls

\(^a\) p<0.05 versus controls

\(^b\) p<0.05 versus ADHD
Working Memory

- Ability to hold information in one’s mind for purpose of generating a response or completing a task
- Test
  - Freedom From Distractibility Index (WAIS/WISC): Digit Span, Letter Number, and Arithmetic
- Child examples
  - When given three things, remembers only the first or last (BRIEF-A)
  - Forgets to hand in homework (BRIEF-A)
- Adult examples
  - Forgets what they are doing in the middle of things (BRIEF-A)
  - Has trouble remembering things, even for a few minutes (BRIEF-A)

Results: Working Memory Deficit Rates

**ADHD Subjects**
- 32% with WMD
- 68% without WMD

**Control Subjects**
- 14% with WMD
- 86% without WMD
Impact of WM on Children with ADHD

Extra Help in School

- Control: 20%
- Control + WM: 36%
- ADHD: 57%
- ADHD + WM: 72%
Impact of WM on Children with ADHD

Repeat Grade in School

- Control: 6%
- Control + WM: 15%
- ADHD: 19%
- ADHD + WM: 36%
Impact of WM on Children with ADHD

Special Class in School

- Control: 24%
- Control + WM: 0%
- ADHD: 20%
- ADHD + WM: 40%

Impact of WM on Children with ADHD
SPECIFIC NEUROPSYCHOLOGICAL APPROACHES TO IDENTIFICATION OF ADHD

EXAMPLE OF LABORATORY MEASURE OF EXECUTIVE FUNCTION—CONTINUOUS PERFORMANCE TEST (CPT)

— FOCUSES ON SPECIFIC AREAS OF EXECUTIVE FUNCTION
  • TASK PERSISTENCE
  • VIGILANCE
  • IMPULSE CONTROL
  • REGULATION OF AROUSAL LEVEL
PRESS BUTTON EVERY TIME A LETTER APPEARS
EXCEPT WHEN THE LETTER “X” APPEARS
CONTINUOUS PERFORMANCE TEST

SCORING CATEGORIES:

- Omissions
- Commissions
- Overall Processing Speed
- Overall Attentional Variability
- Perceptual Sensitivity
- Risk Taking
- Perseverations
- Speed Decrement Over time
- Variability Over time
- Activation/arousal
HIT REACTION TIME

MILLISECONDS

1 SEC
2 SEC
4 SEC

TYPICAL
ADHD
STANDARD ERROR OF HIT REACTION TIME

MILLISECONDS

MILLISECONDS

TYPICAL

ADHD

1 SEC

2 SEC

4 SEC
COMMISSION ERRORS

MILLISECONDS

1 SEC

2 SEC

4 SEC

CONTROLS

ADHD
NON-ADHD CONDITIONS THAT CAN AFFECT SCORES ON CPT:

- **Commissions:** anxiety; irritability
- **Omissions:** depression; dyspraxia;
- **Overall Processing Speed:** depression; anxiety; metabolic conditions (e.g., hypoglycemia)
- **Speed Decrement Over time:** depression; diabetes; hypothyroidism
- **Activation/arousal:** obsessional states; malnutrition
Results of a Neuropsychological Evaluation

- Comprehensive report (8-15 pages) detailing:
  - Medical, developmental and social history
  - Summary of previous evaluations/treatments
  - Behavioral observations
  - Test results (lots and lots of test results)
  - Integrative summary of findings placed in the context of medical, developmental and psychosocial history
  - Diagnostic formulation
  - Recommendations for intervention / remediation
  - Follow-up and case management

Leads to...
<table>
<thead>
<tr>
<th></th>
<th><strong>IDEA</strong></th>
<th><strong>SECTION 504</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PURPOSE</strong></td>
<td>To insure that all children with disabilities have available to them a free education</td>
<td>To prohibit discrimination on the basis of disability in any program receiving federal funds</td>
</tr>
<tr>
<td><strong>WHO IS PROTECTED</strong></td>
<td>13 Categories of qualifying conditions</td>
<td>Much broader. Eligibility: a physical or mental impairment that substantially limits a major life activity</td>
</tr>
<tr>
<td><strong>DUTY TO PROVIDE A FREE APPROPRIATE EDUCATION</strong></td>
<td>Requires the district to provide IEPs. “Appropriate education” means a program designed to provide “educational benefits.”</td>
<td>“Appropriate” means education comparable to the education provided to non-handicapped students</td>
</tr>
</tbody>
</table>

*Individuals with Disabilities Education Act (IDEA)*

**Section of the Americans With Disabilities Act (ADA)**
13 Categories from IDEA

- autism
- deaf-blindness
- emotional disturbance
- hearing impairment (including deafness)
- mental retardation
- multiple disabilities
- orthopedic impairment
- other health impairment (ADHD)
- specific learning disability
- speech or language impairment
- traumatic brain injury
- visual impairment (including blindness)
IDEA/504 CHART

STUDENT NEED

CONSIDERATION OF IDEA

Disability adversely affects educational performance

- yes: IDEA eligibility
- no: not eligible

CONSIDERATION OF 504

Handicap substantially limits one or more major life activities

- no: not eligible
- yes: 504 Protected

Not eligible
FOR A FAIR SELECTION EVERYBODY HAS TO TAKE THE SAME EXAM: PLEASE CLIMB THAT TREE

Our Education System