The prototype of the relationships among cognitive control, memory function, and Theory of Mind in MCI patients: does it differ from the same prototype in community dwelling older adults having vascular risk factors?

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Mild Cognitive Impairment (MCI)

- “MCI” was introduced to describe the trajectory of decline in cognition that is identified with dementia.

- The ability to diagnose MCI and form a prognosis for it is deemed extremely important, especially at its earliest stages, during which it is assumed that it would be possible to intervene in the development of the cognitive decline and delay its adverse effects.

- “MCI” includes a non-homogenous group of symptoms at the cognitive level. Its incidence affects between 3% and 42% of the typical population, and the most common age-range for its emergence is 65 to 85 years. Due to the wide heterogeneity of symptoms, individuals diagnosed with MCI may present deficits across several different cognitive domains, such as language, executive functions, attention, and visuo-spatial perception.
Mild Cognitive Impairment (MCI)

- One of the diagnostic criteria for MCI are **memory deficits**. Deficits in “episodic memory” defined as the memory of personal experiences occurred at a particular time and place, are often evident in persons diagnosed with MCI.

- Besides the well established memory deficits, many patients with MCI deal with problems in **executive functions or cognitive control processes** (Cc), namely, the higher-order cognitive processes that control thought and action.

- In the more recent literature, we come across studies on **Theory of Mind** (ToM) in MCI. ToM is the most known dimension of social cognition that refers to the ability to understand other people’s intentions, beliefs, and desires. What is known till now is that, compared to cognitively healthy older adults, MCI patients seem to perform worse on complex ToM tasks.
Recently, several studies have linked non-diagnosed vascular pathology with cognitive impairment. It is reasonable to maintain that since vascular disease affects the brain, it also affects cognitive functioning and leads to some type of “cognitive frailty”. Indeed, the theoretical approach of the “vascular hypothesis of cognitive aging” posits that basic risk factors for the emergence of vascular disease, such as hypertension, hyperlipidemia, and diabetes mellitus, affect cognitive functions that are supported by the frontal brain regions.
In this light, the present study aims to investigate the differences of older adults having vascular risk factors and MCI patients in regards to cognitive control, memory and Theory of Mind.
Method

Participants

- The sample consists of two groups of older adults, matched for gender, age and educational level. MCI group composed of 45 participants while VRF group consists of 30 participants.
- All participants are at least 60 years old, with at least six years of schooling and Hellenic as their native language.
- All participants are informed about the procedure and the aim of the study, and their written consent is taken.
<table>
<thead>
<tr>
<th>group</th>
<th>age</th>
<th>MoCA</th>
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<tbody>
<tr>
<td>MCI (n=45, men=10)</td>
<td>70.47 (Std 7.1)</td>
<td>24.4 (Std 2.1)</td>
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<tr>
<td>VRF (n=30, men=8)</td>
<td>67.47 (Std 7.2)</td>
<td>26.7 (Std 1.2)</td>
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- The groups did not differ significantly in gender, age ($p=.626$) and education ($p=.082$).
- The groups differ significantly in the Montreal Cognitive Assessment battery ($p=.002$).
**Tools: Neuropsychological Assessment**

- Montreal Cognitive Assessment,
- Rivermead Behavioral Memory Test (subtasks),
- Doors and People Battery,
- Working Memory Index from the WAIS IV GR,
- Trailing Making Test A&B,
- Colour-Word Interference Test,
- Design Fluency Test,
- Verbal Fluency Test
- Tower Test (Delis-Kaplan Executive Function System),
- Social and Cognitive Mental Verbs from the Natsopoulos’ ToM battery,
- Social Inference and Emotion Evaluation from The Awareness of Social Inference Test.
The *Working Memory Test* consists of the two classic conditions, “forward number recall” and “backward number recall”.

The *Design Fluency Test* has three conditions:

1\textsuperscript{st} (initiation): requires to connect five black dots with four straight lines in order to make as much as you can different designs.

2\textsuperscript{nd} (initiation & inhibition): requires linking five empty dots ignoring the black ones.

3\textsuperscript{rd} (initiation, inhibition, switching): requires to connect interchangeably one black to one empty dot.
Tasit B (metaphoric speech - SARCASM UNDERSTANDING)

- assesses an individual’s ability to “read” social cues and to integrate them appropriately so as to determine such things as the speaker’s intention, attitude and feelings.

- Participants watch 15 videos: 5 related to sincere scenes, 5 to simple sarcasm and 5 to paradoxical sarcasm.

- They are asked to answer four questions for each scene: what the actors do, what they say, what they think and what they feel.

In the sarcastic exchanges the speaker means the opposite of what is saying.
Procedure

- From the group of MCI patients 30 participants examined in the Greek Association of Alzheimer’s Disease and Related Disorders and the other (n=15) in the general hospital of Katerini.

- All MCI patients parallel to the neuropsychological batteries submitted to neurological examinations.

- Biochemical analysis presupposed as assignment for VRF group.
Results

- For data analysis the SPSS v. 21 was used.
- From all the batteries administered, differences were found in:
  - the **Design Fluency** test,
  - the **Working Memory** test, and
  - the TASIT subtest examining **simple sarcasm understanding**.
Group effects (MCI & VRF) on total correct designs for the three conditions of the Design Fluency Test.

Condition 1: initiation
Condition 2: plus inhibition
Condition 3: plus switching

$p = .846$
$p = .899$
$p = .018^*$
Group effects (MCI and VRF) on total set of number recalling

Forward $p=.00^{**}$
Backward $p=.00^{**}$
Theory of Mind: metaphoric speech understanding

Group effects (MCI & VRF) on simple sarcasm understanding
- **Do** $p = .003$
- **Say** $p = .000$
- **Think** $p = .012$
- **Feel** $p = .001$

**Do**: what the speaker intend to do

**Say**: whether they want the literal meaning of their message to be believed

**Think**: speaker’s believes and knowledge about the situation

**Feel**: speaker’s emotional states
The proposed study was designed in order to examine early cognitive impairment in older adults, by comparing two groups of older adults (older adults with high risk for developing vascular disease, and older adults with a diagnosis of MCI), along three dimensions of cognition – cognitive control, memory function and Theory of Mind.
As for the Design Fluency test, the last condition – “inhibition plus switching”, as the most complex one, seemed to be extremely difficult for MCI patients.

Especially, the ability to shift between different tasks or rules is a higher-order executive function.

Thus, MCI patients appear to differ from the community dwelling older adults having risk factors for VaD development, only in tasks with higher-level requirements as regards executive functioning.
Working memory (especially the “backward” condition) test requires the recruitment of the supervisory attentional control system, verbal and visual organization, planning, critical ability and reasoning. Deficits in these domains of cognition indeed are linked to MCI diagnosis (Cooper et al 2010, Juvina et al 2011).

As for the forward condition, it is well known that MCI patients display memory deficits, especially deficits in memory supporting encoding and recalling (Sperling et al 2010).
As regards the results related to the “sarcasm understanding” subtest, our findings agree with recent studies for MCI patients who performed worse on complex ToM tasks compared to healthy individuals.

Studies that deal with the neuro-anatomical underpinnings of ToM - prefrontal cortex and, specifically, the orbital frontal regions and the medial prefrontal cortex, support that these areas are seriously affected in MCI patients (Hooker et al 2011).
*As for the future, we aim to complete VRF group (n=50) and examine the interrelationships as well as the causal relations of these three broad dimensions of cognition in a longitudinal design.

Thank you!!!
References


