Understanding Cognitive Performance

"Importance of Observation, Qualitative Interpretation and Critical Thinking"

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Alberto Blanco
Clinical Neuropsychologist



Edith Kaplan

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. DWR-RBANS)
  - Executive (e.g. FAB, Trail Making)
  - Language (BNT)
  - Visuoconstruction (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

⇧ physical symptoms with age

Interpreting Test Performance

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

QUANTITATIVE Interpretation (data driven)
- **How Much-** Merits (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

Misinterpretations

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

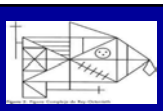
- Can we infer that failure on this test implies a true defect in episodic memory… after all that's what the tests is measuring…
  - Suggestive of hippocampal underfunctioning
  - Perhaps indicative of Alzheimer's Disease?

Clearly not

- **Ignores…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
  - Dif. clinical populations show very similar performance for v. different reasons
  - fvFTD 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

Planning and Problem Solving

Alternating Attention

Perception Spatial Relations

Kernel: Visuoconstruction Skills

Line Orientation

Location of Point

Sensory-Motor

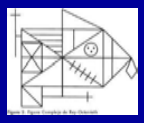
Process Analysis of Test Performance

- Before drawing inferences about the nature of the deficit consider
- Each process can contribute to the overall outcome
- Breakdown in performance on cognitive test can occur at any stage

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

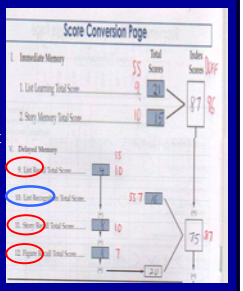
Response Inhibition



Response Inhibition +++

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 dif. memory disorder**
  - **No Savings Score**
  - **Amnestic** vs. **dysexecutive**



- **Over-reliance on Index Scores may lead to erroneous interpretations**

Data from Dr. R.F. Coen

Test Scores Vs. Neuropsychological Inferences

- **Naïve to Expecting Test-Score (Passive Role)**
  - Score ≠nature of cognitive deficit
  - Score ≠ underlying aetiology
  - 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"** (K.W.Walsh, 1992)
- **Method:** Qualitative Process Approach

Qualitative Boston Process Approach

- **European Process Approach (A. Luria, K. Goldstein)**
- **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:

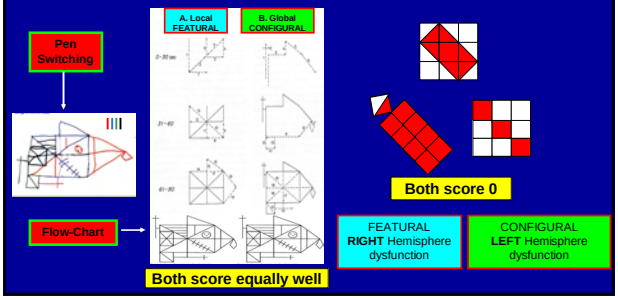
1. **"How"** Process or the favoured cognitive strategies a person employs in order to arrive at a solution (or not)

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



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**

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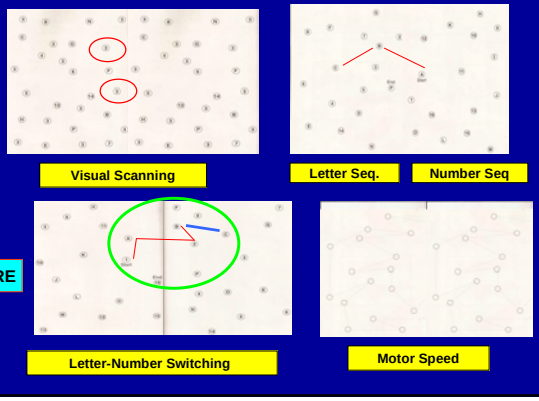
Satellite and Composite Methods



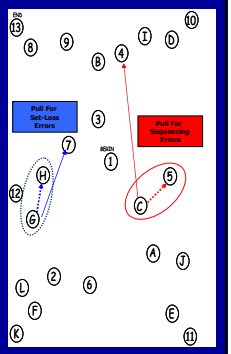
Trail Making (Reitan): Time to Completion

- **Satellite Method**
  - Ruling out alphabet (H…latency…starts beg.)
- **Composite Method**
  - Error Analysis

1. Sequencing
- Alt set maintained but incorrect target selected (1-A-2-C)
- Poor working memory

2. Set-Loss
- Alt set is lost (e.g. 1-A-2-B-3-4)
- Cognitive flexibility

3. Capture
- Pulled to commit error as wrong target nearby
- Response inhibition
  - Sequencing errors (e.g. C-5)
  - Set-loss (e.g. G-H)



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The Boston Naming Test: (1)

- **Multifaceted** cognitive task (sensitive vs. specific)
  - Visuoperceptual 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 mechanism underlying failure
- **In 'typical' early AD (Hodges et al 1991)**
  - Based on the nature of their errors
  - Anomia reflects progressive semantic memory degradation

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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 degrees of degradation)**
    - **Super-ordinate** (severe)
      - ***"Music"***
    - **Associative** (some knowledge)
      - ***"Country Music"***
    - **Circumlocution** (least affected)
      - ***"Your play it blowing into it moving from side to side…has two names, Bod Dylan…"***
  - **Phonemic** (atypical APPA-lg)
    - ***"Harmonica"***

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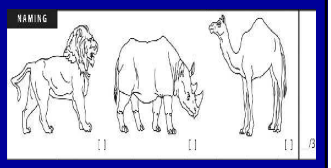
MoCA: **Modifications**

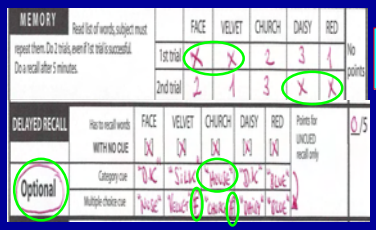
- **Administration**
  - "Beginning on the left, point to each figure and say "Tell me the name of this animal"
- **Modif. technique of administration and data collection**
  - Verbatim not just 0/1
  - Effect of Phonetic Cueing
  - Two scores?



- **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 (primacy / recency)
  - Inter-trial forgetting
  - Type of cued intrusion errors (prototypical vs. subordinate)
  - Familiarity based judgements



No Points – Overlooked

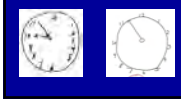
Process Analysis Clock Drawing Test: Standing the Test of Time

Deceivingly simple: Multi-factorial
Same / similar score different cognitive deficits

1. Graphomotor

2. Spatial and/or Planning

3. Conceptual



1. Language
2. Semantic
3. Visuoperc
4. Executive

↓

1. Visuoperc
2. Executive

↓

1. Graphomotor

- **Command + Copy: Diff. dementia subtypes**
- **Command**
  - **Language**
  - **Semantic Memory**
  - **Visuoperceptual / Visuomotor**
  - **Translate one into the other**
  - **Executive control**

Vs.

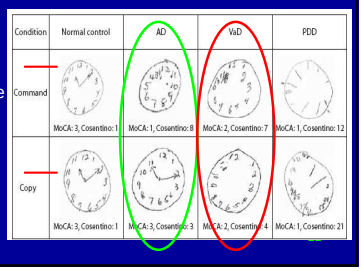
- **Copy**
  - Semantic memory removed
  - Visuospatial and
  - Executive planning remain

Vs.

- **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

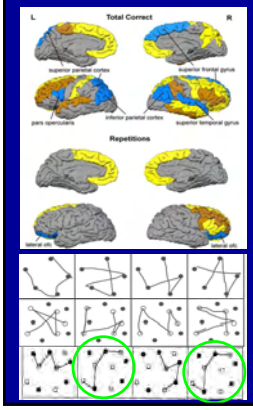
- **Severe amnesia – exclusion criteria fvFTD** (Rascovsky et al 2011)
  - **Yet, memory deficits common in fvFTD = AD** (Hornberger et al 2010; Pennington et al 2011

- **Price et al (2009) – PrVLT-9 in Dementia (Amnesit vs. Dysexecutive Profile)**
  - DAT and SVI-VD regrouped degree subcortical ischemia

List A Monday Shopping	1	2	3	4	5	List B Tuesday Shopping	6	Free S-Delay	Cued Meats	Cued Clothing	Cued Bathroom	Free L-Delay	Cued Meats	Cued Clothing	Cued Bathroom
Deodorant						Peaches									
Gloves						Corn									
Hamburger						Pants									
Shampoo						Radishes									
Lamb						Scarf									
Short						Tangerines									
Veal						Beets									
Comb						Suit									
Jacket						Blueberries									

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 dif / diffuse
      - Repetitions: Worse fvFTD / OFC
- **Patterns of relative impairment**