NEUROPSYCHOLOGY AND COGNITIVE DISORDERS

Sara J. Swanson, PhD
Medical College of Wisconsin
OUTLINE

I. What is Neuropsychology?

II. Cognitive Disorders and Neurobehavioral Syndromes

III. Normal Aging

IV. Neuropsychology Cases: DI, LTC, and Underwriting
I. CLINICAL NEUROPSYCHOLOGY

Neuropsychology:
The study of brain behavior relationships

Clinical Neuropsychology:
Administration of psychological tests to assess cognitive functioning in order to aid in differential diagnosis and treatment planning
I. CLINICAL NEUROPSYCHOLOGY

Cognitive Testing is conducted on patients with brain impairment due to:

**Neurological Diseases:**
- Neurodegenerative disorders (Parkinson’s, Alzheimer’s, Lewy Body)
- Multiple sclerosis, Epilepsy, Encephalitis, (e.g., Moya moya, Sturge Weber, genetic conditions like Huntington’s disease, adrenoleukodystrophy)

**Developmental Disorders:**
- Intellectual Disability, ADHD, Learning Disabilities

**Acquired Injuries:**
- Traumatic Brain Injuries, Strokes,
- Brain tumors, penetrating brain injuries
COGNITIVE DOMAINS TESTED

Intelligence
Memory
Language
Visual spatial
Achievement
Executive
Sensory Perceptual
Motor
Personality
Effort
INTELLIGENCE

Vocabulary

**Bed**

**Tirade**

Fund of Information

Where does the sun rise?

Who was president during the civil war?

What is the Koran?

Verbal Abstraction

How are a table and a chair alike?

How are air and water alike?
INTELLIGENCE

Fig. 15-3  Examples at two levels of difficulty of Progressive Matrices type items.
MEMORY
LANGUAGE

Naming
Comprehension
Repetition
Reading

Graded Naming Test examples – test has 30 of these, presented in order of increasing difficulty

Boston Naming Test examples
VISUAL SPATIAL SKILLS
ACADEMIC ACHIEVEMENT

Reading (speed, accuracy, comprehension)
Arithmetic
Spelling
EXECUTIVE FUNCTIONS

Attention
Awareness
Reasoning
Mental Flexibility
Judgment
Self regulation
JUDGMENT/REASONING
MOTOR AND PROCESSING SPEED

[Image of a hand placing objects into a device]

[Table with symbols and numbers]

*good job, keep going*

[Another table with numbers and symbols]
Personality
Effort
Fifteen Item Test
MALINGERING
SYMPTOM EMBELLISHMENT

1 2 3 4
A C D
1 2 3 4
A B C D
PURPOSE OF NEUROPSYCHOLOGICAL ASSESSMENT

Differential Diagnosis
Description
For the purpose of rehabilitation or remediation
Prognosis or course
Forensic issues
INTERPRETATION

Level of Performance
- normative
- individual

Differential Score Approach (hold v. don’t hold)

Pathognomonic Signs

Right-Left body Side Differences

Dominant-Nondominant hemisphere differences

Pattern or syndrome analysis
<table>
<thead>
<tr>
<th>Hold</th>
<th>Don’t Hold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>Similarities</td>
</tr>
<tr>
<td>Reading</td>
<td>Attention</td>
</tr>
<tr>
<td>Fund of Knowledge</td>
<td>Mental Processing Speed</td>
</tr>
</tbody>
</table>
PATHOGNOMONIC SIGNS
HEMISPATIAL NEGLECT ON COPYING TASKS
PATHOGNOMONIC SIGNS
PATHOGNOMONIC SIGNS
PERSEVERATION

Sincerely,

Sarah Brady
Chair

James S. Brady

C: Cosponsors of H.R. 467/S.1236
   Membership of Handgun Control, Inc.
TEST PROFILE INTERPRETATION

Compare to known neurobehavioral syndromes

Look for consistency across tests and with the type of brain injury

One low score may not be significant

Normative studies show a very high proportion of individuals will have one low score on a battery of tests
II. COGNITIVE DISORDERS/NEUROBEHAVIORAL SYNDROMES

Major Neurobehavioral Syndromes

Rare Neurobehavioral Syndromes
MULTIPLE LONG TERM MEMORY SYSTEMS

Two forms of long term memory

Explicit (declarative)
- Facts
  - Medial temporal lobe
- Events

Implicit (nondeclarative)
- Priming
- Procedural (skills and habits)
- Associative learning: classical and operant conditioning
- Nonassociative learning: habituation and sensitization
  - Emotional responses
  - Skeletal musculature
  - Cerebellum
  - Reflex pathways
DECLARATIVE MEMORY

*Episodic Memory* - explicit recollection of incidents that occurred at a particular time and place in one’s personal past (e.g., remembering a specific visit to Chicago). Remember a story read 20 minutes ago.

*Semantic Memory* - general knowledge of facts and concepts that is not linked to any particular time and place (e.g., Chicago is the third largest city in US)

**Immediate Memory:** short attention span, holding a information in working memory (e.g., a phone number)

**Recent Memory:** What you had for dinner last night, memory of this lecture in an hour from now.

**Remote Memory:** Facts you have acquired (semantic memories), events from the past, remote autobiographical memories
FLASHBULB MEMORY: A SPECIAL TYPE OF EPISODIC MEMORY?
NOVEMBER 22, 1963
SEPTEMBER 11, 2001
### NEUROBEHAVIORAL SYNDROMES

<table>
<thead>
<tr>
<th></th>
<th>Memory Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Immediate</td>
</tr>
<tr>
<td>Confusional States</td>
<td>-</td>
</tr>
<tr>
<td>Dementia</td>
<td>+</td>
</tr>
<tr>
<td>Dementia with confusion</td>
<td>-</td>
</tr>
<tr>
<td>Primary amnesia</td>
<td>+</td>
</tr>
<tr>
<td>Attentional disorder</td>
<td>-</td>
</tr>
</tbody>
</table>

**Frontal Lobe Syndromes:** disinhibited vs apathetic, disorders of abnormal awareness (Capgras)

**Nondominant hemisphere syndromes:** hemispatial neglect

**Aphasic Syndromes**—fluent (Wernicke’s aphasia) and nonfluent (Broca’s), Gerstmann’s syndrome (R/L orientation, finger agnosia, agraphia, acalculia)
Dementia Types

A compromise in two or more core mental functions resulting in significant everyday impairment.
Vascular Dementia

**Subcortical**
- Difficulties with mental manipulation, personality/emotional changes, motor functions, attention

**Cortical**
- Disruption in “higher order” functions, such as memory, language, and semantic knowledge
Dementia subtypes

Cortical

Alzheimer’s disease
Frontotemporal dementia
  Behavioral Variant
  Fluent Primary Progressive Aphasia
  Nonfluent PPA
Vascular dementia

Subcortical

Vascular (CADISIL, Binswangers)
Multiple Sclerosis
Huntington’s disease
Parkinson’s disease
Parkinson’s Plus Syndromes
  Multisystem atrophy
  Progressive Supranuclear Palsy
  Corticobasal Degeneration
  Picks
  Dementia with Lewy Bodies
MILD NEUROCOGNITIVE DISORDER/ MILD COGNITIVE IMPAIRMENT

Subjective symptoms of memory loss
Abnormal memory on at least some neuropsychological tests
No Deficits in Activities of daily living
Considered an intermediate step between normal aging and dementia

Amnestic vs Nonamnestic MCI
- Single Domain
- Multiple Domains
- 4 subtypes:
  - Amnestic MCI, Single domain
  - Amnestic MCI, Multiple domains
  - Nonamnestic MCI, Single domain
  - Nonamnestic MCI, multiple domains
PROGRESSION FROM MCI TO DEMENTIA

Figure 2. Survival curve of persons characterized as having a mild cognitive impairment for 6 years. Approximately 80% have converted to dementia during this time. Reprinted with permission from John Wiley & Sons, Inc.

Progression to dementia:
Healthy controls: 1-2% develop dementia per year
MCI: 10-15% develop dementia per year
80% of aMCI convert to dementia within 6 years
SOMATOFORM DISORDERS

The presence of physical symptoms that suggest a general medical condition but are not fully explained by a medical condition, the effects of a substance or by another mental disorder (e.g., panic)

Physical symptoms reflect underlying emotional conflicts

Symptoms are not under voluntary control (unlike Factitious Disorder or Malingering)

Symptoms cause significant distress or impairment
III. NORMAL AGING

1. What is normal aging?
2. How does the brain change with age?
3. How does cognitive function change with age?
NORMAL AGING

Why not just use brain imaging? Who needs neuropsychological testing?

Brain Atrophy occurs with aging (next slide)

Brain Atrophy precedes clinical symptoms (low hippocampal volume)

New research shows shrinkage in healthy older individuals who were followed for 3 years but remained free of MCI and AD.

Individuals with dementia can have normal scans.

Individuals with abnormal scans can have normal functioning.

- 100 Billion neurons
- 200,000 synapses per neuron
- Shrinkage with age!
44 year old man presented with left leg weakness
VP shunt at 6 months of age for hydrocephalus
Ataxia at age 14 and paresis of left leg which resolved after shunt revision
Verbal IQ was 84, nonverbal IQ=70
Leg weakness and neuro exam normal after shunt revision
Married father of 2, employed as a civil servant
OREGON BRAIN AGING STUDY

87 Year Old  27 Year Old

Location of these scans in the brain
Brain volume decreases with age at a rate of ~2% per decade beginning in early adulthood.

CSF volume increases with age.

Age-related tissue volume ↓ appears primarily related to white matter loss (Guttmann et al 1998).

Blood flow (SPECT) Diminished perfusion in select cortical regions.

Metabolic activity (PET) Diminished uptake in select cortical regions.

fMRI Changes in task-related activation (c.f. HAROLD - Hemispheric Asymmetry Reduction in Old Adults).
LOOK FAMILIAR?

HTN
Hyperlipidemia
CAD
AODM
Osteoarthritis
GERD
s/p MI
Scattered T2 subcortical WM hyperintensities
HCTZ
Lisinopril
Simvastatin
Zantac
Ibuprofen
Glyburide
Albuterol
Proscar
Viagra
Clonazepam
Celexa
Prevalence of CVD in adults age 20 and older by age and sex (NHANES: 2005-2006). Source: NCHS and NHLBI. These data include coronary heart disease, heart failure, stroke, and hypertension.
The spectrum of small vessel disease–related brain changes in MRI: white matter lesions ranging from punctate foci (upper left) to extensive confluent abnormalities (lower left) and lacunar infarcts (lower right).
VERBAL MEMORY (RAVLT) NORMATIVE DATA

Males with average education

VAN DER ELST ET AL., JINS 2005
FAS-COWA

Normative data by age and education
Tombaugh, Kozak & Rees (1996)
Animal Naming
Tombaugh, Kozak & Rees (1996)

![Bar chart showing average animal naming score by age group.](chart.png)
Trail Making Test - B
Tombaugh, Rees, & McIntyre (1996)
THE TOP COMPLAINTS

WHAT DO PATIENTS ACTUALLY COMPLAIN OF?

AND IS THIS NORMAL?
Hi. I’m, I’m, I’m….. You’ll have to forgive me.
I’m terrible with names.

The case of the man who could not name that thing that climbers use.
Uh oh! Looks like Bill’s been forgetting to take his memory enhancement pills!

Drat! What was I going to say?!

It was right on the tip of my...

My...

You know, that thing in my mouth...
Now why did I come in here?
What the heck was I about to say…???
I’M ALWAYS LOSING THINGS
I think it was in Section GG-17… or was it DD-71?
SENESCENT FORGETFULNESS (SF)  
(KRAL 1962)

Benign SF: “the inability...to recall relatively unimportant data and parts of an experience, like a name, a place, or a date, whereas the experience of which the forgotten data form a part can be recalled...”

Malignant SF: “inability to recall events of the recent past, whereby not only relatively unimportant data and parts of an experience but the experience as such cannot be recalled”

In Clinical practice:
“I have trouble recalling why I went into a room, recalling names of people I have met recently.”  **Worried Well**
“My husband asks 10 times in one hour the time for his upcoming appointment, forgets how many children he has”  **Pathologic**
AGING: VULNERABLE PROCESSES

Fluid intelligence (visual spatial skills)

Processing Speed (reaction time, speed of sensori-motor output)

Working memory

Executive Function: multi-tasking/divided attention

Long-term memory
  - Episodic memory
  - Source recall

Complex visual processing
NEUROGENESIS AND PLASTICITY

**THEN**: The brain is equipped with a finite complement of neurons. Once a neuron dies, it is never replaced. Therefore aging entails a relentless, subtractive process.

**NOW**: New neurons sprout in the hippocampus throughout the lifespan. The change in the absolute number of neurons is not significant.

**CAVEAT**: Old outgoing neurons do not transmit their experience to new replacements.

Peter Eriksson & Fred Gage, *Neurogenesis in the adult human hippocampus.*

*Nature Medicine* 1998
PET BRAIN ACTIVITY DURING SOURCE MEMORY TASK

Old-Low performing subjects recruited similar PFC regions as young adults but used them inefficiently.

Old-High performing subjects compensated for age-related memory decline by reorganizing the episodic retrieval network.

→ SUPPORTS COMPENSATION VIEW OF HAROLD

Hemispheric Asymmetry Reduction in Old Adults

Cabeza et al. (2002, Neuroimage)
THE GOOD NEWS

Social Involvement
- social support ↑ cognitive function

Effects of exercise
- ↑ Lung function
- ↑ Cerebral blood flow
- ↓ CVD risk factors (HTN, hypercholesterolemia, obesity)
- CV health augments brain plasticity
- ↑ Capillary growth around neurons
- ↑ Synaptic density

Vascular risk factors are controllable:
- Cigarette smoking
- Obesity
- HTN
- Hypercholesterolemia
- Diabetes
YOUR BRAIN: USE IT OR LOSE IT

MacArthur Foundation study
- Years of education correlates most robustly with cognitive outcome in aging

High levels of education convey neuroprotective effect in withstanding AD pathology

Rush U study: frequency of engagement in intellectually stimulating activity better predicts dementia diagnosis than years of education

Importance of Lifelong Learning
Daily exercise and weight control

- Whole grain foods (at most meals)
- Fruits, 2–3 times/day
- Vegetables (in abundance)
- Nuts, legumes, 1–3 times/day
- Fish, poultry, eggs, 0–2 times/day
- Dairy or calcium supplement, 1–2 times/day
- Multiple vitamins for most
- Alcohol in moderation (if appropriate)
- Use sparingly

Red meat, butter

White rice, white bread, white pasta; potatoes, soda, and sweets
NORMAL AGING REDEFINED

There’s nothing normal about aging
Typical or average or usual aging
Optimal aging
Super aging
Healthy Aging
MIN BAHADUR SHERCHAN, NEPALESE CLIMBER, 76, OLDEST MAN TO CONQUER EVEREST

May 2008
Joe Willie Namath

I can't wait until tomorrow...
'cause I get better looking every day

THE BOMBSHELL BESTSELLER

8 PAGES OF UP-TO-THE-MINUTE PHOTOGRAPHS
NICK NOLTE
2/8/1941
SISTER MADONNA BUDER
82 YEARS OLD

Roman Catholic nun

Completed her first triathlon at age 52

Oldest person (man or woman) to complete an Ironman

2.4 mile swim, 112 mile bike, 26.2 mile run
IV. CASES

- DI
- LTC
- Underwriting
DI CASE

56 year old attorney claiming limitations due to speech problems

His firm has asked him to leave the law practice

Insured’s wife reports a 9 month history of reduced fluency of speech

Insured is under stress at work and has lost several large clients

Insured believes he is still capable of working

Graduated from an Ivy league law school

______________________________

Neuropsychological testing:

- Reading: Superior
- Intellectual skills: 98 Verbal Index, 126 Perceptual Reasoning Index
- Boston Naming Test: 43/60 (Impaired)
- Verbal phonemic fluency (impaired)
- Ability to judge line angles: High Average
- Memory scores: Normal (high average)
- Beck Depression Inventory: Mild
DIAGNOSIS?
LIMITATIONS?

Primary Progressive Aphasia
Total
DI CASE

41 year old woman involved in a motor vehicle accident 2 years ago

No loss of consciousness or period of amnesia, briefly dazed

Claims headaches, dizziness, light sensitivity, inattention, and poor memory preclude her from working as a business consultant

Involved in litigation against the driver of the vehicle

Broken femur

Neuropsychological testing:

Average intelligence

Average delayed recall but borderline impaired recognition memory

Normal effort testing

Variable scores on attention measures

Personality Testing showed: elevations on somatization and conversion

Beck Depression Inventory: Moderate Depression
Common DI Cases:

1. Traumatic brain injury (mild to severe)
2. Dementia (early onset Frontotemporal dementias, later onset garden variety AD)
3. Psychiatric condition presenting with cognitive concerns (depression, anxiety, and co-morbid cognitive concerns)
4. Somatic Symptom Disorders
   - Mild Concussion and now multiple unrelenting somatic physical and cognitive concerns not explained by the concussion but explained by underlying psychosocial stressors, misattribution of normal symptoms to TBI, or misattribution of depressive symptoms to brain injury residuals
   - Severe pervasive belief that an individual has a medical condition (e.g., the case of Morgellons--delusional belief that they have been infested by a disease causing agent like insects, parasites, hairs or fibers, sometimes claiming to pull hairs or fibers out of their skin) Delusional infestation
LONG TERM CARE

81 year old woman former teacher

- Osteoarthritis
- Diabetes
- History of alcohol use
- Living independently with some intervention from family
- Losing weight
- Family believes she needs supervision in the home due to memory problems
- No diagnosis of dementia in her medical records
- MMSE 26/30 (normal score for her age)
  - Missed all words after a delay and misstated the date
- Neuropsychological Testing (often unavailable)
  - IQ: High Average
  - Immediate memory: high average
  - Delayed recall and recognition: impaired
  - Diagnosis?
  - Need for LTC?
MOCA VS MMSE
Montreal Cognitive Assessment (MOCA)

- Sample of Trail Making Test
- Three Dimensional Cube
- Clock Drawing
- Picture Naming
- Receptive and Expressive Screen
- Orientation

Screening Test – 24 to 26 cutoff
57 yr old female MD worked night shift in ER
Saw her physician after she got lost driving home
Is she at risk for Dementia? Yes?
Neuropsychological Testing was normal

Applied for LTC 2 years later
Issue policy?
Another Neuropsychological evaluation was requested and there was no decline in her scores over time.

Neuropsychological testing after a 2 year interval with baseline testing for comparison is the strongest evidence that there is not a dementing condition.

Found to have Circadian Rhythm Sleep-Wake disorder related to shift work in ED
57 year old woman with memory concerns
Works as a seamstress
23/30 on the MMSE
2/3 for delayed recall
Missed the sentence, spelling WORLD or serial 7s

Neuropsychological testing in

<table>
<thead>
<tr>
<th>Test</th>
<th>2010</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>82</td>
<td>86</td>
</tr>
<tr>
<td>Memory</td>
<td>low ave</td>
<td>low ave</td>
</tr>
<tr>
<td>Object Naming</td>
<td>low ave</td>
<td>low ave</td>
</tr>
<tr>
<td>Trails</td>
<td>average</td>
<td>average</td>
</tr>
<tr>
<td>Reading</td>
<td>2nd grade level</td>
<td></td>
</tr>
</tbody>
</table>
Neuropsychological testing is an objective way to evaluate cognitive and psychological functioning (brain structure does not equal function).

Neurobehavioral syndromes are defined by the results of cognitive testing (memory in particular).

Forgetting and word finding problems are common.

Neuropsychological testing is useful for differentiating normal from abnormal aging or neurodegeneration.

Provides information that can be useful for evaluating claims and underwriting.
MCAS phone screening tool is validated for differentiating individuals who are normal from those who have mild to moderate cognitive impairment.

More studies are needed to assess ability to differentiate MCI from normal aging or developmental disorders (ADHD) from degenerative disorders.

Applicants can “cheat” by writing information down or looking at their phone or watch for the date.

Some items will be failed by individuals with attentional problems or learning disabilities who struggle to perform math in their heads or repeat digit strings.

If questions persist, ask for a neuropsychological evaluation.

Presenting with adult onset ADHD symptoms can be a red flag and some will have a cognitive disorder but more will have a psychiatric condition.