# Cognitive Function II: Assessing Cognition in Older Adults with Visual or Hearing Impairment


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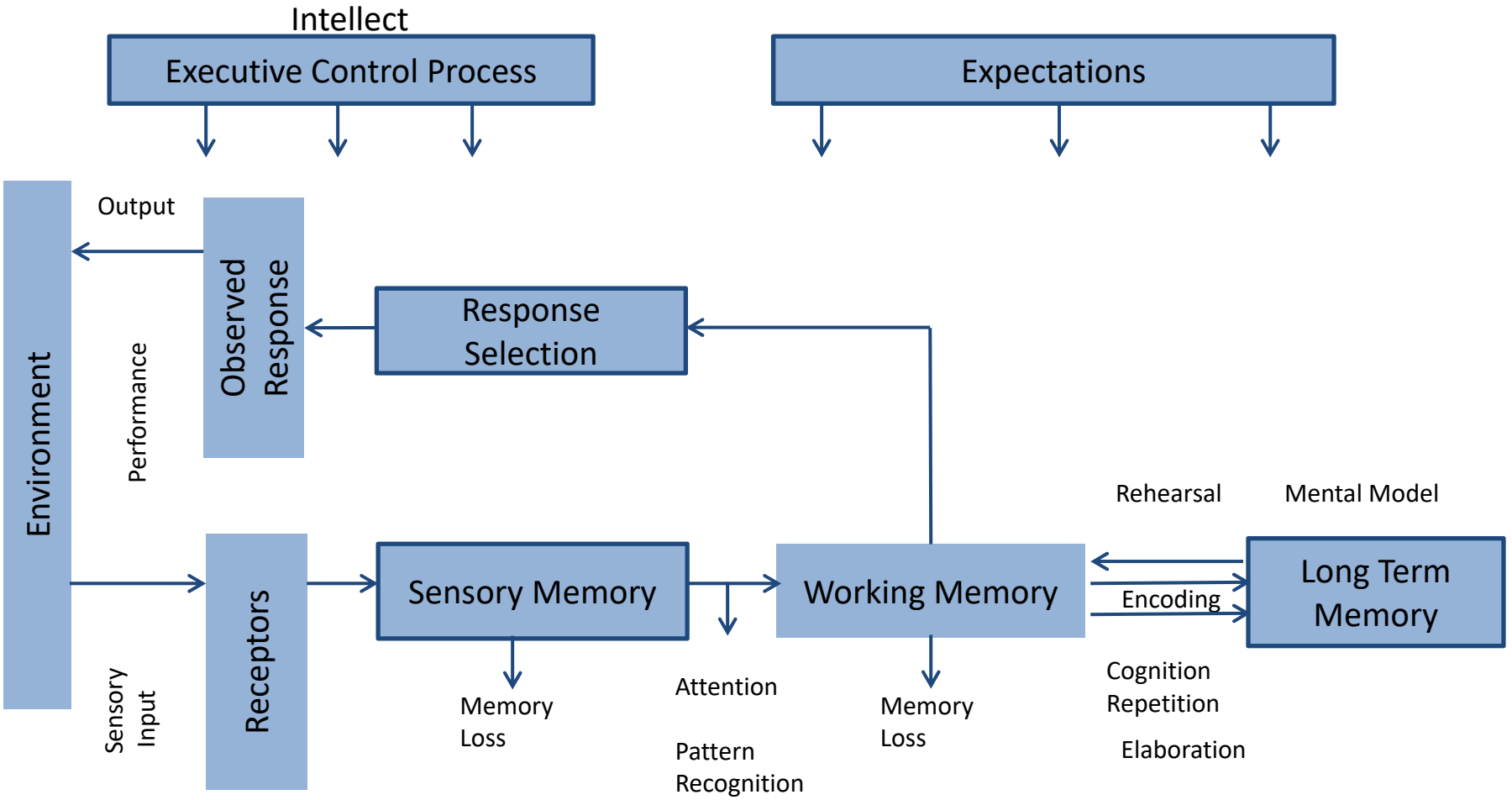
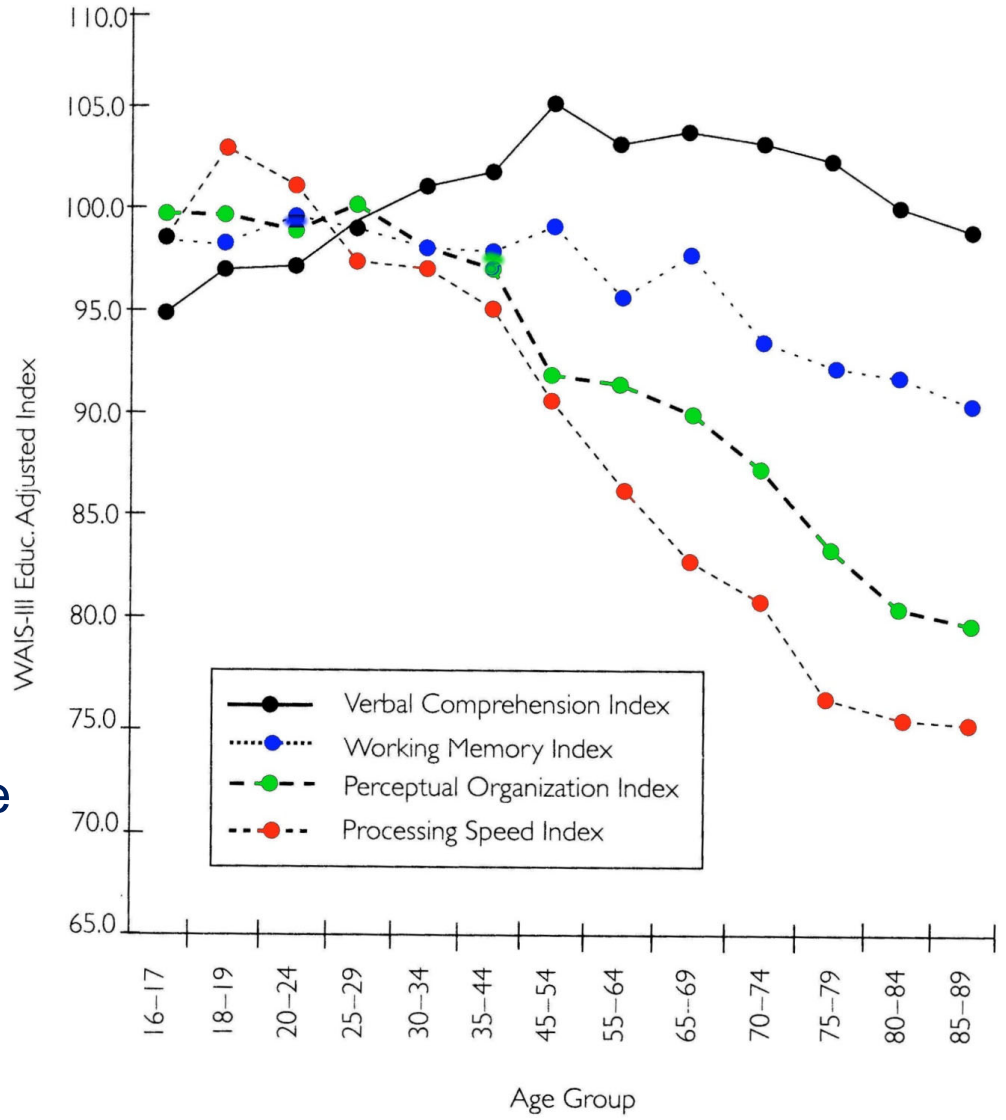
# Conflict of Interest

- I have no conflict of interest to declare for this presentation

# Cognition is not a *thing,* it is a multi-stage multi-determined set of *processes*



# Change in cognition across the lifespan (Wechsler, 1987)




- Sensory-perceptual function
- Intellectual function, knowledge
- Processing speed
- Attention
- Executive function
- Working memory
- Memory (verbal and non-verbal)
- Speech and language

# Why assess cognitive function?

- To evaluate cognitive ability
  - Diagnosis (e.g., dementia due to AD, etc.)
  - Predict functional outcomes, advise clients
  - Inform treatment or need for referral
- To screen out (or in) research participants
- For research data

- The purpose will dictate the methods/tests

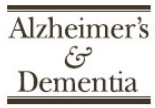
# Sensory function, cognition, aging, and dementia: Why should we care?

- Cognitive decline, hearing loss, and visual loss are
  - each very prevalent
  - increase with age
  - co-morbid
  - Albers et al., (2015)





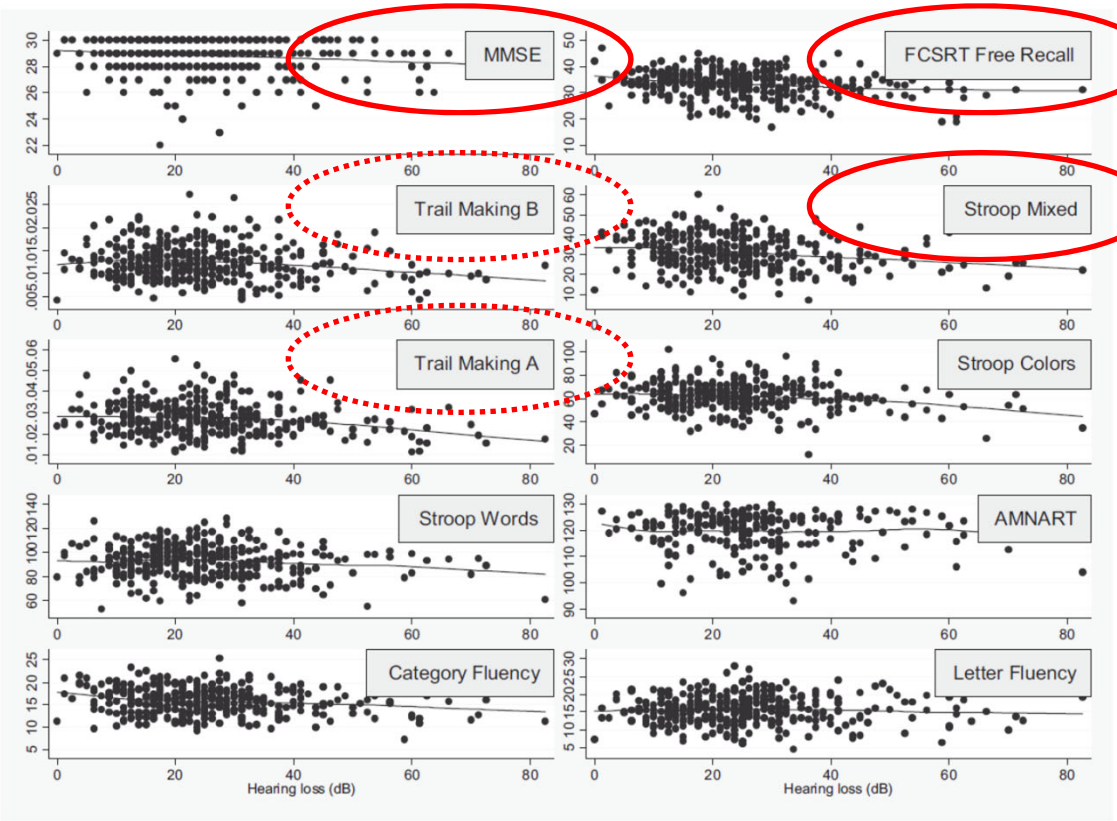
Alzheimer's & Dementia 11 (2015) 70-98




At the interface of sensory and motor dysfunctions and Alzheimer's disease

- Strong connection between sensory loss and cognitive loss
  - Hearing loss is independently associated with incident dementia, pooled risk ratio 1.94 (Livingston et al., 2017)
  - Vision loss is associated with greater cognitive decline (Zheng et al., 2018) and risk for dementia (Rogers & Langa, 2010)
  - Potential mechanisms:  exhaustion of cognitive reserve, social isolation, environmental de-afferentation
- A common-cause marker for early degeneration or a modifiable risk factor?

# Is the link between sensory loss and cognition simply due to poor quality input?




Lin, Ferrucci et al., (2011)

- BLSA
- HL associated with
  - MMSE
  - verbal memory
  - ** non-verbal executive function
- 25 dB ↑ in hearing threshold = ~6-7 year ↑ in "cognitive age"

# Sensory adjustments lead to better performance in auditory verbal memory (Wong et al., 2018)

Table 3

*Descriptive Statistics and Group Comparisons of HVLT-R Raw Scores for HL (n = 41) and NH (n = 41) Groups*

| | HL | | NH | | | | |
|---|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | *M* | *SD* | *p* | *d* | 95% CI of the difference |
| HVLT natural | | | | | | | |
| Total recall | 13.1 | (8.6) | 23.4 | (5.4) | <.001 | 1.43 | [−13.45, −7.13] |
| Delayed recall | 3.7 | (3.8) | 7.3 | (3.6) | <.001 | .97 | [−3.66, .81] |
| Retention (%) | 59.4 | (42.6) | 73.4 | (30.4) | .091 | .38 | [−30.48, 2.31] |
| Recognition dis. | 6.4 | (3.6) | 10.2 | (2.0) | <.001 | 1.30 | [−5.09, −2.52] |
| HVLT crossed | | | | | | | |
| Total recall | 22.8 | (5.0) | 13.2 | (7.4) | <.001 | 1.52 | [6.86, 12.41] |
| Delayed recall | 7.0 | (2.9) | 4.3 | (3.5) | <.001 | .84 | [2.78, .71] |
| Retention (%) | 72.5 | (23.8) | 63.7 | (40.9) | .237 | .26 | [−5.90, 23.50] |
| Recognition dis. | 10.0 | (1.8) | 7.4 | (3.0) | <.001 | 1.05 | [1.53, 3.74] |
| HVLT visual | | | | | | | |
| Total recall | 23.7 | (5.5) | 24.8 | (5.0) | .339 | .21 | [−3.45, 1.20] |
| Delayed recall | 8.7 | (2.8) | 9.0 | (2.6) | .656 | .11 | [−.27, .60] |
| Retention (%) | 91.5 | (17.7) | 90.7 | (16.5) | .832 | .05 | [−6.72, 8.33] |
| Recognition dis. | 11.1 | (.8) | 11.0 | (1.2) | .528 | .10 | [−.31, .61] |

# Guidelines for the psychologist (2014)

http://psychologybenefits.org/2014/11/06/28-tips-for-treating-older-clients/


**To address hearing loss:**

- Minimize **background noise** (e.g., close the office door, forward incoming calls) as individuals with hearing loss have difficulty discriminating between sounds in the environment.
- **Look at your client** when speaking. Many individuals with hearing loss read lips to compensate.
- **Speak slowly and distinctly**. Older adults may process information more slowly than younger adults.
- **Do not** over-articulate or **shout** as this can distort speech and facial gestures.
- Use a **lower pitch** of voice because the ability to hear high frequency tones is the first and most severe impairment experienced by many older adults with compromised hearing.
- Arrange seating to be conducive to conversation. **Sit close** to your client, face-to-face, at a table rather than on the far side of a desk.
- Focus more on written communication to compensate for problems in oral communication. Provide **written summaries** and follow-up material.
- Have auditory **amplifiers**. Many companies sell hand-held amplifiers that connect to headphones for in-office use.

**To address vision loss:**

- Increase **lighting**.
- Reduce the impact of **glare** from windows and lighting as older adults have increased sensitivity to glare. Have clients face away from a bright window.
- **Do not use glossy print materials** as they are particularly vulnerable to glare.
- Format documents in **large print** (e.g., 14 or 16-point font) and double-spaced as presbyopia (blurred vision at normal reading distance) becomes more prevalent with age.
- Give your client **adequate time to refocus** his or her gaze when shifting between reading and viewing objects at a distance, as visual accommodation can be slowed.
- Be mindful of your client's **narrowing field of vision.** A client may not be aware of your presence in the room until you are directly in front of him or her.
- **Have reading glasses and magnifying glasses available** on conference tables.
- **Arrange furnishings** so pathways are clear for those with visual or physical limitations

# A case study:

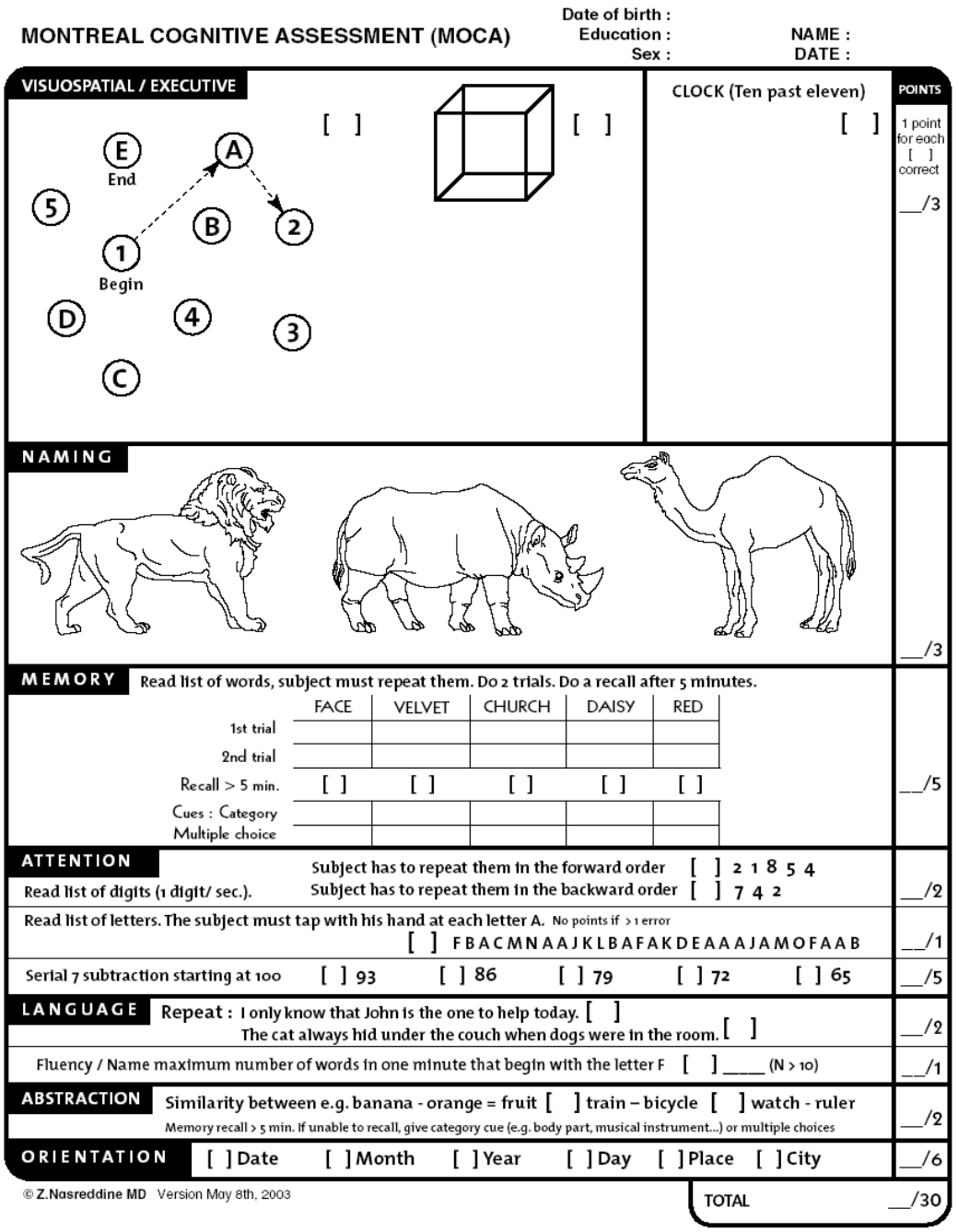
## The Montreal Cognitive Assessment (MoCA)

Ziad S. Nasreddine, Howard Chertkow, Natalie A. Phillips

**J.Am Geriatr Soc 53:695–699, 2005**

- a cognitive screening tool for detection of MCI
- One page
- 30-point scale
- 10 minutes to administer
- Score<26 abnormal
- > 40 languages/dialects

- Tests 8 cognitive domains
- Used globally
- Available at www.mocatest.org
- Free!
- But it has its issues . . .



MONTREAL COGNITIVE ASSESSMENT (MOCA)

Date of birth :
Education :
Sex :

NAME :
DATE :

**VISUOSPATIAL / EXECUTIVE** [ ] [ ] CLOCK (Ten past eleven) [ ] — POINTS: 1 point for each [ ] correct __/3

E End, A, 5, B, 2, 1 Begin, D, 4, 3, C

**NAMING** __/3

**MEMORY** Read list of words, subject must repeat them. Do 2 trials. Do a recall after 5 minutes.

| | FACE | VELVET | CHURCH | DAISY | RED |
|---|---|---|---|---|---|
| 1st trial | | | | | |
| 2nd trial | | | | | |
| Recall > 5 min. | [ ] | [ ] | [ ] | [ ] | [ ] |
| Cues : Category | | | | | |
| Multiple choice | | | | | |

__/5

**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 — __/2

Read list of letters. The subject must tap with his hand at each letter A. No points if > 1 error. [ ] 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 — __/5

**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. [ ] — __/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] ____ (N > 10) — __/1

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

Memory recall > 5 min. If unable to recall, give category cue (e.g. body part, musical instrument...) or multiple choices

**ORIENTATION** [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City — __/6

© Z.Nasreddine MD Version May 8th, 2003

TOTAL __/30

Visual

Visual

Auditory

Auditory

Auditory

Auditory

**Executive function**

Sequencing, WM

Planning, semantic memory

**Semantic memory**

Word retrieval

**Episodic Memory**

learning, STM, Recall memory,

Cued memory

**Short-term memory**

**Attention**

**Working memory**

Simple math

Semantic memory search, flexibility

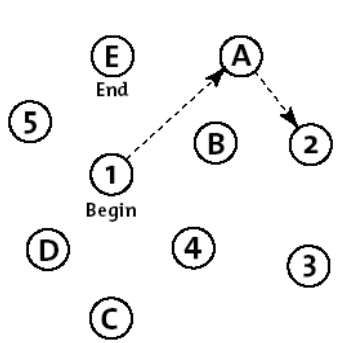
semantic memory, abstract thinking

**MONTREAL COGNITIVE ASSESSMENT (MOCA)**

Date of birth :
Education :
Sex :

NAME :
DATE :

**VISUOSPATIAL / EXECUTIVE**

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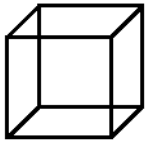


[ ]

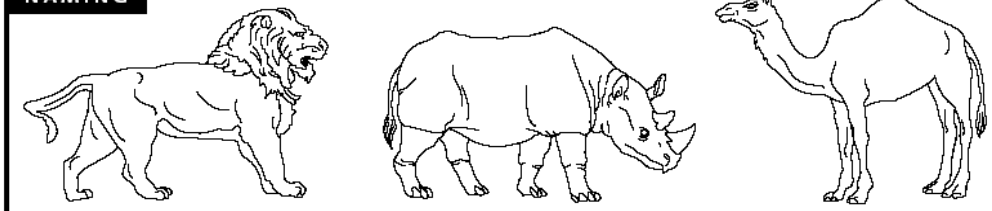
CLOCK (Ten past eleven) [ ]

POINTS

1 point for each [ ] correct

__/3

**NAMING**



__/3

**MEMORY** Read list of words, subject must repeat them. Do 2 trials. Do a recall after 5 minutes.

| | FACE | VELVET | CHURCH | DAISY | RED |
|---|---|---|---|---|---|
| 1st trial | | | | | |
| 2nd trial | | | | | |
| Recall > 5 min. | [ ] | [ ] | [ ] | [ ] | [ ] |
| Cues : Category<br>Multiple choice | | | | | |

__/5

**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

__/2

Read list of letters. The subject must tap with his hand at each letter A. No points if > 1 error
[ ] 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

__/5

**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. [ ]

__/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] ____ (N > 10)

__/1

**ABSTRACTION** Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler
Memory recall > 5 min. If unable to recall, give category cue (e.g. body part, musical instrument...) or multiple choices

__/2

**ORIENTATION** [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

__/6



TOTAL __/30

## Sensitivity and Specificity of the Montreal Cognitive Assessment Modified for Individuals Who Are Visually Impaired

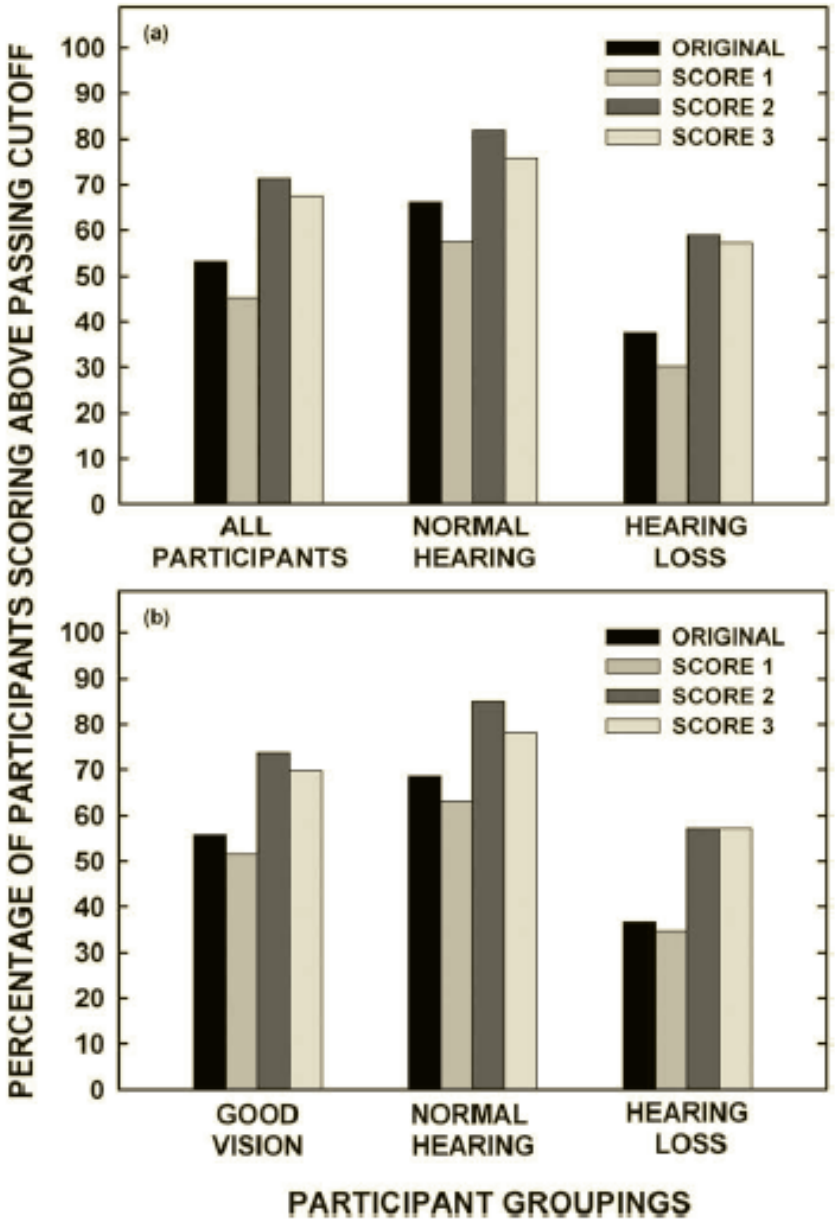
Walter Wittich, Natalie Phillips, Ziad S. Nasreddine, and Howard Chertkow

*Journal of Visual Impairment & Blindness*, June 2010

- eliminated visual items
  - Trail Making, cube copy, clock drawing, naming
- leads to a trade-off between sensitivity and specificity
- eliminating items leads to eliminating cognitive domains

***Table 1***
**Sensitivity and specificity values for the MoCA and the MMSE.**

| | MoCA[a] | MMSE[a] | MoCA-B Absolute | MoCA-B Relative | MMSE[b] Telephone | MMSE[c] Visually impaired |
|---|---|---|---|---|---|---|
| Cutoff | 26 | 26 | 17 | 18 | 17 | 15–17 |
| % of total | 83 | 83 | 77 | 82 | 77 | 68–77 |
| Sensitivity (%) | | | | | | |
| MCI | 90 | 18 | 44 | 63 | – | – |
| AD | 100 | 78 | 87 | 94 | 67 | 91–100 |
| Specificity (%) | 87 | 100 | 98 | 98 | 100 | 80–100 |




## Dupuis et al. (2014)

- 47% of total failed
  - older, ↑ PTA and WIN thresholds, poorer health
- Scoring modifications:
  - Score 1: minus sentence repetition; sus't attention; digit span; cutoff <21/25
  - Score 2: minus delayed recall; cutoff <21/25
  - Score 3: all above; cutoff <17/20
- proportion passing when delayed recall removed
  - ↑ 16% NH and 21% HL
  - Nevertheless, failing was 2X higher in HL than NH (41% vs. 18%)
- increased generalizability or decreased sensitivity?
- modality-specific versions are necessary

# Cognitive Screening . . .

- is important
  - In research:  if you want data or uncontaminated samples
  - In the clinic: potential to improve outcomes
- Age-related cognitive decline ≠ dementia
- Failing a cognitive screening test ≠ dementia
- Cognitive screening requires an established referral network for professional evaluation and management
  - family physician, neurologist/geriatrician, neuropsychologist, psychologist, mental health professional, ophthalmology, audiology, etc.
- If you modify the test, you have changed the task and you have changed what you measure

# Research Gaps and Challenges

- The development of cognitive tests that are "sensory-fair"
  - Administered in audio-visual modalities?
  - Likely achievable in some cognitive domains
    - Learning and memory, semantic memory/ crystalized knowledge, processing speed
  - Unlikely in other cognitive domains
    - Inhibition, attention
- Must establish psychometric properties
  - Validated (Sensitivity/specificity)
  - Normed
  - Predictive utility/ecological validity

# Acknowledgements and thanks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