The value of a pediatric Neuropsychological evaluation for the Clinical care of maltreated children

Fiona Burrows, Psy.D.  
Pediatric Neuropsychologist  
Stonebridge Alliance, L.L.C.

Kristy Hagar, Ph.D.  
Pediatric Neuropsychologist  
Developmental Neuropsychology Services, PLLC
Presentation Overview

• The Pediatric Neuropsychological Evaluation
• How neuropsychological evaluation differs from psychological and psychoeducational assessment
• Neurocognitive domains typically measured in a neuropsychological evaluation
• When is it appropriate to refer a child for evaluation?
• Assessment data indicating referral for neuropsychological evaluation
Presentation Overview

• Neurocognitive and neurobehavioral patterns among children with neurological impact/conditions
• Review of Functional Brain Anatomy
• Brain Development
• Effects of early deprivation and neglect
• Effects of trauma and neglect on brain structure
Presentation Overview

• Effects on brain structure and neuropsychological functioning
• Factors to consider for neuropsychological evaluation of traumatized children
• Translating neuropsychological results into supports and interventions in schools
• Case examples
The Pediatric Neuropsychologist

- Focuses on brain-behavior relationships
- Uses standardized psychometric tests and observation of behavior to define a child’s pattern of cognitive development within the context of their psychological makeup.
- The child’s performance is compared to what is expected at the child’s age-level.
- The child’s individual pattern of strengths and weaknesses is defined based on this comparison.
- Uses knowledge of brain development, brain organization, and the effects of various forms of brain injury and neurological conditions on development to guide this assessment and to interpret the results.
Pediatric Neuropsychological Assessment

• Based on an understanding of functional neuroanatomy and brain development
• Delineates how a child is functioning in comparison to expectations for the child’s age level
• The neuropsychologist is interested in how a child obtains a specific test score as well as in the pattern of test scores.
• E.g., a child may have problems following directions because he/she does not pay attention to the direction, does not comprehend the direction, or has difficulty remembering the direction. The pediatric neuropsychologist endeavors to understand the areas in which a child is having difficulty and why.
Psychological or Psychoeducational Assessment

- Psychological/psychoeducational and neuropsychological evaluations typically include:
  - Background Information
  - Behavioral observations
  - Intellectual functioning (IQ test)
  - Adaptive functioning
  - Academic achievement
  - Psychological/emotional functioning
  - Diagnostic Impressions
  - Recommendations
Pediatric Neuropsychological Assessment

• Neuropsychological assessment includes background information focused on:
  • Medical (e.g., head trauma, pregnancy & birth history, significant illness e.g., RSV, hypoxia/anoxia)
  • Genetic history (Learning disorders, ADHD, genetic syndromes)
  • Prenatal and postnatal factors (neglect, exposure to teratogens – alcohol, prescription medication, illicit drugs)
Pediatric Neuropsychological Assessment

- Neuropsychological assessment may also include administration of tests in the following domains:
  - Learning and memory
  - Visual perceptual and visuospatial functions
  - Language
  - Visual motor skills and fine motor speed/precision
  - Attention/concentration
  - Executive functions
Learning and Memory

- Ability to store information in memory and to retrieve this information once learned
- Verbal
- Visual/nonverbal
- Working memory
- Learning
Visual perceptual and Visuospatial Function

- Nonverbal abilities
- Attentiveness to visual space
- Visual neglect
- Perceptual and spatial abilities
Language

- Receptive vs. Expressive
- Ability to comprehend what others say
- Formulate words in order to share information, thoughts and feelings with others
- Phonological processing
- Speeded Naming
Visual Motor Skills and Fine motor Speed/Precision

- Visual-motor integration
- Fine motor speed and efficiency
- Ability to coordinate visual information with hand movements in order to complete activities such as:
  - drawing
  - writing
  - manipulating objects
Attention/concentration Skills

• Ability to pay attention
• Prioritize effectively and maintain focus on the important elements for completing a task
• Remain attentive until a particular task is completed
Executive Functions

• Executive function and self-regulation skills enable us to:
  • Plan
  • focus attention
  • remember instructions
  • juggle multiple tasks successfully
• Just as an air traffic control system at a busy airport safely manages the arrivals and departures of many aircraft on multiple runways, the brain needs this skill set to:
  • filter distractions
  • prioritize tasks
  • set and achieve goals
  • control impulses.
Executive Functions

• Organizational skills
  • initiating activities
  • developing directions into a plan of action for completing a task
  • modifying the plan if certain components are not working
  • monitoring the materials required to completed the task;

• Cognitive Flexibility
  • Set shifting
When is it appropriate to consider neuropsychological assessment?

• Every child experiencing school problems or behavior problems does not require a neuropsychological assessment

• Neuropsychological assessment can be helpful if a child demonstrates significant behavioral difficulties and/or academic performance deficits and has:
When is it appropriate to consider neuropsychological assessment?

• A neurological condition
  • hydrocephalus
  • cerebral palsy
  • epilepsy (seizures)
  • Neurofibromatosis
  • brain tumor
When is it appropriate to consider neuropsychological assessment?

- A brain injury as a result of an accident, a stroke, or an infection of the brain.
- Other medical problems that place him/her at an increased risk of brain injury
  - Diabetes
  - chronic heart or respiratory problems
  - certain genetic disorders
  - treatment of childhood cancer
  - premature birth and/or low birth weight
  - birth complications
When is it appropriate to consider neuropsychological assessment?

- Chronic exposure to toxins such as
  - lead
  - illicit drugs
  - Inhalants
- Prenatal exposure: Exposed to the above substances or to tobacco, alcohol prior to birth
- Postnatal exposure: Exposed to the above substances, tobacco, marijuana after birth
- Assessment by a clinical psychologist or a school psychologist, but the interventions resulting from that assessment did not result in the expected behavioral and/or academic performance improvements.
Assessment Data Indicating Referral

• Clinical Observations
  • dysmorphic features
  • “soft signs” can be markers for an as yet unrecognized cognitive d/o
    • borderline or abnormal EEG without overt behavioral manifestation
    • mild memory changes
    • attention lapses
    • speech disturbances
    • motor dysfunction (i.e., below-age gait or posture, involuntary movements, asymmetrical motor-overflow movements)
Assessment Data Indicating Referral

• History
  • medical
  • Developmental
    • Milestones
    • handedness
  • familial
  • environmental
Assessment Data Indicating Referral

- **Donders and Warschausky (1997)**
  - distinct subtype of children with TBI characterized by selective impairments on tasks comprising the PSI and POI.
- Calhoun & Dickerson Mayes (2005): Processing speed in children with clinical disorders
  - N=980
  - neurodevelopmental d/disorders
    - ADHD
    - Autism
    - Bipolar
    - LD
Assessment Data Indicating Referral

- Calhoun & Dickerson Mayes (2005)
  - PSI & FDI < group mean IQ and VCI & POI
  - Coding < SS
  - majority had learning, attention, writing and processing speed weaknesses
  - pattern not found in other clinical groups
    - Depression: low PSI
    - Anxiety, ODD, MR : No PSI weakness
TBI

• Diffuse white matter damage

• Intellectual functioning
  • early research: Verbal IQ > Nonverbal IQ
  • more recent studies: deficits in both nonverbal and verbal intellectual functioning
  • traditional omnibus IQ measures vs. more recent versions of IQ tests:
    • specific deficits in **processing speed** rather than either verbal or nonverbal skills per se
TBI

- Memory impairment
  - working memory
  - verbal memory (slower rates of acquisition)
- Slowed processing speed
- Impaired executive function
- Attention problems
- Significant persistent behavioral changes
  - behavioral disinhibition
  - emotional liability
- Word-finding difficulties
Fetal Alcohol Spectrum Disorders

- Global deficits
  - IQ scores range from 20-120
  - significantly lower IQ scores than nonexposed peers
  - VIQ>PIQ – though not consistent
  - average between 65 and 72
  - without facial dysmorphia > dysmorphic
- Pervasively impaired visual sustained attention
- Auditory sustained attention deficits on high-demand tasks
- Impaired learning and memory of verbal material
- Deficits across several executive function domains
- Difficulties with fine and gross motor abilities
Genetic Disorders

• Turner Syndrome (XO and XO/XX mosaics)
  • intact IQ
  • verbal>nonverbal
• Neurofibromatosis (NF1)
  • no typical profile
  • common deficits:
    • 40% meet criteria for ADHD
    • EF, particularly inhibition
    • 20-50% with LD
    • visuospatial skills
    • motor skills
Genetic Disorders

- Williams Syndrome
  - common deficits
  - $\downarrow$ global cognitive ability
  - visuospatial ability
  - strengths
    - language
    - verbal short-term memory
    - history of formal music lessons = better verbal memory when singing rather than speaking
Functional Brain Anatomy

- MOTOR AREA
  - voluntary movement

- FRONTAL
  - attention
  - motivation
  - emotions
  - judgment
  - problem solving
  - decision making
  - language

- PARIETAL
  - sense of touch

- OCCIPITAL
  - sight

- TEMPORAL
  - memory

- CEREBELLUM
  - balance
  - coordination

- BRAIN STEM
  - sleep
  - heart rate
  - breathing
Brain Development

- Creation and migration of neurons
- “bottom up” sequential development
- “pruning”
- Adolescent brain development
- Plasticity
- Sensitive periods
- Memories
- Stress response
Neuropsychological Effects of Early Deprivation and Neglect

- In 1989, Nicolae Ceauşescu was overthrown in Romania
- Over 150,000 children were in overcrowded, impoverished institutions
- Researchers (Fox, Nelson, Zeanah, and others) responded to the opportunity to follow and evaluate a subset of these children, termed the Bucharest Early Intervention Project
  - The “institutionalized brain” – lower volume of gray and white matter
  - Children assessed at age 8 demonstrated weaker memory and executive functioning skills
  - But, children placed with foster families showed improvement in cognitive functioning over time
  - Younger children showed the greatest improvements
Neuropsychological Effects of Trauma and Neglect

• Work by Bruce Perry, M.D., Ph.D.
• Neurologists reported that the sizeable difference between the two brains of two different 3-year-olds (as illustrated in the following CT scans) has one primary cause: the way that their caregiver/s treated them.
Effects on Brain Structure and Activity

- Hippocampus
- Corpus collosum
- Cerebellum
- Prefrontal cortex
- Amygdala
- Cortisol levels
- Etc.
- Epigenetics
Effects on Behavioral, Social, and Emotional Functioning

- Chronic fear response
- Hyperarousal
- Internalizing symptoms
- Impaired executive functions
- Delay in achieving developmental milestones
- Reduced response to positive feedback
- Poor social interactions
- Adolescents
CT scans illustrating the impact of neglect on the developing brain

Left: Healthy 3-year-old with an average head size
Right: 3-year-old with a history of severe sensory-deprivation neglect – significantly smaller in size, abnormal development of the cortex

Factors to Consider for Neuropsychological Evaluation of Traumatized Children

  - motor deficits (60%)
  - visual deficits (48%)
  - epilepsy (20%)
  - speech and language abnormalities (64%)
  - behavioral problems (52%)
  - mean psychomotor index = 69.9 (SD: ±25.73)
  - mean mental development index = 74.53 (SD: ±28.55)
Factors to Consider for Neuropsychological Evaluation of Traumatized Children

  • features of inflicted TBI:
    • acute computed tomography/magnetic resonance imaging findings of preexisting brain injury, extraaxial hemorrhages, seizures, retinal hemorrhages
    • significantly impaired cognitive function without prolonged impairment of consciousness.
Factors to Consider for Neuropsychological Evaluation of Traumatized Children

- Clinical report of VIQ<PIQ (Coverstone)
- Lack of background data (pregnancy, birth, medical events)
- Environmental stimulation
- Prenatal care and development
- Trauma
Neuropsychological Recommendations for School

- If the child’s achievement in the school setting falls below that of his/her peers (due to factors such as neurocognitive deficits, behavioral or emotional difficulties, etc.), then schools can provide supports and services in an attempt to improve functioning and improve the child’s functioning to as close to peers as possible. This process is a stepwise process referred to as Response To Intervention (RTI)
Outside evaluations are not an automatic entrance to school accommodations or supports. Schools must consider whether the child exhibits difficulties in the school setting to support the need for services.
Response to Intervention (RTI)

- The road to interventions and supports often starts with discussion and collaboration with the child’s caregivers and school personnel.
- The child may be referred to a team or committee to address initial concerns
  - Student Support Committee
  - CARE team
  - RTI Committee
Response to Intervention (RTI)

- Interventions and supports might include:
  - Classroom accommodations
  - Small Group Instruction
  - Section 504 accommodations
  - Special Education
  - Other Specialized services - counseling, dyslexia services, etc.
Classroom Accommodations

• May be provided informally, especially in the elementary setting when teachers take each child’s strengths and weaknesses into consideration
• Recommend formalizing accommodations when possible, for several reasons:
  • Provides a “paper trail” of accommodations that make it easier to follow through and promote consistency and accountability
  • Provides opportunity to routinely review (usually at least yearly) how the student is progressing and how accommodations are working or not working
  • Helps provide consistency if student moves frequently
  • Maintains appropriate supports as children move into higher grades and transition to different campuses
Section 504

- Section 504 of the Rehabilitation Act of 1973 – is a civil rights statute that prohibits discrimination and assures that disabled students have educational opportunities and benefits equal to those provided to non-disabled students.
- A student may be eligible for accommodations through Section 504 if:
  - Has a physical or mental impairment which substantially limits one or more major life activities (e.g. learning, concentrating, communicating)
  - Has a record of such an impairment or
  - Is regarded as having such an impairment
Special Education

- IDEA – Individuals with Disabilities Education Act – federal regulations assuring students with disabilities receive free appropriate public education (FAPE) in the least restrictive environment

- Can be a long process but provides the protections and supports that some students require in order to be successful in the school environment
Special Education Eligibilities

- Eligibility categories often related to psychological/neuropsychological evaluation results include:
  - Autism (AU)
  - Emotional Disturbance (ED)
  - Intellectual Disability (ID)
  - Other Health Impairment (OHI)
  - Specific Learning Disability (LD)
  - Traumatic Brain Injury (TBI)
Case Studies

- David
- Georgia
- Susan
- Luke
<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wechsler Intelligence Scale for Children-Third Edition (WISC-III)</strong></td>
<td></td>
</tr>
<tr>
<td>IQs/Composites</td>
<td></td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>113</td>
</tr>
<tr>
<td>Performance IQ</td>
<td>77</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>95</td>
</tr>
<tr>
<td><strong>Woodcock-Johnson Tests of Achievement III (WJIII)</strong></td>
<td></td>
</tr>
<tr>
<td>Broad Reading</td>
<td>116</td>
</tr>
<tr>
<td>Broad Math</td>
<td>128</td>
</tr>
<tr>
<td>Broad Written Language</td>
<td>131</td>
</tr>
<tr>
<td>Letter-Word Decoding</td>
<td>99</td>
</tr>
<tr>
<td>Passage Comprehension</td>
<td>107</td>
</tr>
</tbody>
</table>
# Georgia

## Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV)

<table>
<thead>
<tr>
<th>IQs/Composites</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Comprehension</td>
<td>77</td>
</tr>
<tr>
<td>Perceptual Reasoning</td>
<td>88</td>
</tr>
<tr>
<td>Working Memory</td>
<td>65</td>
</tr>
<tr>
<td>Processing Speed</td>
<td>68</td>
</tr>
<tr>
<td><strong>Full Scale</strong></td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VC Subtests (Scaled Scores)</th>
<th>PR Subtests (Scaled Scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similarities</td>
<td>Block Design</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>Picture Concepts</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Matrix Reasoning</td>
</tr>
<tr>
<td><strong>WM Subtests (Scaled Scores)</strong></td>
<td><strong>PS Subtests (Scaled Scores)</strong></td>
</tr>
<tr>
<td>Digit Span</td>
<td>Coding</td>
</tr>
<tr>
<td>Letter-Number Seq.</td>
<td>Symbol Search</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Georgia

**Wide Range Achievement Test – Revision 3 (WRAT3)**

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Standard Scores</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>49</td>
<td>K</td>
</tr>
<tr>
<td>Spelling</td>
<td>61</td>
<td>K</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>81</td>
<td>2</td>
</tr>
</tbody>
</table>
Susan

**Wechsler Intelligence Scale for Children-Third Edition (WISC-III)**

<table>
<thead>
<tr>
<th>IQs/Composites</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal IQ</td>
<td>67</td>
</tr>
<tr>
<td>Performance IQ</td>
<td>95</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>78</td>
</tr>
</tbody>
</table>

**Woodcock-Johnson Tests of Achievement III (WJIII)**

<table>
<thead>
<tr>
<th>Subtests</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Reading</td>
<td>84</td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>82</td>
</tr>
<tr>
<td>Math Calculation</td>
<td>84</td>
</tr>
<tr>
<td>Applied Problems</td>
<td>77</td>
</tr>
<tr>
<td>Writing Samples</td>
<td>63</td>
</tr>
<tr>
<td>Writing Fluency</td>
<td>90</td>
</tr>
</tbody>
</table>
Luke

• WECHSLER INTELLIGENCE SCALE FOR CHILDREN – FIFTH EDITION (WISC-V)
  • Verbal Comprehension 98
  • Visual Spatial 92
  • Fluid Reasoning 94
  • Working Memory 67
  • Processing Speed 75
  • Full Scale 84
Luke

- **WIDE RANGE ASSESSMENT OF MEMORY & LEARNING (WRAML-2)**
  - Verbal Memory Index 97
  - Visual Memory Index 91
  - Attention/Concentration Index 88
  - Working Memory 94
  - Verbal Recognition 82
  - Visual Recognition 112
Luke

• **Delis-Kaplan Executive Function System (D-KEFS)**
  
  • **Trail Making Test**: Luke performed below average on the switching task (9\textsuperscript{th} percentile)
  
  • The **Verbal Fluency Test**: Luke had significant difficulty on the switching task, with his performance falling within the low range (5\textsuperscript{th} percentile). Luke also demonstrated several “set-loss” errors (i.e. words that did not match the category requested) compared to peers, suggesting impulsivity and/or poor monitoring or “filtering” of the words requested during each of the tasks
  
  • The **Color-Word Interference Test**: Luke’s performance fell in the low average range (9\textsuperscript{th} percentile) on the inhibition task and within the low range (5\textsuperscript{th} percentile) on the switching task