Understanding Cognitive Performance

“Importance of Observation, Qualitative Interpretation and Critical Thinking”

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Flexible Approach: Core & Satellite Tests
Informed by Process Approach: selection, admin, score, interpretation...

Core Battery
- Short tapping into most domains
  - Overall Ability (CAMCOG)
  - Attention (e.g. Mental Control)
  - Memory (e.g. DNR-RBANS)
  - Executive (e.g. FAB, Trail Making)
  - Language (BNT)
  - Visuospatialization (Clock)

Active Process
- Observation of how
- Nature of Errors
- Generation of clinical hypothesis

Satellite Tests
- Complement
- Used to confirm clinical hypothesis
  - Semantic Dementia
  - Pyramids and Palm Trees
  - Word-Picture Matching

Before Interpreting ‘Apparent’ Cognitive Deficits

• Modulating variables
  – Other than cog. dysfunction due to neurodegenerative disease
  – May account for defective cognitive test performance

• Among Many Others
  – Test anxiety
  – Sensory / Motor deficits
  – Medication
  – Common physical ailments mimic cognitive profiles
    - COPD (dysexecutive)
    - Sleep apnoea

Interpreting Test Performance
Delayed Recall=3/10 at 2nd ile & Boston Naming=35/60 at 5th ile

Quantitative Interpretation (data driven)
- How Much: Meets (norms) but liabilities
- Score = statistically normal or abnormal vs. why

Qualitative Interpretations (Process driven)
- How: Strategies used en route to solution
- Nature of Errors: Qualitative analysis of responses
- Why: Nature core cognitive defective responsible for failure

CLINICAL DIFFERENTIAL DIAGNOSIS
- Neurocognitive deficits
- Aetiology

So...
If someone performs within the impaired range on a word-list...

• Can we infer that failure on this test implies a true defect in episodic memory... after all that’s what the tests is measuring...
  – Suggestive of hippocampal underfunctioning
  – Perhaps indicative of Alzheimer’s Disease?

Clearly not
• Ignore...Episodic Memory + Additional component cog. processes
  – Attention: Focus & sustain
  – Working Memory: Hold the information STM
  – Semantic Memory: Understand meaning words (SD)
  – Executive control: Organize, semantically / sequentially
  – Etc.

• Unwise to attribute failure to episodic memory deficit
  – Equating a score with the unitary cognitive process it is supposed to reflect
  – Can lead to spurious interpretations

• Unwise and unsafe to attribute the cause to a particular disease
  – All clinical populations show very similar performance for different reasons
  – fTDP vs. AD (Pennington et al 2011)
Quantitative Approach: Liabilities (1)

- Pure test-scores approach ignores:
  - Multi-factorial Nature of Tests
    - No test taps single function
    - Even deceivingly simple require multiple cog processes
    - It doesn't only do what it says in the tin (read small print)
  - Yet most tests provide a single total score...
    - Either (0-1), time to completion, number of correct items
    - Fails to capture the component processes
    - Difficult to infer core reason for failure

Decomposing the Task

Process Analysis of Test Performance
- Planning and Problem Solving
- Alternating Attention
- Perception Spatial Relations
- Kernel: Visuoconstruction Skills
- Line Orientation
- Location of Point
- Sensory-Motor

Quantitative Approach: Liabilities (2)

- Index Scores
  - Mixing single scores (similar tests)
  - Underlying core cognitive deficit hidden
- RBANS – Delayed Memory Index
  - Mixes list, story and figure memory
  - Mixes free recall with recognition
  - Recognition too much statistical weight
- Same Index score different memory disorder
  - No Savings Score
  - Amnestic vs. dysexecutive
- Over-reliance on Index Scores may lead to erroneous interpretations

Principals of good test selection and data interpretation

- What tests helpful diagnostically?
  - The simpler, the better
  - The clearer the nature of the cognitive processes required by test...
  - The higher the certainty that the score represents a distinct cognitive process (and not others)
  - Score easier to interpret and more clinically meaningful

Test Scores Vs. Neuropsychological Inferences

- Naïve to Expecting Test-Score (Passive Role)
  - Score nature of cognitive deficit
  - Score if underlying pathology
  - Unwise interpretations
- Active-Observation Role: Ask not what the test can do for you...
  - Because “In a very real sense there is virtually no such thing as a neuropsychological test. Only the method of drawing inferences about the test is neuropsychological” [W. Walsh, 1980]
  - Method: Qualitative Process Approach

Qualitative Boston Process Approach

- European Process Approach (A. Luna, K. Guttmann)
- Boston Process Approach
  - Defined and Standardised Method
    - Administration, recording, scoring routine tests
    - Inform clinical interpret data
- Rather relying on a test score i.e. “how much”, emphasis on:
  1. How: Process or the favoured cognitive strategies a person employs in order to arrive at a solution (or not)
  2. Nature of errors, qualitative analysis & scoring
- Goal: To answer why
  - Core underlying cognitive deficit responsible for failure
  - Clinical and diagnostic value
Qualitative Observation How / Errors / Why

- Differences in administration and scoring
- Technique of Data Collection: Pen-Switching and Flow Charts

FEATURAL
RIGHT Hemisphere Dysfunction
CONFIGURAL
LEFT Hemisphere Dysfunction

Satellite and Composite Methods

Visual Scanning
Letter Seq.
Number Seq.

Letter-Number Switching
Motor Speed

The Boston Naming Test: (1)

- Multifaceted cognitive task (sensitive vs. specific)
  - Visual perceptual skills
  - Semantic Memory
  - Lexical Retrieval
  - Articulatory process
- Traditional Achievement Score (Total Words)
  - Same score different reasons in different clinical populations
- Method of Process Approach
  - How:
    - Qualitative analysis of errors
    - Benefits of phonemic and semantic cueing (e.g. Mus instr. Har...)
    - Why: core mechanisms underlying failure
  - In ‘typical’ early AD (Hodges et al 1991)
    - Based on the nature of their errors
    - Anoma reflects progressive semantic memory degradation

Process Approach: Methodology

- Satellite Testing
  - New complementary tasks developed to partial out component cognitive processes
  - DKEFS
- Composition
  - New scores developed to capture nature of component cognitive processes (e.g. response inhibition)
  - Error types (e.g. set-loss) – rich clinical info re nature of deficit
- While there are purposely designed process approach instruments...
- Any test can be subject to these methods

The Boston Naming Test: (2)

- Classification of nature naming errors (Hodges et al 1991)
  - Different answers, same score (≤0), different underlying mechanisms:
    - Perceptual
      - “Don’t Know” or “Motel”
    - Semantic Loss (different degree of degradation)
      - Superordinate (severe)
        - “Music”
      - Associates (some knowledge)
        - “Country Music”
      - Communication (least affected)
        - “Your play it blowing into it moving from side to side...has two names, Bob Dylan...”
    - Phonemic (atypical APPA-lg)
      - “Harmonica”
MoCA: Modifications

• **Administration**
  - "Beginning on the left, point to each figure and say "Tell me the name of this animal"

• **Modif. technique of administration and data collection**
  - Verbatim not just 0/1
  - Effect of Phonetic Cueing
  - Two scores?

• **Data analysis**
  - Application of Hodges et al classification of naming errors

MoCA / RBANS: Maximising Data

• **Modif. technique of administration and data collection**
  - Verbatim responses
  - Serial order of word recall (primary / recency)
  - Inter-trial forgetting
  - Type of cued intrusion errors (prototypical vs. subordinate)
  - Familiarity based judgements

Process Analysis Clock Drawing Test: Standing the Test of Time

- Command + Copy: Diff. dementia subtypes

- Command
  - Language
  - Semantic Memory
  - Visuospatial / Visuomotor
  - Translate one into the other
  - Executive control

- Copy
  - Semantic memory removed
  - Visuospatial and
  - Executive planning remain

- Tracing (Evans & Burke, 2005)
  - All removed but graphomotor aspects

MoCA Clock Drawing: Command vs. Copy

- **Value adding copy condition to MoCA** (Price et al 2011)
  - Command vs. Copy very useful in dementia
  - MoCA: Only command version
  - Basic scoring open to interpretation
  - Compared AD with PDD, IVD

  • Drawing to command
    - Total achievement score
    - Failed to differentiate

  • Command vs. Copy
    - Diagnostic differences

  • It only takes 1-2 minutes

Summary

• **Over-relying** on test-scores can result in erroneous interpretations

• **Complemented** with Qualitative Process Approach

  • How: Process, strategies, and qualitative error analysis
    - Why: Core cognitive mechanism

  • Think not what the test can do for you…
  - No neuropsychological test, only the interpretation is neuropsychological

  • Process Approach offers a Method
    - Any examiner (wear your BPA hat)
    - Any test

As Kaplan often said…

"The Process is the Achievement"
Philadelphia (repeatable) Verbal Learning Test (PrVLT-9)

From experimental to clinical

- Severe amnesia – exclusion criteria fvFTD (Rascovsky et al. 2011)
  - Yet, memory deficits common in fvFTD vs. AD (Hornberger et al. 2010;Penninger et al. 2011)

- Price et al. (2009) – PrVLT-9 in Dementia (Amnestic vs. Dysexecutive Profile)
  - DAT and EVD/OD regressed degree subcortical schemes

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- Recognition (36 words)

  - List A and List B
  - Semantic Foils: 9 Prototypical items from semantic categories used (e.g. Chicken)
  - Unrelated Foils: 9 Neither semantically nor related to List A items included in List B (e.g. Lighter)

- Total Score vs. Qualitative Error Analysis

  - Impaired EFs fvFTD – Diagnostic criteria
    - Elusive (Piguet & Hodges, 2013)

  - Traditional EF total achievement
    - Many early stages perform normally
    - When impaired fail dist fvFTD vs. AD

  - Process Approach Error Analysis
    - Possin et al. 2012 (fvFTD vs. AD)
      - Design Fluency
        - Total score: No diff / diffuse
        - Repetitions: Worse fvFTD / OFC

- Patterns of relative impairment