

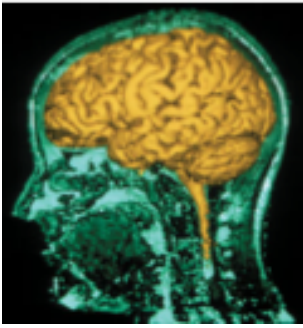
Neuropsychological Assessment in TBI

Dr Swati Kedia

Consultant Clinical Psychologist

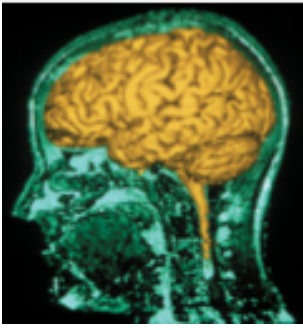
Holy Family Hospital, Delhi

Introduction - TBI



- Two main types of TBI: open-head injury and closed-head injury.
- Open-head injuries :
 - Skull is penetrated (e.g., gunshot), or in which fragments of bone penetrate the brain substance.
 - Usually no loss of consciousness
 - Distinctive symptoms that undergo rapid and spontaneous recovery
- Closed Head Injury:
 - result from a blow to the head, which can subject the brain to a variety of mechanical forces (e.g., coup and countercoup, edema, microscopic lesions etc.)
 - Usually results in coma
 - Discrete impairment of specific functions mediated by the cortex at the site of the coup or countercoup lesion e.g., probmem-solving), or more generalized impairments from widespread trauma throughout the brain (e.g, mental speed, concentration)

Introduction – Neuropsychological Assessment



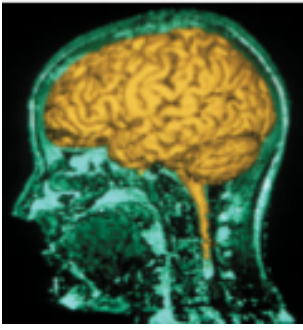
- A method of studying brain-behavior relationship

- Address issues of:
 - Cerebral lesions
 - Lateralization
 - Localizations
 - Functional impairment due to disease condition

- History of neuropsychology traced back to 1800s

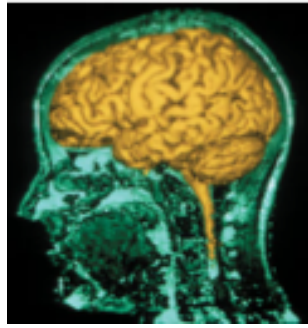
- 1st neuropsychological assessment - 1930s

Introduction – Neuropsychological Assessment



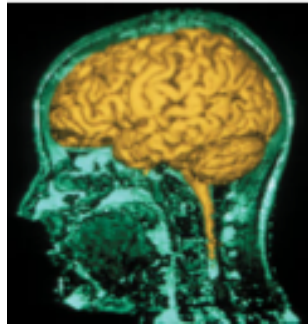
- Many early neuropsychological procedures carried out during war-time to
 - assess the cognitive status and suitability of military personnel and
 - study effect of missile injuries
- Status as a discipline signaled by:
 - *Neuropsychologia* (1963) and
 - *Journal of Clinical Neuropsychology* (1964)
- Recognition as a formal discipline by American Psychiatric Association (1996)

Introduction – Neuropsychological Assessment and TBI



- A comprehensive approach required to assess cognitive domains, psychiatric symptoms, psychological factors, psychosocial variables and functioning in clients with TBI.
- Evaluation must assess both acute and chronic deficits to best predict functional outcome and ability.
- Performance on neuropsychological tasks linked with functional status 6 months after injury, and with ability to return to work and employment outcomes (Ryu et al., 2010)

Clinical Utility of Neuropsychological Assessment



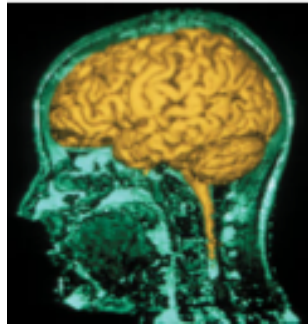
1. Differential diagnosis

- Are the patient's reported cognitive difficulties due to TBI or some other condition

2. Characterization of cognitive, behavioral, and emotional abilities/limitations

- What cognitive and behavioral deficits does the patient have? How these affect daily functioning?
- Is a treatable psychiatric condition that can have an adverse impact on engagement in TBI rehabilitation (eg, depression) present?

Clinical Utility of Neuropsychological Assessment



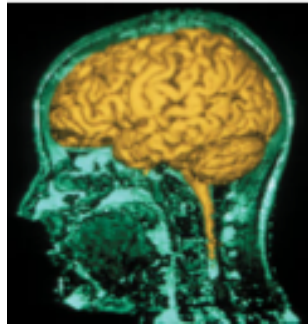
3. Treatment planning

- What specific cognitive impairments should be targeted for rehabilitation for a patient with a subarachnoid hemorrhage?
- What behavioral interventions would be effective for a patient with disinhibited and hypersexual behavior after TBI?
- What academic accommodations does a patient with a TBI and residual cognitive deficits need if he/she wishes to pursue college coursework?

4. Treatment evaluation

- Has there been an improvement in mental status and cognition after surgical evacuation of a hematoma?
- Has the patient's attention improved after initiation of medication X?
- Has a cognitive remediation protocol resulted in an improvement in the patient's memory?

Clinical Utility of Neuropsychological Assessment

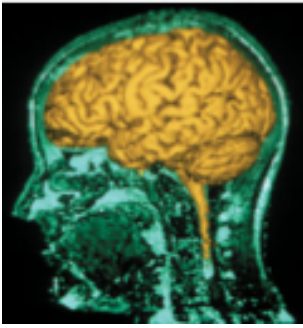


5. Research

- Is a newly developed test able to accurately predict cognitive and functional outcomes after TBI?
- Has an investigational medication resulted in objective improvements in cognition among patients with TBI?

6. Forensic

- Does this person have cognitive deficits from a TBI sustained during a workplace injury that prevents him/her from holding employment?
- Would he/she get any disability benefits?



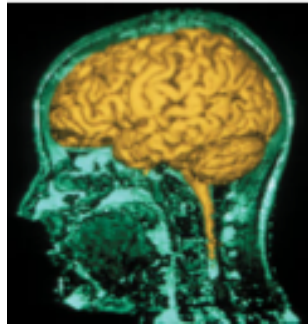
Important considerations

Clinical Interview

Test Selection and Interpretations

Recent Advances

Ethical Issues



Important considerations

Clinical Interview

Test Selection and Interpretations

Recent Advances

Ethical Issues

Age

Multiple TBI's

Depression

PTSD

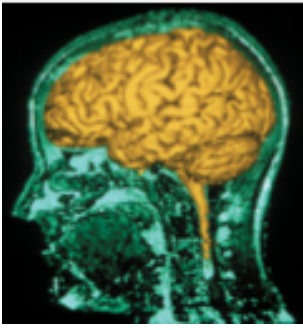
Substance Use

Effort

Litigation and
Disability

Pain

Important Considerations



- **Age**

- Young children and older adults are at greater risk of experiencing long-term cognitive deficits (Chaytor et al., 2007; Lezak et al., 2004)

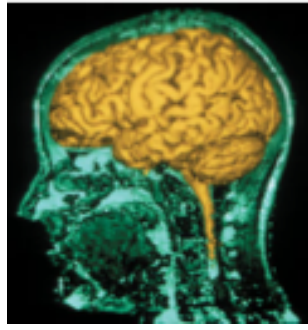
- **Multiple TBI's**

- History of prior TBI increases the likelihood of cognitive deficits from subsequent events (Granwall, 1991; Gaultieri & Cox, 1991)

- **Depression**

- Reported in 14-61% of people during first year of injury (Bombardier et al., 2010)
- Certain cognitive functions (e.g., attention, executive functioning, memory, and psychomotor speed) impaired in both conditions
- Sleep disturbance & side-effect of medicines may worsen cognitive deficits

Important Considerations



- **Post-traumatic Stress Disorder**

- Much overlap in the symptoms and cognitive deficits of posttraumatic stress disorder (PTSD) and TBI (Danckwerts & Leathem, 2003)

- Need to employ objective measures to ensure accurate diagnoses and prevent misdiagnoses of either condition (Greiffenstein et al., 2008)

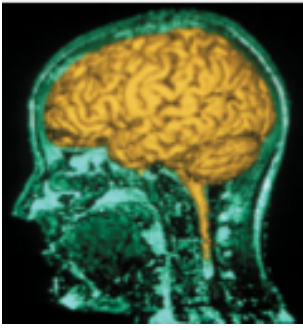
- **Substance Abuse**

- Past or current alcohol and substance abuse maybe common in individuals who suffer from TBI.

- Both share similar cognitive deficits, esp in domains of executive functions and memory (Rourke & Grant, 2009; Gonzalez et al., 2009)

- No difference seen in cognitive functioning of Individuals with mild TBI and history of substance abuse (Lang et al., 2008)

Important Considerations



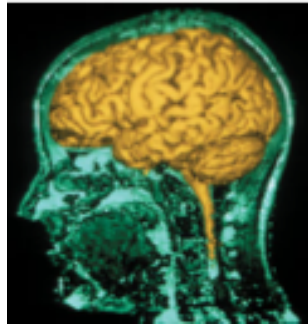
- **Effort**

- Effort accounts for greater proportion of the variance on neuropsychological performance than the severity of TBI (Green et al., 2001).
- Important to judge whether test is invalid due to lack of effort or malingering

- **Pain**

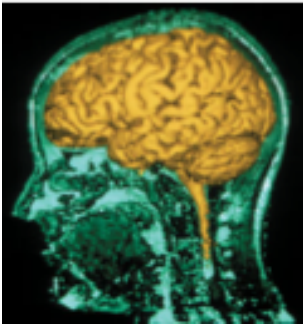
- Significant confounding factor
- Chronic pain associated with significant deficits in area of working memory/attention and psychomotor speed (Hart et al., 2000)

Important Considerations



- **Litigation Status**

- Important and controversial factor
- Involves individuals who are seeking financial compensation for residual injuries following a TBI
- A prominent and consistent factor accounting for poor outcome and prolonged recovery from mild TBI (Harris et al., 2005)
- Those in litigation present with greater subjective complaints and poorer performance on neuropsychological assessment (Bellanger et al., 2005)
- **Presence of active litigation should be carefully considered when determining the aetiology of cognitive impairment seen following TBI**



Important considerations

Clinical Interview

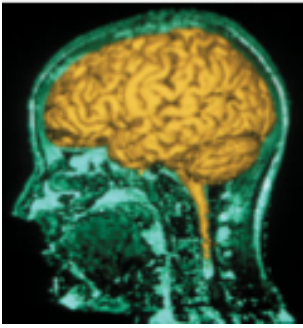
Test Selection and Interpretations

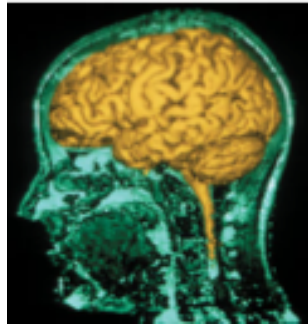
Recent Advances

Ethical Issues

Clinical Interview

- A detailed Clinical History must include:
 - Symptom presentation
 - Nature of injury and time since injury
 - Current or past emotional/psychological factors (e.g., PTSD, depression, anxiety etc.)
 - Effect on functional ability
 - Behavioural/Personality Changes
 - Premorbid functioning and cognitive ability
 - Past or present substance or alcohol use
 - Medical Findings
 - Reason for seeking assessment





Important considerations

Clinical Interview

Test Selection and Interpretations

Recent Advances

Ethical Issues

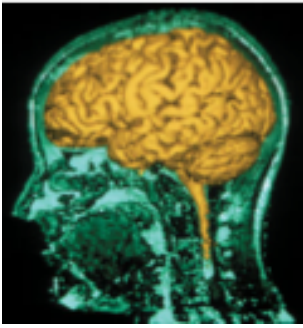
Fixed vs Flexible

Areas to be Assessed and Tests Used

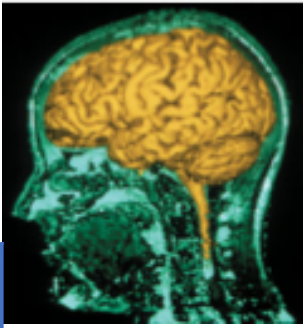
Interpretation

Test Selection and Interpretation

- Selection of tests often determined by:
 - Severity of injury
 - Current functional status of individual
 - Demographic variables
 - Age
 - Gender
 - Educational Level
 - Ethnicity
 - Primary Language
 - Presence of any other physical or sensory disability



Test Selection and Interpretation



Fixed Battery Approach

Same tests administered to every patient regardless of presenting illness, referral question, or background

Advantages

- Comprehensive assessment of multiple cognitive domains
- Use of standardized format – form databases for clinical and scientific analysis

Disadvantages

- Time and labor intensiveness; and
- Lack of flexibility in different clinical situations

Flexible Battery Approach

Individual tests are chosen based on the patient's presenting illness or referral question

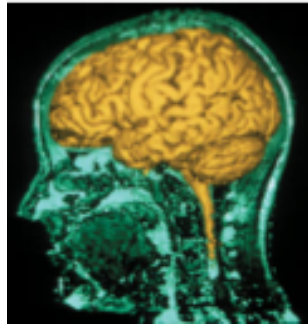
Advantages:

- Potentially shorter administration time
- Economical feasibility
- Can be tailored to client's needs
- Easy to adapt to different clinical situations

Disadvantages:

- Greater clinical experience required
- lack of standardized administration rules for some tests
- Potential lack of comprehensiveness

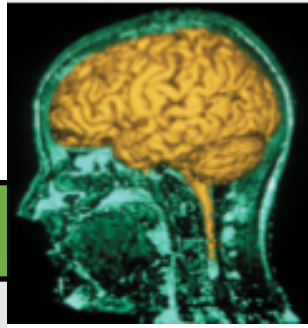
Areas of Assessment



FUNCTION	DEFINITION	TESTS
Pre-injury Assessment	Level of ability and cognitive functions prior to injury	<ul style="list-style-type: none">✓ Demographic details✓ Actual test performances (if any)✓ Wide Range Achievement Test (WRAT-V)*
Global Cognitive/Intellectual Functioning	Multidimensional construct made of various abilities Influencing our day-to-day behavior	<ul style="list-style-type: none">✓ Weschler's Scales✓ Progressive Matrices✓ Bhatia's Short Battery
Arousal and Orientation	Arousal-basic level of consciousness as a function of Reticular Activating System Orientation: Time/Place/Person	<ul style="list-style-type: none">✓ Clinical Judgement✓ Glasgow Coma Scale (eye opening, verbal and motor response)

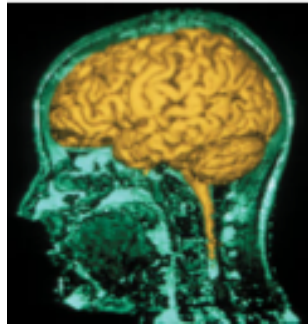
* Assesses foundational academic skills (word reading, sentence comprehension, spelling and arithmetic)

Areas of Assessment



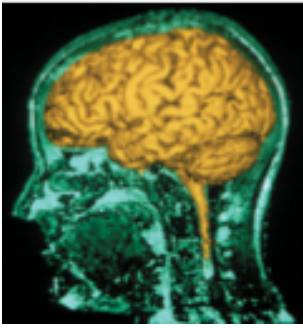
FUNCTION	DEFINITION	TESTS
Attention and Concentration	Attention: Being aware of environmental stimuli Concentration: ability to focus attention	<ul style="list-style-type: none">✓ Digit Span✓ Continuous Performance Test✓ Knox Cube Test✓ Cancellation Tests✓ Visual Spatial Span
Executive Functions	Skills related to sequencing and organization of cognition & behavior. incl. Problem-solving, reasoning, judgment	<ul style="list-style-type: none">✓ Stroop Color-Word Test✓ WCST✓ Category Test✓ Trail Making A and B✓ Executive Control Battery. Delis-Kaplan Executive Functions System.
Language	Includes Naming, repetition, comprehension, reading/writing Left-hemisphere dominance in majority	<ul style="list-style-type: none">✓ Western Aphasia Battery✓ Vocabulary✓ Verbal Fluency✓ Boston Naming Test

Areas of Assessment



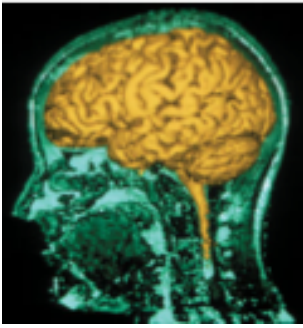
FUNCTION	DEFINITION	TESTS
Visuo-spatial Skills	Ability to process visual/nonverbal information Function of right hemisphere (parietal)	<ul style="list-style-type: none">✓ Clock Drawing Test✓ Bender Gestalt Test✓ Block Design✓ Rey-Osterrieth Complex Figure Drawing
Memory	Information storage & retrieval. Verbal/nonverbal memory Temporal Lobe function	<ul style="list-style-type: none">✓ Wechsler Memory Scale- WMS IV✓ PGI-MS✓ Audio Verbal Learning & Memory Test✓ Design Learning Test
Motor & Sensory	Involves primary motor and sensory areas of the cortex	<ul style="list-style-type: none">✓ Finger Tapping Test✓ Hand Tapping Test✓ Cube construction✓ Testing for ideomotor apraxia (e.g. saying namaste); ideational apraxia (candle)

Areas of Assessment



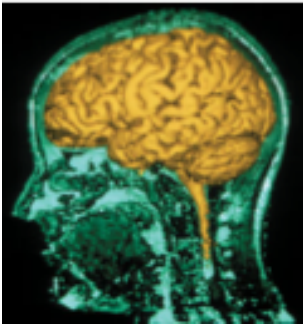
- Personality and Affective Symptoms
 - Clinical History
 - Personality Assessment (MCMI, MMPI, NEO)
 - Diagnostic Interviews and Rating Scales
- Effort and Motivation
 - Reliable cognitive assessment requires good observation, clinical judgment and training: E.g. “Do the results make sense given what has happened to the patient?”
 - Word memory test
 - Tests of memory malingering
 - Portland Digit Recognition Test
 - Dot counting test.

Word Memory Test (Green et al., 1996; Green et al., 2003)



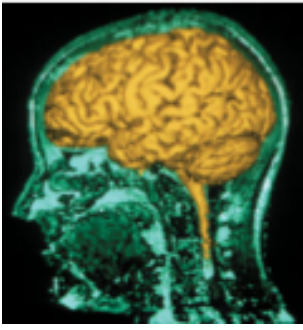
- A computerized test of the ability to learn a list of 20 semantically-related word pairs (e.g., dog/cat, man/woman, pig/bacon, fish/fin).
- Each word pair presented for 6 s.
- For immediate recognition (IR), the person is shown word pairs containing only one of the words from the original list (e.g., dog/rabbit, man/boy), and he/she selects the word from the original list.
- A similar recognition test, but with different foil words (e.g., dog/rat), is administered after a 30 min delay interval (i.e., “delayed recognition,” DR).

Test of Memory Malingering (TOMM) (Tombaugh 1996)



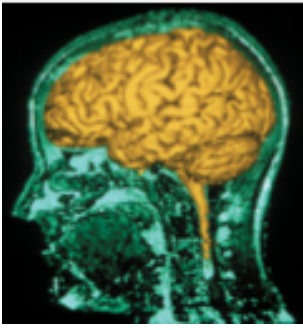
- Employs a forced-choice recognition paradigm using 50 black target stimulus items (line drawings).
- During the study phase, the subject is shown each drawing for 3 s.
- After presenting the 50 items, each drawing is presented along with a distracter drawing and subject has to choose original drawing (done twice)
- After 15 min, a retention test is given. The Retention trial is considered optional if the examinee passes Trial 2 (raw score > 44).

Portland Digit Recognition Test (Binder & Willis, 1991)



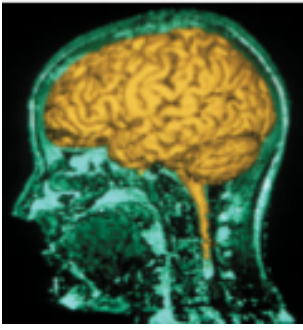
- A forced-choice performance validity test (PVT) consisting of 72 trials
- Each trial- a five-digit number is presented followed by a distractor period in which the examinee is required to count backward for either 5 s (first 18 trials), 15 s (second 18 trials), or 30 s (last 36 trials).
- Then, two five-digit numbers are presented, and the examinee is instructed to identify the number that was initially presented.
- Computerized version available the PDRT is now available in a computer-administered version.

Dot Counting Test (Rey, 1941)



- Examinees are shown a series of 12 cards (usually 3" × 5") with printed dots 1/16th of an inch in diameter.
- Each of the first six cards contains an odd number of randomly arranged dots (ungrouped), while the final six cards show an even number of dots arranged in an organized pattern (grouped).
- The task requires examinees to count the dots as quickly as possible by the fastest means possible.
- Both time to completion and errors are recorded.
- Expectation: cooperative examinees will count *grouped* dots more quickly and accurately than *ungrouped* dots.

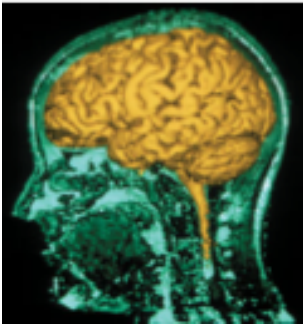
Test Interpretation

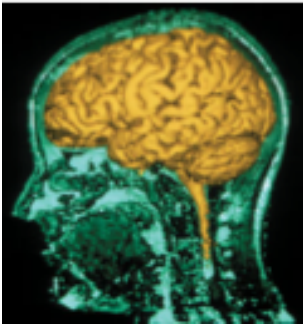


- No neuropsychological measure captures an isolated aspect of cognitive functioning - each test depends on patients' simultaneous use of multiple cognitive abilities.
- Neuropsychologist's task - determine which cognitive deficits are causing impaired performance by looking for a pattern of deficits across functions

Test Interpretation

- Test interpretation involves
 - normative comparisons to population data.
 - Comparison with client's pre-morbid level of functioning
 - Behavioral observation of client
- Thus, a comprehensive report includes:
 - Results from each test
 - Behavioral observations during tests
 - Medical findings
 - Information from collateral sources
 - Functional Assessment and
 - Recommendations and predictions regarding socio-occupational functioning





Important considerations

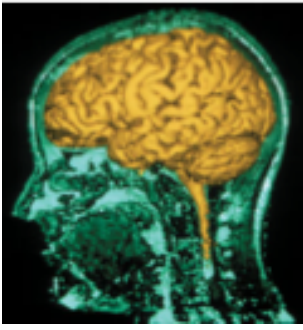
Clinical Interview

Test Selection and Interpretations

Recent Advances

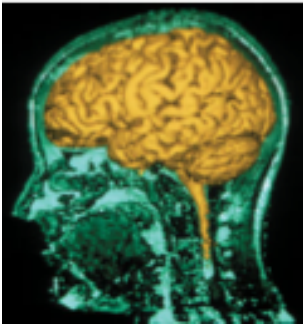
Ethical Issues

Recent Advances – Use of Computers

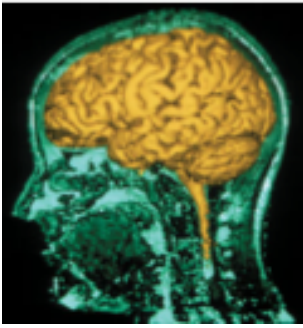


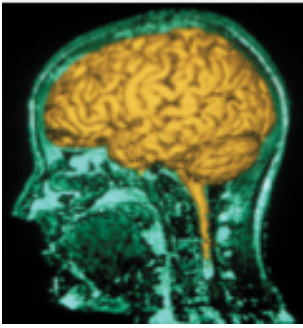
- In use since 1980s in military and sport-related concussions
- Automated Neuropsychological Assessment Metrics (ANAM; Reeves, Winter, Bleiberg, & Kane, 2007) – widely used test in US military services
- Other routinely used tests include- Cogstate; CNS-Vital Signs (CNS-VS); ImPact (sport concussions)

Recent Advances - Ecologically Valid Tests



- Assessments that enhance the understanding of the ways in which brain injuries affect the patients' ability to interact with his/her environment and organize everyday activities
- Recent enhancements in 3D rendering capabilities that allow for greatly improved texture and shading in computer graphics → Creation of virtual environment
- Some commonly used tools include:
 - Virtual kitchen (Besnard et al., 2016)
 - Virtual classroom (Parsons, & Carlew, 2016)
 - Virtual environment grocery store (Parsons & Barnett, 2017)
 - Virtual apartment (Parsons & Barnett, 2017)
 - Virtual library (Renison et al., 2012)





Important considerations

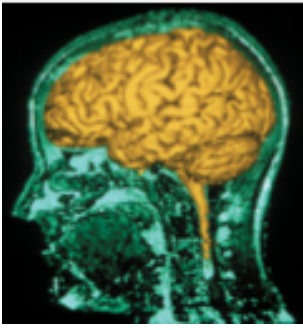
Clinical Interview

Test Selection and Interpretations

Recent Advances

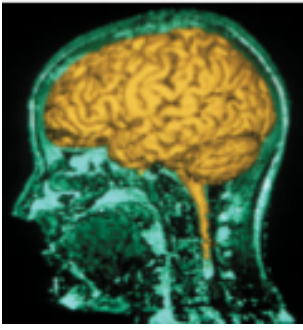
Ethical Issues

Ethical Issues: Check-point 1 # Professional Competence



- Have I administered this type of assessment tool before?
- Is my knowledge on the patient's unique circumstances (e.g., medical, sociocultural) sufficient to conduct an unbiased and comprehensive assessment?
- Is my knowledge of all factors relevant to the assessment up-to-date and rooted in evidence-based research?
- Avoid blind spots in professional competency through continued professional development and peer consultation

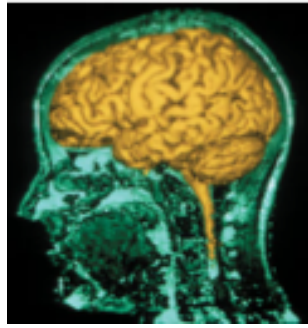
Check-point # 2: Consent



- Have I ensured that the consent process is dynamic and ongoing?
- Have I implemented all possible measures to ensure maximal client understanding during the consent process?

- Monitor capacity changes throughout recovery to ensure that the appropriate consent procedures are followed
- Accommodate injury-related impairments (e.g., cognitive, sensory) to maximize client understanding of the assessment process

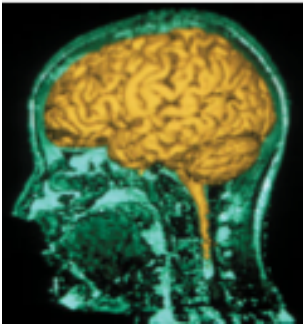
Check-point 3 # Neuropsychological Testing



- Are appropriate norms available in light of the patient's presenting characteristics?
- Can the use of an interpreter be minimized or avoided with the appropriate administrative adaptations?
- Are my interpretations based on a cohesive integration of all available data?

- Ensure test validity and available normative data applicable
- In the event that an objective interpreter is deemed necessary, note in the report any adaptations made to the original protocol
- Interpretation is often best based on multiple measures of cognition
- Maintain awareness of potential psychological comorbidities and their effect on test performance

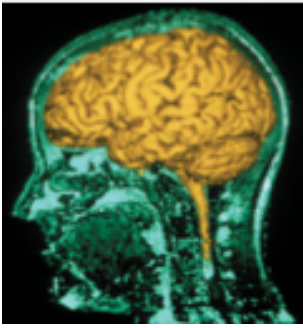
Check-point 4 # Confidentiality and Record Keeping



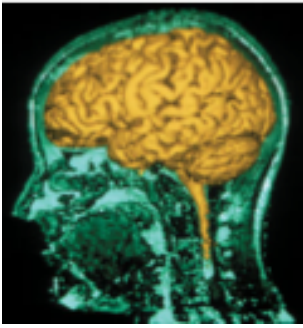
- Have I included only essential information necessary for continuity of care, without including any harmful extraneous information?
- Have I ensured that the individual requesting the raw data possesses the necessary qualifications to interpret the data appropriately?
- Content of assessment report stored in electronic filing systems should be limited to the information necessary for the provision of continuous services

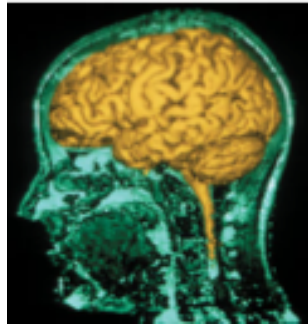
Summary

- TBI associated with significant cognitive deficits that impact functioning of individual
- Role of neuropsychological assessment is multi-fold
- Important to consider nature of injury, demographic variables and litigation status in test selection and interpretation
- Role of a clinical neuropsychologist is not just administration, but integration of all findings to predict prognosis and functioning → requires expertise and acute observation
- Important to be aware of recent advances in normative data and use of technology and incorporating the same.

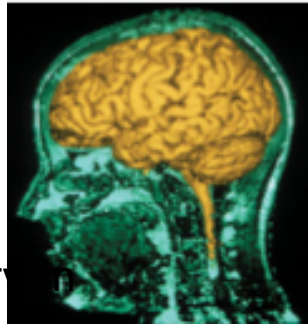


THANK YOU...





- Chaytor N, Temkin N, Machamer J, et al. The ecological validity of neuropsychological assessment and the role of depressive symptoms in moderate to severe traumatic brain injury. *J Int Neuropsychol Soc* 2007;13:377–85.
- Lezak MD, Howieson DB, Loring DW. *Neuropsychological assessment*. 4th edition. Oxford (UK): Oxford University Press; 2004.
- Gronwall D. Minor head injury. *Neuropsychology* 1991;5:253–65.
- Gaultieri R, Cox DR. The delayed neurobehavioral sequelae of traumatic brain injury. *Brain Inj* 1991;5:219–32
- Bombardier CH, Fann JR, Temkin NR, et al. Rates of major depressive disorder and clinical outcomes following traumatic brain injury. *J Am Med Assoc* 2010; 303:1938–45.
- Danckwerts A, Leathem J. Questioning the link between PTSD and cognitive dysfunction. *Neuropsychol Rev* 2003;13:221–35.
- Greiffenstein M, Baker W. Validity testing in dually diagnosed post-traumatic stress disorder and mild closed head injury. *Clin Neuropsychol* 2008;22:565–82.
- Rourke SB, Grant I. The neurobehavioral correlates of alcoholism. In: Grant I, Adams K, editors. *Neuropsychological assessment of neuropsychiatric and neuromedical disorders*. Oxford (UK): University Press; 2009. p. 398–454.
- Gonzalez R, Vassileva J, Scott JC. Neuropsychological consequences of drug abuse. In: Grant I, Adams K, editors. *Neuropsychological assessment of neuropsychiatric and neuromedical disorders*. Oxford (UK): University Press; 2009. p. 455–79.
- Lange RT, Iverson GL, Franzen MD. Comparability of neuropsychological test profiles in patients with chronic substance abuse and mild traumatic brain injury. *Clin Neuropsychol* 2008;22:209–27.



- Green P, Rohling ML, Lees-Haley PR, et al. Effort has a greater effect on test scores than severe brain injury compensation claimants. *Brain Inj* 2001;15: 1045–60.
- Hart RP, Martelli MF, Zasler ND. Chronic pain and neuropsychological functioning. *Neuropsychol Rev* 2000;10:131–49.
- Harris I, Mulford J, Solomon M, et al. Association between compensation status and outcome after surgery: a meta-analysis. *J Am Med Assoc* 2005;293(13): 1644–52.
- Belanger HG, Curtiss G, Demery JA, et al. Factors moderating neuropsychological outcomes following mild traumatic brain injury: a meta-analysis. *J Int Neuropsychol Soc* 2005;11(3):215–27
- Green, P., Allen, L. M., & Astner, K. (1996). *The Word Memory Test: A user's guide to the oral and computer-administered forms, US version 1.1*. Durham: CogniSyst.
- Binder L. M., Willis S. C. Assessment of motivation after financially compensable minor head trauma, *Psychological Assessment*, 1991, vol. 3 (pg. 175-181)
- Tombaugh, T. N. (1997). The test of memory malingering (TOMM): Normative data from cognitively intact and cognitively impaired individuals. *Psychological Assessment*, 9(3), 260–268.
- hantel D. Mayo, Vanessa Scarapicchia, Lara K. Robinson & Jodie R. Gawryluk (2018): Neuropsychological assessment of traumatic brain injury: Current ethical challenges and recommendations for future practice, *Applied Neuropsychology: Adult*, DOI: 10.1080/23279095.2017.1416472