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Child and Adolescent Mental Health Service

Neuropsychological Assessment: Picking up the Pieces

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A member of Cambridge University Health Partners

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The science of assessment not static (aims, questions, operationalised and hypothesis driven)

- Purpose of assessment, i.e. rehabilitation needs
- Questions to be answered by assessment, i.e. what are this child's strengths and weaknesses?
- Tools used to answer questions require decisions: tests, observations, questionnaires, medical notes
- Testing process is hypothesis driven and an evolving : i.e. may start out thinking deficits are in attention but conclude deficits are in speed of response.

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Not all assessments are the same: carried out to answer different questions

- Different questions require different assessment procedures
- A research question, for example, like "Are there dissociations between long term memory and short term memory" will be answered one way
- A clinical question such as "Can this woman go back to work" will require a completely different approach.

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Questions that we can answer with standardised tests

- What is this person's general level of intellectual functioning?
- Is this a decline from the premorbid level?
- How does this person compare with others of the same age?
- Does this person have a global memory deficit or is it restricted to a particular modality?
- What kind of language disorder does this person have?

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Questions that are hard to answer with standardised tests

- How do the problems manifest themselves in everyday life?
- What does the family find difficult to cope with?
- What coping strategies are used?
- What treatment strategies should we apply?
- Can this person return to work/school/home?

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Behavioural or Functional Assessments

- Although standardised tests can build up a profile of a person's cognitive strengths and weaknesses, they can't tell us all we need to know
- We need to assess real life functioning
- We can do this with direct observation, self report measures and interviews.

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Neuropsychological Assessment Approaches

- the **psychometric** approach based on statistical analysis
- the **localization** approach whereby the examiner attempts to assess which parts of the brain are damaged and which are intact
- assessments derived from **theoretical models** of cognitive functioning (as described above)
- definition of a syndrome through **exclusion** of other explanations
- **ecologically valid** assessments

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What is Neuropsychological Assessment?

- **Psychometrics** – study of psychological measurement
- **Neuropsychology** – study of the structure and function of the brain in relation to specific psychological processes and overt behaviours
- **Neuropsychological Assessment** – measurement of cognition and behaviour, including examining the effects of any brain injury or neuropathological processes. Involves the administration of neuropsychological tests for the formal assessment of cognitive function as well as observation of the patient.

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Who Does Neuropsychological Assessment?

- Psychologists (Clinical and Educational) are trained to undertake Neuropsychological Assessment as part of their core training
- Most of the standardised neuropsychological assessment measures are licensed for use only by Clinical Psychologists, Educational Psychologists and Psychologists with relevant PhDs (plus trainee Psychologists under close supervision)

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Referral Question Should Inform the assessment

- Is there evidence of cognitive/intellectual impairment?
- What kind of cognitive impairments does this person have? How severe are they?
- How much insight does this person have into their own difficulties?
- **Mental Capacity** – can this person consent to treatment? Manage their own affairs?
- How does this person compare with others of the same age or others with the same diagnosis?
- How well will this person cope in a particular setting, e.g. Education? Employment?
- How can rehabilitation best be planned or delivered considering this person's difficulties?

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Theoretical Considerations

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Neuropsychological Assessment

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    graph TD
        GI[General Intelligence] --> Mem[Memory]
        GI --> EF[Executive Function]
        GI --> Lang[Language]
        GI --> Att[Attention]
        GI --> MP[Motor Planning]
        GI --> VS[Visual-spatial]
        
        Mem --> STM[Short term memory]
        Mem --> LT[Long term]
        
        EF --> PL[Phonological loop]
        EF --> CE[Central Executive]
        EF --> VSP[Visual-spatial sketch pad]
        
        Lang --> E[Episodic]
        Lang --> S[Semantic]
        
        Att --> S1[Sustained]
        Att --> Sw[Switching]
        Att --> C[Concentration]
        Att --> Sh[Shifting]
        
        MP --> Supp1[Suppressing]
        
        VS --> Supp2[Suppressing]
    
```

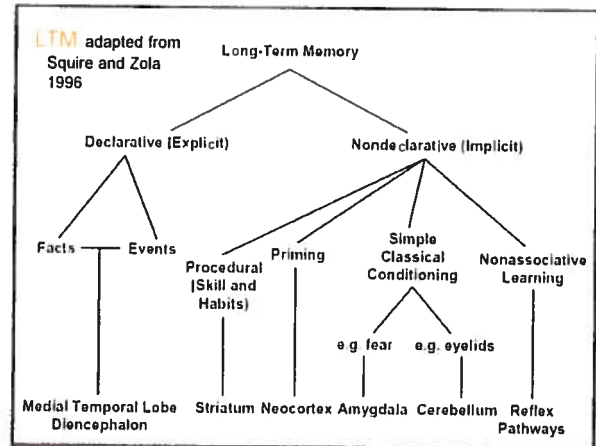
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Working Memory

Baddely and Hitch (1974) Baddely (2000)

The diagram shows 'Short Term "Working" Memory' branching into three categories:

- Phonological Loop**: e.g. Tests of digit span, Sentence repetition
- Central Executive**: e.g. Letter/Number sequencing, Digit span backwards, Spatial span backwards
- Visual Spatial Sketchpad**: Spatial span, Facial Memory test



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Measure Explicit Long Term Memory

- **Semantic Memory – Fact Memory.**
 - Typically cannot remember where and when we learnt it, we just know it, for (e.g. UK first World War Prime Minister).
- **Episodic memory – Event memory**
 - Autobiographical memory
 - Emerging evidence of double dissociation involving a "developmental amnesia" from bilateral hippocampal pathology with relative preservation of semantic memory
 - with impaired episodic memory (see Vargha-Khadem's research)
 - Many Risk factors including birth asphyxia, anoxia, prematurely, seizure history

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Executive Function

- Umbrella term that typically is associated with frontal lobe functioning
- Includes: planning, working memory, inhibition of prepotent responses, cognitive flexibility
- Predominantly "frontal" functions
- Ability to pass tests prior to brain maturation
- Late myelination in PFC

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Executive Function

- **Dorsal-lateral prefrontal cortex**- selection of behavior based on short term memory - executive control of cognitive activities
- **Medial frontal cortex (Anterior Cingulate)**- Cognitive control over actions; monitoring and resolution of response conflict
- **Orbital frontal cortex** - processing of reward and punishment, social referencing & affective regulation - difficulty with context, especially in social situations - social gaffes - rule breaking

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Executive Function – main theories


Think of as dissociable Executive Functions

- **Stuss (1992)**
 - development of goals (and sub goals)
 - maintenance in memory
 - monitoring of performance
 - control of interference
- **Working Memory (previous slide)**
- **Norman and Shallice (1986) Model of Attention** Including a supervisory attention system
- **Damasio** - Social-emotional executive model

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Attention


- Overlapping construct with Executive Function
- Limited capacity for preferential processing of information to the exclusion of all other stimuli
- Stuss et al (1995) model of attention
 - Sustaining,
 - Concentrating
 - Sharing
 - Suppression
 - Preparation
 - Setting



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Attentional	(neuropsychological tests: vigilance and matrices) main component processes: monitoring, preparing, and adjusting possible anatomical basis: right frontal
Self-organizing	(neuropsychological tests: verbal fluency, RT, main component processes: inhibition, reorganizing, adjustment of contents in scheduling, possible anatomical basis: (supplary)
Shifting	(neuropsychological tests: dual task performance) main component processes: monitoring, preparing, possible anatomical basis: (supplary, orbitofrontal)
Suppression	(neuropsychological tests: Stroop) main component processes: inhibiting possible anatomical basis: dorsolateral
Switching	(neuropsychological tests: WCST) main component processes: switching, reorganizing, possible anatomical basis: dorsolateral frontal
Preparation	(neuropsychological tests: animal RT) main component processes: changing, possible anatomical basis: dorsolateral
Setting of attention	(neuropsychological tests: sustained attention RT task) main component processes: monitoring, monitoring, possible anatomical basis: left dorsolateral frontal


Figure 1. Attention Tasks, Their Key Component Processes (adapted from Stuss et al., 1995)



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Neuropsychological Tests

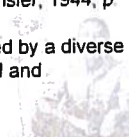
Some Gold Standard Measures



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Specific Tests, Wechsler Tests


- Wechsler -
 - Romanian-born American Psychologist (1896-1981)
 - worked on studying deficits resulting from injury in soldiers
 - Defined Intelligence is "the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment (Wechsler, 1944, p. 3)."
 - realised that intelligence could be measured by a diverse set of tasks, some verbal, others nonverbal and perceptual.



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Wechsler Tests: General Principles


- A 'psychometric' test based on large standardisation data
- All index test scores are standardised to have a normal distribution with a mean of 100, and a standard deviation of 15
- Classification:
 - below 69 is Extremely Low,
 - 70-79 is Borderline,
 - 80-89 is Low Average,
 - 90-109 is Average,
 - 110-119 is High Average,
 - 120-129 is Superior,
 - 130+ is Very Superior.
- All subtest scaled scores have a mean of 10 and a standard deviation of 3
- Both UK and US standardisation samples



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WISC-IV

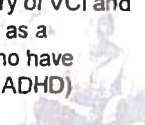
- Wechsler Intelligence Scale for Children (Version IV) – published in 2003
- Normed for ages 6y-16y8m
- Takes approximately 90 minutes to administer
- Yields
 - Full scale IQ score (FSIQ)
 - Indices: verbal comprehension (VCI)
 - Perceptual reasoning (PRI)
 - Working memory (WMI)
 - Processing Speed (PSI)



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WISC-IV (2)

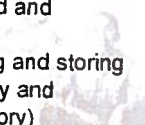
- FSIQ – may not always be a useful summary score, particularly when there is high variability between scores on different subtests – in this case, a single score does not accurately summarise ability
- GAI – general ability index – summary of VCI and PRI – may be especially appropriate as a summary ability score for children who have particular problems with WM/PS (eg ADHD)



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WISC-IV (3)

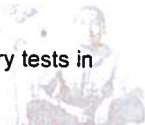
- Verbal Comprehension Index – summary of verbal abilities utilising reasoning, comprehension and conceptualisation
 - Information Subtest (measure of crystallised knowledge)
 - Vocabulary Subtest (meanings of words learned which can be recalled and expressed coherently)
 - Similarities Subtest (acquiring and storing concepts in long term memory and accessing via semantic memory)



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Attention



- E.g. The Test of Everyday Attention for Children (TEA-Ch) - an 'ecologically valid' test
- Domains of:
 - selective attention,
 - attentional control/switching
 - sustained attention
- Sustained Attention – The Continuous Performance Task (US model of battery tests in ADHD diagnosis)



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Delis-Kaplan Executive Function System (D-KEFS)


- Assesses well known tests of Executive Function in verbal and spatial modalities
 - Trail Making, Verbal Fluency, Design Fluency, Color-Word Interference (STROOP), Sorting, Twenty Questions, Word Context, Tower, and Proverb.
- With standard scores and norms (1 500 individuals)
- Children and adults

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NEPSY-II– NeuroPSYchology battery


- 'Model based' – maps onto accepted domains of cognitive function
- Covers 6 cognitive domains (32 subtests):
 - Attention and Executive Function
 - Language
 - Social Perception
 - Visuospatial processing
 - Memory and Learning
 - Sensorimotor



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NEPSY


- Results: scaled scores and percentile ranks.
- Opportunities for qualitative analysis of behaviour during assessment (e.g. off task behaviour)
- 6 domains intended to assist differential diagnosis (e.g ADHD, PDD, SLD, Maths disorder, Reading disorder)



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NEPSY – affect recognition (Social Perception)

Which two faces show the same emotion?



• Next level – which two faces show the same emotion as the one previously presented?

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Rivermead Behavioural memory Test 3 (RBMT, Wilson et al., 2008)

- Real life, ecologically valid test – very good prediction of everyday memory problems
- Adult and child version
- Useful for patients with more severe cognitive deficits
- Tests of Immediate and Delayed recall
- E.g. "When the alarm goes, I want you to ask me....." Examiner sets alarm for 30 minutes.

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Assessment following Acquired Brain Injury (ABI)

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Acquired Brain Injuries (ABI)

- Intellectual Impairment (Anderson and Catroppa, 2006)
- Butler (2007): Most common deficits post TBI
 - Attention dysfunction
 - Memory problems
 - Self-control difficulties
 - Possible language involvement
 - Visual-motor integration difficulties
- Also deficits in Executive function, speed of processing, adaptive functioning, social skills (Anderson et al., 2001)

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ABI 2

- Executive functioning, particularly organisation, planning, problem solving and judgement (Garth et al., 1997).
- Attention, Speed of Information Processing and Novel Learning are often compromised (Donders, 2007).
- Specifically tasks with strong emphasis on rapid and efficient performance, new complex (Yeates et al., 2002)
- Continued language difficulties (may not be detected on standardised tests of basic language in children with moderate-severe TBI (Chapman et al., 2004)

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Disagreements – the tests

- Tests chosen: not enough, not right (language and ABI)
- Scores reported too broad: Full IQ score does not tell the detail (observation and report tells us what to test)
- Scores considered in isolation: need a profile of strengths/weaknesses and predicted v. obtained (IQ & WIAT)
- Ignoring the psychometrics of a measure – how confident can we be in a result?
- Ignoring test behaviour: a score without information about response time (ABI slows down the brain)
- Ignoring test conditions: medication, fatigue, security
- Ignoring pre-morbid function: Children with ADHD at higher risk of ABI
- Reliance on observation OR standardised tests: need both (environments and time of day important, disinhibition)
- Some functions are not readily tested within a typical assessment e.g. autobiographical memory; forgetting; social-emotional processes

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Disagreements – the tester

- knowledge of the condition e.g. a child is likely to 'grow into' a deficit following brain injury
- attitudes e.g. towards mild TBI and effort
- theoretical models influencing the clinician may 'bias' interpretation or direct the clinician to different types of information
- degree of confidence/risk the clinician can tolerate e.g. stick rigidly to what the manual says, or venture other opinions
- test preferences, and knowledge and experience of test used

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Disagreements – the person being tested

- presentation and performance may vary between testing sessions
- executive problems may give rise to variable rather than clearly impaired test results
- the acquired difficulties might be poorly understood by (neuro)psychology
- or there may not be good validated tests for a specific function
- cultural or language factors may contribute to variations in performance or interpretation of performance

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Making Sense of a Neuropsychological Report

- Will comment on:
 - Factors affecting Assessment -
 - Environment (distractions)
 - Cultural/Educational/Language considerations
 - Drug type and level
 - Timing
 - Mood
 - Motivation and co-operation
 - Motor/speech problems
 - Hearing
 - Behavioural Observations – during testing as compared to self- and informant reports
- **RESULTS MUST BE INTERPRETED WITH THIS CONTEXT IN MIND**

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Making Sense of a Neuropsychological Report (2)

- EG. WISC-IV - Will then report:
 - Findings/Results:
 - Full Scale IQ (FSIQ)
 - Sub-indices (VCI, PRI, WMI, PSI)
 - Significant discrepancies between indices or between subtests within an index
 - Note that FSIQ may not be interpretable if there are large discrepancies between or within indices
 - Any relevant psychometric issues (especially for ecologically valid tests)
 - Discussion of Results:
 - Comments on pattern of results in light of context and background information, and considers possible explanations

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Summary

- Psychology is not an exact science
- Neuropsychology seeks to understand brain-behaviour links
- 'Cognitive processes' are models our 'best guesses' about what happens between brain and behaviour
 - Our understanding is limited by the quality/scope of the science, and therefore tests and their interpretation
- Being a child and having a brain injury add further challenges to interpretation
- Clarification of assessment question, rationale for choice of tests and triangulation of information from multiple sources is required

