Neuropsychological Evaluation

Geoffrey Tremont, Ph.D., ABPP-CN
Rhode Island Hospital & Alpert Medical School of Brown University
Outline of Talk

• Neuropsychology Definition
• Training in Neuropsychology
• Purpose of a Neuropsychological Evaluation
• Approaches and Methods
• Normative Data
• Deficit Measurement
• Components of an Evaluation
• Cognitive Domains
Outline Continued

- Neuropsychological Report
- Normal Cognitive Aging
- Mild Cognitive Impairment
- Dementia
- Depression-Related Cognitive Dysfunction
Neuropsychology Definition

- Study of brain-behavior relationships
  - Cognition
  - Mood
  - Functional ability
- Observation and formal assessment to identify CNS integrity
Training In Neuropsychology

• Clinical Psychology PhD (PsyD, EdD)
• Neurology, neuroanatomy, neuroscience
• Specialized training internship & fellowship
• Licensed as clinical psychologist
• Board Certification not standard like medicine
  – American Board of Clinical Neuropsychology (ABCN)
  – American Board of Professional Psychology (APN)
Purpose of Neuropsychological Evaluation

• Pattern of overall cognitive and behavioral functioning (strengths and weaknesses)
• Differential diagnosis (e.g., dementia v. depression)
• Cognitive change following neurologic disorder, head injury, or surgery
• Disability determination, competency, or other litigation
• Baseline for later comparison
Purpose of Neuropsychological Evaluation cont.

• Track progression of degenerative diseases

• Recommendations about placement, medications, other testing/diagnostic procedures, behavioral interventions, cognitive rehabilitation, and safety concerns
Approaches and Methods

- Fixed battery approach
- Flexible approach/Hypothesis Testing
- Process approach
- Most use a combined core battery with flexibility
- 100’s of tests and batteries
Normative Data

• To identify areas of impairment need a healthy reference group
• Need to consider demographics factors that can affect performance – age, education, gender, race
• Compare performance to normative data
• Premorbid ability estimation
  – Regression based (Barona equation)
  – Ability based (Wechsler Test of Adult Reading)
# AGE and EDUCATION WEIGHTED NORMS TABLE FOR MINI-MENTAL
STATE EXAMINATION
Ages 18 - 85+ and Education Level 0 - 13+ YEARS

*JAMA* [May 12, 1993], 269(18), 2386-2391.

Compiled by: Dr. Bill Lynch - BIRU [ZB2-PAD]

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*College experience or higher degree
Deficit Measurement

- Different standard scores used (IQ, T-scores, z-scores, scaled scores, percentiles)
- Impairment defined by
  - 1-2 SD below mean (Mild)
  - 2-3 SD below mean (Moderate)
  - >3 SD below mean (Severe)
- Interpret in context of premorbid ability
Components of Examination

• Medical record review
• Clinical interview – medical, social, psychological, educational history
• Collateral interview – especially important in dementia
• Behavioral observations/Mental status
• Motivational/Effort Testing
Motivation and Effort

• Detection of exaggeration and malingering is important when there is potential secondary gain

• Performance validity testing – Test of Memory Malingering, Word Memory Testing

• Symptom validity - Minnesota Multiphasic Personality Inventory – 2 (Validity Scales, Fake Bad Scale) – medical & psych malingering/exaggeration
Cognitive Domains

- Intellectual/Academic/Global Cognition
- Attention
- Processing Speed
- Executive Functioning
- Language & Related Functions
- Visuospatial
- Learning and Memory
- Mood and Behavior
- Sensory/Perceptual/Motor
Intellectual/Achievement
Global Cognition

- IQ tests provide a measure of overall cognitive strengths and weaknesses
- Academic achievement testing useful for learning disorders
- Global cognitive measures can be used for screening or tracking progression of disease
- MMSE (1-2-point decline per year in dementia) – generally insensitive to executive dysfunction
- Mattis Dementia Rating Scale (14-point decline per year in dementia)
Attention

• Capacity
• Sustained
• Selective
• Examples: Digit Span
• Disorders: Delirium, ADHD
• Typically preserved in dementia
Processing Speed

- Psychomotor
- Information Processing
- Examples: Trail Making Test A, Paced Auditory Serial Addition Test
- Disorders: Multiple Sclerosis, Parkinson’s dementia, cerebrovascular disease
Executive Functioning

- Problem solving & Judgment
- Organization/Planning
- Sequencing
- Inhibition
- Abstraction
- Initiation/Perseveration/Personality Change
- Examples: Similarities, Stroop Test, Trail Making Test B, Wisconsin Card Sorting Test, Verbal Fluency
- Disorders: Frontotemporal Dementia, Traumatic brain injury
Stroop Color-Word Test

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Language & Related Functions

- Comprehension
- Repetition
- Naming
- Reading
- Writing
- Arithmetic
- Examples: Boston Naming Test
- Disorders: stroke, primary progressive aphasia (Frontotemporal dementia)
Visuospatial Skills

• Perception
• Construction
• Mental rotation
• Examples: Clock Drawing Test, Judgment of Line Orientation, Rey-Osterrieth Complex Figure
• Disorders: right hemisphere stroke
Mild Cognitive Impairment
Alzheimer’s Disease
Lewy Body Dementia
Frontotemporal Dementia
Sensory/perceptual/motor

- Right-left orientation
- Neglect
- Grip strength/manual dexterity
- Examples: cancellation task
- Disorders: stroke, brain tumor
Learning & Memory

- Learning/encoding
- Free recall/retrieval
- Retention
- Recognition - Discriminability
- Examples: Logical Memory, Hopkins Verbal Learning Test, Brief Visuospatial Memory Test
- Disorders: Alzheimer’s disease, Alcohol-Induced Amnestic Disorder (Korsakoff’s disorder)
Memory Processes

• **Encoding**
  • Process by which information is initially recorded in a form usable to memory

• **Storage**
  • Maintenance of material saved in the memory system

• **Retrieval**
  • Material in memory storage is located, brought into awareness
Memory Concepts

**Short-Term Memory**
Holds information for 15 to 25 seconds ($7 \pm 2$ items)

**Rehearsal**
Repetition of information that has entered short-term memory

**Chunking**
Used to expand ability to remember things in short term; organize material into meaningful groups
Other Aspects of Memory

**Declarative Memory**
- Factual information

**Procedural Memory**
- Skills and habits

**Semantic Memory**
- General knowledge and facts about the world

**Episodic Memory**
- Biographical details of our individual lives
Forgetting & Interference

Decay
Loss of information through its nonuse when new material is learned, a memory trace (engram) occurs

Proactive interference
Information learned earlier interferes with recall of newer material

Retroactive interference
Difficulty in recall of information because of later exposure to different material
Anatomy of the Memory System

Squire L, and Zola S PNAS 1996;93:13515-13522
Mood and Behavior

• Affect
• Personality
• Mood
• Behavior
• Examples: Beck Depression Inventory, Minnesota Multiphasic Personality Inventory, Frontal Systems Behavior Scale
• Disorders: Frontotemporal dementia, Lewy body dementia
Neuropsychological Report

• Serves as permanent record of patient’s performance
• Differences among neuropsychologists
  – Length of report
  – History
  – Test scores
  – Diagnostic impressions
  – Recommendations
NEUROPSYCHOLOGY IN AGING
Normal Aging

• Cognitive aging hypotheses
  – Right hemisphere
  – Frontal hypothesis
  – Fluid vs. Crystallized Intelligence

• Most changes are not dramatic
• Processing speed
• Stress, depression, medical illness, and medications can contribute
Pathology/Physiology in Normal Aging

- Decrease in brain weight/volume
- Selective loss of neurons
- Declines in oxidative metabolism/accrual of oxidative stress
- Changes in adrenal/hormonal levels
- Changes in cerebrovascular supply
- Presence of AD pathology
Charting the Course of Healthy Aging, MCI, and AD

- **AD brain changes start decades before symptoms show**
- **Amnestic MCI:** memory problems; other cognitive functions OK; brain compensates for changes
- **Cognitive decline accelerates after AD diagnosis**

- **Birth**
- **40**
- **60**
- **80**
- **Death**

**Life Course**

- **Healthy Aging**
- **Amnestic MCI**
- **Clinically Diagnosed AD**

**Normal age-related memory loss**
**Total loss of independent function**
Mild Cognitive Impairment

- Condition between normal aging and dementia
- Associated with an increased risk of developing dementia (10-15% per year)
- Healthy elderly (1-2% per year)
- 80% MCI may eventually develop dementia
- Decline in cognitive skills greater than 1.5 SDs below normative mean
- No impairment in ADLs - need good informant to establish functional ability
Role of Neuropsychology in Mild Cognitive Impairment

- Establish level of impairment – Is it severe enough to meet the <1.5 SD threshold?
- Are there other problems (depression, medical illness) that explain problems?
- Identifying subtypes- amnestic, amnestic plus, single domain
- Monitor change at yearly intervals
- Evaluate the validity of informant report
FIGURE 1. Algorithm for MCI diagnosis and subtyping

COGNITIVE COMPLAINT
- Not normal for age
- Not demented
- Cognitive decline
- Essentially normal functional activities

MCI

Is memory impaired?

Yes
Amnesiac MCI

Memory impairment only?

Yes
AMNESIAC MCI SINGLE DOMAIN (associated with AD, depression)

No
AMNESIAC MCI MULTIPLE DOMAIN (associated with AD, vascular dementia and depression)

Non-Amnesiac MCI

Single nonmemory cognitive domain impairment?

Yes
NON-AMNESIAC MCI SINGLE DOMAIN (associated with frontotemporal dementia)

No
NON-AMNESIAC MCI MULTIPLE DOMAIN (associated with dementia with Lewy bodies, vascular dementia)

Role of Neuropsychology in Dementia

• Helpful in identifying pattern
  – Memory < other functions – AD
  – Visuospatial < other functions – Lewy Body
  – Frontal/Executive/Behavior < other functions – FTD
  – Executive/slowing - subcortical (e.g., Parkinson’s)

• Establish severity and track progression

• Determine response to treatment
MCI
- Objective loss of memory
- Loss of interest
- Normal everyday activities

Mild AD
- Frequent forgetfulness
- Loss of episodic memory
- Psychological and behavioral symptoms of dementia: apathy, depression, loss of instrumental functions

Moderate AD
- Progression of cognitive deficits
- Aphasia
- Loss of executive functions
- Disturbed elementary everyday activities
- Multiple psychological and behavioral symptoms of dementia
- More extensive care required

Severe AD
- Multiple psychological and behavioral symptoms of dementia: agitation ++
- Alteration of sleep
- Total dependence - dressing, eating, hygiene

Years
- MMSE=26
- MMSE=19
- MMSE=10
Depression-Related Cognitive Dysfunction

- Also referred to as pseudodementia or dementia syndrome of depression (may not be appropriate terms)
- Depression is common in adults over 65 (20%)
- Cognitive deficits associated with depression are variable – almost never meet criteria for dementia
- Deficits in visuospatial skills, executive functioning, & psychomotor speed
Depression-Related Cognitive Dysfunction

- Depressed older adults with significant cognitive deficits may reflect a pre-dementia group – may not be responsive to antidepressants.
- Late-life-onset depression may be different than early-life-onset – could reflect brain change – prodromal dementia.
- Deficits should improve with effective antidepressant treatment and/or psychotherapy.
Depression-Related Cognitive Dysfunction

• Depression early in life increases risk for late-life dementia
• MCI + depression more likely to convert to dementia than MCI alone
• AD + depression (30-40%) greater cognitive impairment and faster decline than AD alone
Cognition & ADL Performance

• Cognition is weakly to moderately associated with functional status (explains about 20% of variance)
• Medication management, finances, and telephone use have highest correlations with cognition
• Similar correlations between cognition and ADLs and IADLs
• Executive functioning has strongest relationship with functional status (3x memory)
• Screening tests (MMSE, Mattis DRS) have stronger relationships with functioning than most formal neuropsychological measures
• Behavior change also shows a strong relationship with functional status
When to Refer Older Adults for Neuropsychological Evaluation

- Dementia versus depression
- Perform below expectations on screening test
- Reports from patient and family member of repetitious speech or behavior
- Change in ADL performance
Conclusions

• Neuropsychological evaluation provides detailed study of brain-behavior relationships
• Important component of work-up for MCI and dementia
• Careful consideration of premorbid abilities
• Pattern analysis can be helpful in differentiating MCI/dementia type
Questions?