

5th Congress of the European Academy of Neurology

Oslo, Norway, June 29 - July 2, 2019

Teaching Course 18

Testing of cognitive functions by the neurologist (Level 1)

**When standardized neuropsychological testing
is needed**

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When standardized Neuropsychological Assessment is needed

Professor Lisa Cipolotti



1. Assess cognitive impairments arising from brain damage
2. Identify neuropsychological syndromes
3. Further our understanding of the brain

When is a Neuropsychological Assessment needed?

1. Diagnosis
2. Treatment and Management
3. Research

When is a Neuropsychological Assessment needed?

1. Diagnosis

- Shortcomings of the cognitive screening tests
- How the methods of assessing cognitive functions have developed
- Principles that underpin neuropsychological assessment
- Methods of assessing cognitive functions

Cognitive screening tests

1. Identify major cognitive deficits
2. Overcome resource limitations


e.g. MMSE, MoCA etc.

Mini Mental State Examination- MMSE


MINI MENTAL STATE EXAMINATION (MMSE)

Name: _____
 DOB: _____
 Hospital Number: _____

One point for each answer

						DATE:		
ORIENTATION						...../ 5	...../ 5	...../ 5
Year	Season	Month	Date	Time				
Country	Town	District	Hospital	Ward/Floor	...../ 5	...../ 5	...../ 5	
REGISTRATION						...../ 3	...../ 3	...../ 3
Examiner names three objects (e.g. apple, table, penny) and asks the patient to repeat (1 point for each correct. THEN the patient learns the 3 names repeating until correct).								
ATTENTION AND CALCULATION						...../ 5	...../ 5	...../ 5
Subtract 7 from 100, then repeat from result. Continue five times: 100, 93, 86, 79, 65. (Alternative: spell "WORLD" backwards: DLROW).								
RECALL						...../ 3	...../ 3	...../ 3
Ask for the names of the three objects learned earlier.								
LANGUAGE						...../ 2	...../ 2	...../ 2
Name two objects (e.g. pen, watch).								
Repeat "No ifs, ands, or buts".						...../ 1	...../ 1	...../ 1
Give a three-stage command. Score 1 for each stage. (e.g. "Place index finger of right hand on your nose and then on your left ear").						...../ 3	...../ 3	...../ 3
Ask the patient to read and obey a written command on a piece of paper. The written instruction is: "Close your eyes".						...../ 1	...../ 1	...../ 1
Ask the patient to write a sentence. Score 1 if it is sensible and has a subject and a verb.						...../ 1	...../ 1	...../ 1
COPYING: Ask the patient to copy a pair of intersecting pentagons						...../ 1	...../ 1	...../ 1
						...../ 1	...../ 1	...../ 1
TOTAL:						...../ 30	...../ 30	...../ 30

MMSE scoring
 24-30: no cognitive impairment
 18-23: mild cognitive impairment
 0-17: severe cognitive impairment

 GME Oxford Medical Education

Montreal Cognitive Assessment: MoCA

MONTREAL COGNITIVE ASSESSMENT (MOCA)

NAME: _____ Education: _____ Date of birth: _____
 Sex: _____ Age: _____ DATE: _____

VISUOSPATIAL / EXECUTIVE

Copy cube Draw CUBE (Ten past eleven) Points: _____
 (3 points)

NAMING

Contour Numbers Hands Points: _____/5

MEMORY

Read list of words, subject must repeat them. Copy 2 trials, until it fails to succeed. Do a recall after 5 minutes.

FACE	VELVET	CHURCH	DAISY	RED	No points
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1st trial					
2nd trial					

ATTENTION

Read list of digits (1 digit/sec). Subject has to repeat them in the forward order 2 1 8 5 4 Points: _____/2
 Subject has to repeat them in the backward order 7 4 2

Read list of letters. The subject must tap with his hand at each letter. Repeat if > 2 times.

F B A C M N A A J K L B A F A K D E A A A J A M O F A A B Points: _____/1

Serial 7 subtractions starting at 100 93 86 79 72 65 Points: _____/3

4 or 5 correct subtractions: 3 pts, 2 or 3 correct: 2 pts, 1 correct: 1 pt, 0 correct: 0 pt

LANGUAGE

Repeat: I only know that John is the one to help today. I Points: _____/2
 The cat always fell under the couch when dogs were in the room.

Fluency / Name maximum number of words in one minute that begin with the letter F (30 x 11 words) Points: _____/1

ABSTRACTION

Similarity between e.g. banana - orange or fruit train - bicycle watch - ruler Points: _____/2

DELAYED RECALL

Has to recall words WITH NO CLUE Points for UNASSISTED recall only: _____/5

FACE	VELVET	CHURCH	DAISY	RED
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Optional

Multiple choice test

ORIENTATION

Date Month Year Day Place City Points: _____/6

© Z.Nasreddine MD Version 7.1 www.mocatest.org Normal <= 26 / 30
 Add 9 points if <= 12 yrs old

TOTAL Points: _____/30

- The UK national guidelines recommend that, within 6 weeks from suffering a Stroke, patients should be assessed for cognitive impairment (e.g. NCGS, 2012; Nice, 2013).
- The assessment should entail a validated tool such as the **MoCA** (e.g. Nasreddine et al, 2011).

Stroke Screening

Normal ≥ 25

Impaired < 25

MONTREAL COGNITIVE ASSESSMENT (MOCA)

NAME: _____ Date of birth: _____
 Education: _____ Sex: _____ DATE: _____

VISUOSPATIAL / EXECUTIVE

Copy cube Draw CLOCK (Ten past eleven) (3 points)

Points: _____/5

NAMING

Points: _____/3

MEMORY

Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED	No points
1st trial						
2nd trial						

ATTENTION

Read list of digits (1 digit/sec). Subject has to repeat them in the forward order 2 1 8 5 4
 Subject has to repeat them in the backward order 7 4 2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 min.

F B A C M N A A J K L B F A K D E A A A J A M O F A A B

Serial 7 subtractions starting at 100 93 86 79 72 65

4 or 5 correct subtractions: 3 pts, 2 or 3 correct: 2 pts, 1 correct: 1 pt, 0 correct: 0 pt

LANGUAGE

Repeat: I only know that John is the one to help today.

The cat always hid under the couch when dogs were in the room.

Fluency / Name maximum number of words in one minute that begin with the letter F _____ (N ≥ 11 words)

ABSTRACTION

Similarity between e.g. banana - orange as fruit train - bicycle watch - ruler

DELAYED RECALL

Has to recall words WITH NO CUE Points for UNCLUED recall only

Category cue Multiple choice cue

Optional

Date Month Year Day Place City

ORIENTATION

Date Month Year Day Place City

Points: _____/6

© 2004 Neurotime MD Version 7.1 www.mocatest.org Normal $\geq 25 / 30$
 Administered by: _____ TOTAL Add 1 point if ≤ 12 yr edu. _____/30

Impairment in selective cognitive domains is a good predictor of post-stroke outcomes:

Memory and executive impairments are good predictors of:

- Length of hospital stay
- Long-term impairment
- Burden on community services

(Barker- Collo, Feigin, 2006; Galski, et al., 1993; Tatemichi et al, 1994; Van Zandvoort et al., 2005).

MoCA : Assessment of specific cognitive domains

Domains not assessed

- Intellectual functioning
- Speed of information processing
- Non-verbal memory

MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.3 Original Version

NAME: _____ Education: _____ Date of birth: _____
Sex: _____ DATE: _____

VISUOSPATIAL / EXECUTIVE Copy cube [] Draw CLOCK (Ten past eleven) [] Points: []/5

NAMING [] Contour [] Numbers [] Hands [] Points: []/3

MEMORY Read list of words, subject must repeat them after 5 minutes. Do a recall after 5 minutes. [] FACE [] VELVET [] CHURCH [] DAISY [] RED [] No points

ATTENTION Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order [] 2 1 8 5 4 [] 7 4 2 []/2
Read list of letters. The subject must tap with his hand at each letter A. No points if > 2 errors [] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B []/1
Serial 7 subtraction starting at 100 [] 93 [] 86 [] 79 [] 72 [] 65 []/3

LANGUAGE Repeat: I only know that John is the one to help today. [] The cat always hid under the couch when dogs were in the room. [] maximum number of words in one minute that begin with the letter F. [] (N > 11 words) []/1

ABSTRACTION Similarity between e.g. banana - orange = fruit [] train - bicycle [] watch - ruler []/2

DELAYED RECALL Use to recall words: FACE [] VELVET [] CHURCH [] DAISY [] RED [] Points for UNRECALLED recall only []/5

Optional Category cue Multiple-choice cue [] [] [] [] [] []

ORIENTATION [] Date [] Month [] Year [] Day [] Place [] City []/6

© Z.Naredidine MD www.mocatest.org Normal 8.26 / 30 TOTAL []/30
Add 1 point if > 12 yr edu

174 acute stroke patients with MoCA and Neuropsychology Assessment (Chan et al., 2014; 2017)

1. Are MoCA intact patients also intact on a neuropsychological assessment?
2. Are patients with MoCA intact cognitive domains also intact on the corresponding neuropsychological domain?
3. Does lesion side impact on the sensitivity of the MoCA?

1. Are MoCA intact patients also intact on a Neuropsychological Assessment? NO!

40 MoCA intact patients – all Neuropsychologically impaired

MoCA Intact	% of patients with neuropsychological impairment
≥2 Cognitive Domain	70%
1 Cognitive Domain only	30%

2. Are patients with MoCA intact cognitive domains also intact on the corresponding Neuropsychological Domain? NO!

MoCA domains	% of patients with intact scores on the MoCA domains	% of patients impaired in neuropsychological corresponding domains
Attention	30%	59%
Memory	14%	35%
Visuospatial/executive	18%	30%
Naming	68%	21%
Abstraction	42%	12%
Language	26%	9%

3. Does the lesion laterality impact on sensitivity of the MoCA? YES!

Laterality	MoCA Intact (n = 40, 23.6%)
Right Side lesion	32 (80%)
Left Sided lesion	3 (7.5%)
Bilateral Lesion	5 (12.5%)

- Cognitive screening tests such as the MoCA underestimate cognitive impairment
- The neuropsychological assessment is therefore needed to identify and quantify cognitive impairment in patients with suspected or confirmed brain damage

When is a Neuropsychological Assessment needed?

1. Diagnosis

- Shortcomings of the cognitive screening tests
- How the methods of assessing cognitive functions have developed
- Principles that underpin neuropsychological assessment
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“..His vocabulary is copious..... from time to time he misses a word...He *repeats correctly* whole sentences, if not too long...”

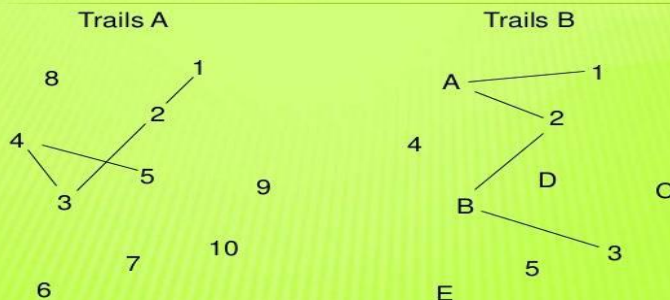
(Lichtheim, 1885, p.p. 448-449; derived from Shallice, 1988)

“...The assessment of organic impairment of intellect is a task which might be expected to be within the competence of a Clinical Psychologist. Nevertheless, there are several statements by psychologists disclaiming their ability to do so with an adequate degree of validity...”

(Piercy, 1959)

Halstead-Reitan Battery

SAMPLES OF TESTS...



Trails A and Trails B – from **Halstead-Reitan test battery**

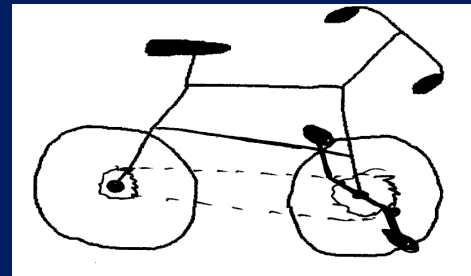
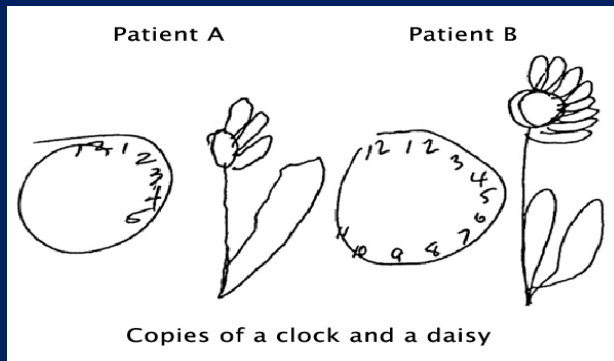
“...little, if anything, could be gained by translating neuropsychological deficits into quantitative values...”

Letter from Luria to Reitan (1967; translated)

Clinical tests fell into two categories

1. *Psychometric tests*: originally developed for the measurement of either scholastic attainment or occupational guidance
2. *‘Qualitative’ tests*: often improvised by the various clinicians

Clock, bicycle and daisy drawing (Zangwill)



Lezak, 1983; McFie & Zangwill, 1960

When is a Neuropsychological Assessment needed?

1. Diagnosis

- Shortcomings of the cognitive screening tests
- How the methods of assessing cognitive functions have developed
- Principles underpinning the neuropsychological assessment
- Methods of assessing cognitive functions






Neuropsychological Assessment Principles

1. The cerebral cortex has a high degree of functional specialisation
2. Complex cognitive skills are organised in a broadly modular fashion
3. Brain damage can selectively disrupt these cognitive skills

Brain damage can selectively disrupt cognitive skills

Patients (Cipolotti, 2000; Incisa della Rocchetta et al, 2004)					
	BF	TM	AD	SMcD	TF
STM	✓	✓	✓	✓	✓
Non Verbal LTM	✓	✓	✓	✓	✓
Verbal LTM	✗	✗	✗	✗	✗

Patients with selective preservation of country names (Cipolotti, 2000; Incisa della Rocchetta et al, 2004)

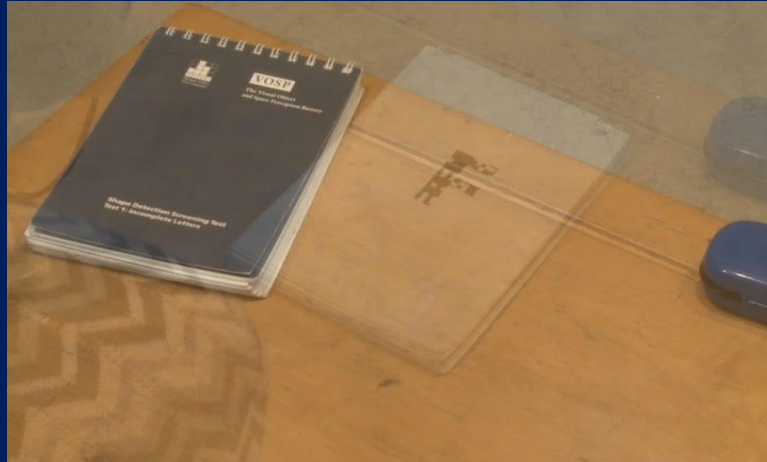
		BF	TM	AD	SMcD	TF
	Maps (%) Correct	100	100	90	100	90
	Colours (%) Correct	50	40	60	70	70
	Objects (%) Correct	30	10	60	30	10
	Animals (%) Correct	60	10	40	40	20
	Body Parts (%) Correct	20	50	90	50	10

Research studies started to focus on furthering our understanding of complex cognitive functions.

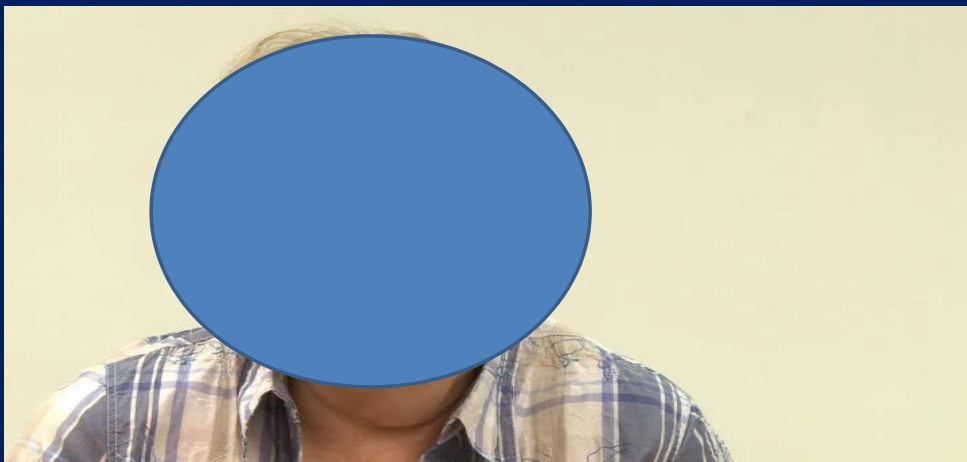
This stimulated the development of tests, initially designed as research tools assessing cognitive functions in neurological patients.

Once the tests proved their worth as research measures they were adopted as clinical tools.

VOSP: Incomplete Letters



Phonemic fluency



When is a Neuropsychological Assessment needed?

1. Diagnosis

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Identification of acquired cognitive impairments

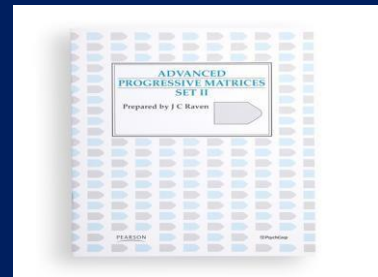
1. Establish whether the individual is functioning at their premorbid optimal level or whether there has been deterioration
2. Assess whether the individual is suffering from a neurological / organic or a psychological / functional condition

Assessment of *premorbid* intellectual functioning

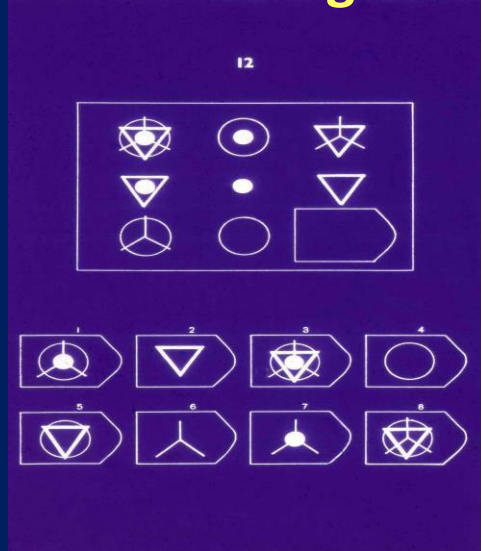
1. Educational and Occupational background
2. Reading skills
 - Generally robust to brain damage
 - Highly correlated with IQ
 - Reading tests (e.g. National Adult Reading Test: NART)

Assessment of *current* intellectual functioning – Intelligence Tests

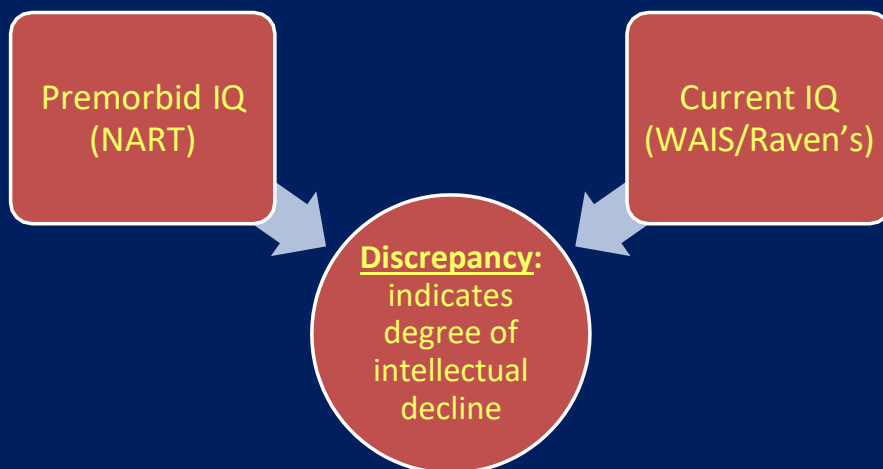
1. Raven's Advanced Progressive Matrices
2. Wechsler Adult Intelligence Scales (WAIS, WAIS-R, WAIS-III, WAIS-IV)



Raven's Advanced Progressive Matrices



Assessing cognitive functioning



Differential Diagnosis

Psychological / Functional - *Risk of “false positive” diagnosis*

Neurological / Organic - *Risk of “false negative” diagnosis*

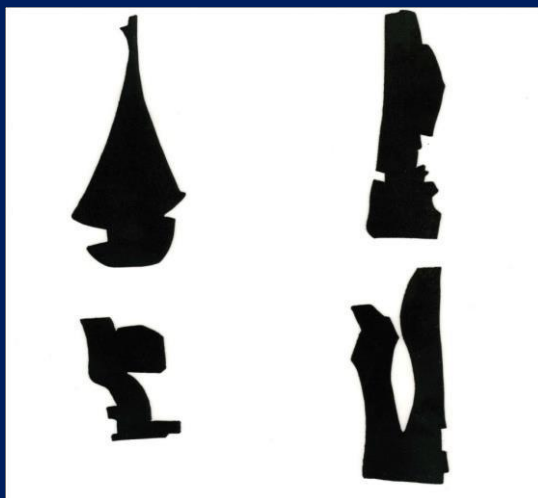
Determining extent of damage

1. Premorbid ability
2. General intelligence
3. Memory
4. Language
5. Calculation
6. Executive function
7. Alertness and attention
8. Visual and space perception

Language – Graded Naming Test



Visuospatial/Visuoperceptual Function VOSP: Object Decision



Executive Functions: Stroop Test



Psychometric properties of tests needed in cognitive testing I

1. VALID

They measure what they are designed to measure; i.e. they probe an established cognitive domain

2. COMPARABLE DIFFICULTY

They allow results to be compared across tasks

3. SENSITIVE TO CHANGE

Graded difficulty tests for which normally distributed scores are available. This allows the rate of disease progression to be monitored and avoid uninformative ceiling and floor effects

Psychometric properties of tests needed in cognitive testing II (Bird et al., 2003, 2004)

1. Reliable over time
2. Resistant to practice effects or
3. Have well known practice effects, so that scores at reassessment can be adjusted according to the expected gains

Recognition Memory Test – Words



Familial Alzheimer's Disease: FAD

Examinations	Results
MMSE	30/30
Neurological examination	Normal
Standard MRI Findings	Normal

Critically, neither the patient nor his/her relatives reported any memory difficulties

7 at risk FAD members: Performance on the RMT

(Godbolt et al., 2006)

	Words (max. 50)			Faces (max. 50)		
	Session			Session		
	1	2	3	1	2	3
4.3	49	48	45	48	46	48
4.13	46	45		46	45	
4.5	49	49	47	45	47	45
4.9	37 [±]	48	47	47	46	44
4.1	40 [*]	28 [*]	38	49	31 [±]	36 [†]
4.12	40 [*]	27 [±]		42	37	
4.10	33 [±]	25 [*]	13 ^{±§}	33 [±]	35 [±]	11 ^{*§}

Discrepancy score: * <25%; † <5%; ± <1%. § Maximum 25

The Neuropsychological Assessment is needed to:

1. Identify cognitive impairments in neurological patients
2. Differentiate between neurological/organic and psychological/functional impairments
3. Determine the extent of damage

When is a Neuropsychological Assessment needed?

2. **Treatment and management**
 - Monitoring
 - Planning rehabilitation programmes
 - Discussion of the implication of the diagnosis

Treatment and Management I

Repeated Neuropsychological Assessments can help in monitoring :

1. *Cognitive impairment* in neurological conditions such as Stroke and Head Injury
2. *Rate of decline* in neurodegenerative disorders
3. *Evaluating medical and surgical treatments* such as Parkinson, Hydrocephalus, Brain Tumours, Epilepsy and MS

Treatment and Management II

Planning rehabilitation programmes:

1. Establish realistic treatment goals
2. Evaluate patients' capacity to benefit from treatment
3. Monitor rehabilitation programme

Treatment and Management III

Discussing the implication of diagnosis:

1. Neuropsychological results can provide useful information for the patients and their families regarding the difficulties they may face in the future
2. This information can help them to come to terms with the diagnosis and plan for their future care

When is a Neuropsychological Assessment needed?

Research

1. Developing a powerful neuropsychological methodology

Pre-symptomatic changes in FAD; cognitive screening tests

2. Refining the diagnosis of neuropsychological syndromes

E.g. amnesia, dysphasia, executive impairments

3. Furthering our understanding of the functioning of the brain

Theoretically driven research has proven of fundamental importance in the study of the organisation of cognitive functions

When is a Neuropsychological Assessment needed?

Diagnosis, Treatment, Management and Research of a wide variety of neurological conditions

Differential diagnosis:

Organic and functional memory impairments

Can be distinguished by:

1. Highlighting discrepancies between subjective complaints and objective performance
2. Identifying improbabilities in the patient's apparent pattern of impairment

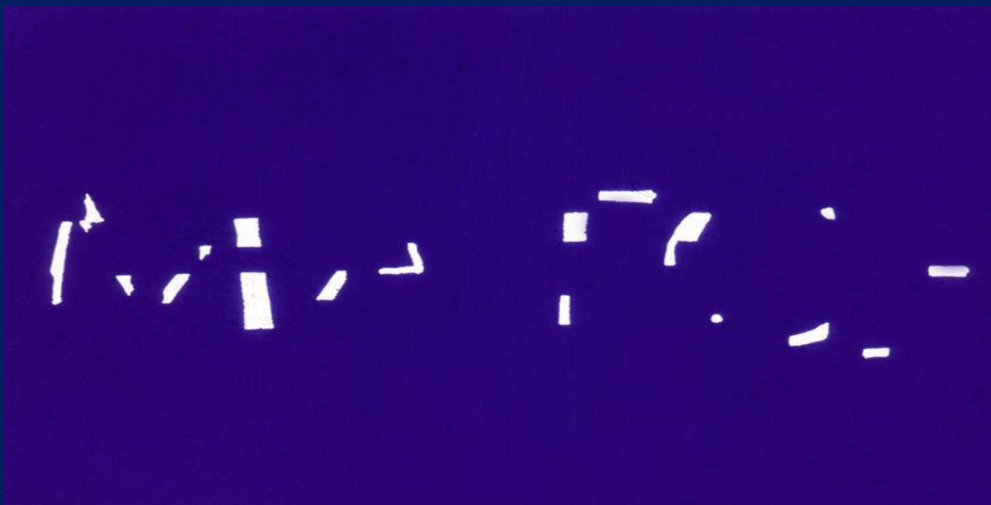
Differential diagnosis:

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Can be distinguished by:

1. Highlighting discrepancies between subjective complaints and objective performance
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Implicit learning task – Degraded words



Implicit learning task – Degraded words



Implicit learning task – Degraded words

