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Acta Neurologica Belgica

ISSN 0300-9009

Acta Neurol Belg
DOI 10.1007/s13760-020-01483-3

Springer

Acta Neurologica Belgica
https://doi.org/10.1007/s13760-020-01483-3

ORIGINAL ARTICLE

Famous faces naming test predicts conversion from mild cognitive impairment to Alzheimer's disease

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Received: 19 April 2020 / Accepted: 24 August 2020

Abstract
The presence of semantic memory dysfunction in Alzheimer's disease (AD) has been widely investigated. Several studies have showed a higher degree of impairment in naming persons and objects, compared to general semantic knowledge in early stages of AD. The aim of this study was to investigate if the Famous Faces Naming Test can help to differentiate patients with mild cognitive impairment (MCI) who will progress to AD and those who will not. A Famous Faces Naming Test was administered to 17 patients with MCI who did not convert to AD and eight patients with MCI who converted to AD 2 years later. MCI patients who converted to AD 2 years later performed significantly worse on Famous Faces Naming Test compared to MCI patients who did not convert over that time period. A neuropsychological task of semantic knowledge of famous people may be useful in the early diagnosis of Alzheimer's disease.

Keywords Mild cognitive impairment · Famous faces naming test · Semantic memory

Introduction

Healthy elderly people between 60 and 80 years start complaining of having difficulties in doing some cognitive tasks, particularly those involving memory. This cognitive decline has been commonly considered to be a normal consequence of brain aging, but it can also indicate the onset of dementia, a general term to describe a group of symptoms that negatively impact memory in addition to other cognitive functions and is severe enough to interfere with daily life.

Alzheimer's disease is the most common cause of dementia, accounting for 60–80% of cases [1, 2]. In 2011, about 33.9 million people worldwide had AD, and the prevalence is expected to triple by 2050 [3], meaning an important increase of health-care costs. In addition to having more hospital stays than other elderly people, they also require more skilled nursing attendance and home health-care visits per year [4]. Therefore, early diagnosis and interventions to delay the onset of the disease are beneficial not only for the patients and their caregivers, but also for health-care systems in terms of cost savings.

Early diagnosis is possible because AD patients are symptomatic years before the diagnosis of the disease, when brain degeneration has already started but remains subclinical. Several terms have been used to describe this stage between normal aging and cognitive decline. The most popular one is mild cognitive impairment (MCI), proposed by Petersen et al. in the late 1990s [5, 6].

Longitudinal studies provide evidence for different possible progressions for MCI patients, ranging from the development of AD or other neurodegenerative diseases to the stabilization or even regression of cognitive impairments [7]. The MCI patients that tend to convert to Alzheimer's disease account for 10–15% of cases per year. This is in contrast to normal elderly subjects who may develop AD at a rate of 1–2% per year [8]. The early distinction between MCI patients who converted to AD and those that may present other causes of cognitive decline remains a big challenge. A large number of potential predictors have been proposed, with most investigations focusing on biomarkers. However, Gomar et al. found that the conversion from MCI to AD is

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Published online: 04 September 2020

better predicted by cognitive markers than by biomarkers [9].

The cognitive profile of Alzheimer's disease has been widely documented. Deficits in semantic memory predominate in the early stages [7–10]. Among its various domains, naming and identifying people are particularly complex [10–18]. Proper names are thought to be more difficult to retrieve than common nouns, even in the healthy aged, due to the weak and arbitrary links between a proper noun and its reference [19–23]. In this respect, when a familiar face is presented, sometimes one may experience difficulties in retrieving that person's name. Healthy individuals often resolve spontaneously this situation and the correct name comes to mind. This phenomenon, at the-tip-of-the tongue (TOT), occurs more often in elderly people [19, 24–27] and some studies indicate that knowledge for famous people seems to be especially vulnerable [28]. In this line, some research suggests that tests of a person's knowledge are sensitive to early AD and could even act as a useful diagnostic marker [21]. Therefore, this task might be included in neuropsychological protocols for early diagnosis.

A specific test to assess semantic memory loss, related to proper names, is the Famous Faces Naming Test. MCI and AD patients present marked deficits doing this task [17, 28, 29], as they provide less semantic information, even when the characters are correctly recognized [30]. The items of this test have to be constantly renewed, since people who are famous at present might not be in the future.

The aim of this work is to investigate if the Famous Faces Naming Test can help to identify which patients will progress to Alzheimer's disease and who will not. To achieve this goal, MCI patients were assessed using a newly devised battery of tasks.

Methodology

Participants

Twenty-five MCI patients (ten females) were recruited from the Hospital of Cabueñes, Gijón, Spain. Demographic data are shown in Table 1. All of them underwent a neuropsychological evaluation twice to follow up their global cognitive status. The first time, all of them maintained the diagnosis of MCI. The second time, 2 years later, eight of them converted to AD. To determine if the impairment of famous faces is present early in the disease, we analyzed the differences between these eight patients who developed AD (MCI-AD) from those 17 who did not (MCI-non AD) at the time in which they all maintained the original diagnosis.

Therefore, two subject groups participated in the study: eight patients with MCI who developed AD 2 years after the first evaluation (3 females) and, as a control, 17 patients with MCI who did not develop AD in that period of time (6 females). The demographic data are shown in Table 2.

It is worth mentioning the age difference between both groups. Although all subjects were diagnosed with mild cognitive impairment, some developed symptoms at an early age while others at an older age. Nevertheless, the difference of almost 3 years between both groups is not statistically significant.

Inclusion criteria for MCI aimed at selecting elderly persons with [5, 31]: (1) evidence of memory impairment; (2) preservation of general cognitive and functional abilities; (3) absence of diagnosed dementia. A medical history, neurological examination, and brain scans (TAC or RM) were also reviewed for all patients.

The NINCDS-ADRDA Alzheimer's Criteria (1984), proposed by the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's disease and Related Disorders Association, were used to identify those MCI patients who converted to AD [32].

Material

The tests selected for the follow0up included tests of screening: the Mini Mental State Examination (MMSE), the Montreal Cognitive Assessment (MoCA) and the Clock Drawing Test (CDT); tests of episodic memory: the Word List subtest of the Consortium to Establish a Registry for Alzheimer's Disease (CERAD); test of semantic memory: the Famous Faces Naming Test; and a test of language: the Boston Naming Test (BNT).

Table 1 Summary of demographics data of MCI patients

	N	Age mean (SD)	Education level (basic/primary/superior	Gender (male/female)
MCI	25	74.44 (5.21)	8/11/6	15/10

MCI mild cognitive impairment. *SD* standard deviation

Table 2 Summary of demographics data of MCI patients who progress to dementia (MCI-A) and who did not (MCI-non-AD)

	N	Age mean (SD)	Education level (basic/primary/superior	Gender (male/female)
MCI-non-AD	17	75.41 (5.42)	5/8/4	10/7
MCI-AD	8	72.38 (4.34)	3/3/2	5/3

MCI-non-AD mild cognitive impairment which did not convert to AD 2 years later. *MCI-AD* MCI which converted to AD 2 years later. *SD* standard deviation

The Famous Faces Naming Test was designed to assess face identification and naming. Twenty-two colored portrait photographs of public figures were selected. Some of them had remained famous for a limited period in the past, while others were current celebrities. The photographs included singers, politicians, kings, actors, TV personalities, celebrities of gossip shows and sportsmen from two distinct time eras (1950s and recent) to control the possibility that time would influence the patients' performance. (Appendix). Each famous face was presented in an A4-sized folder.

In addition, a range of anterograde episodic and semantic memory tests were applied. The neuropsychological test data are shown in Table 3. The patients with MCI-AD performed worse than those with MCI-non-AD. The results of the follow-up are also shown in Table 3.

Procedure

The MCI group was run through the experimental battery individually in one single session for the follow-up. This battery included the Famous Face Test. For administration purposes, the order of the photographs was randomized. For each photograph, there were two potential parts: naming and identification.

For naming, subjects were presented each photograph and asked to name the famous person represented (name, last name or full name). If the answer was incorrect (error of omission or commission), the subject then proceeded to the second part (identification) for that item. If the subjects gave an incorrect name, but spontaneously described the famous person correctly, it was scored as identification; if the subjects committed an omission, the examiner encouraged them to provide a detailed description of the famous person represented. Neither for naming nor for identification, no feedback was given; in particular, on no occasion was the name of the famous face given by the examiner. Tip-of-the-tongue phenomenon was also registered.

Thereby, three types of scores were obtained: naming score, the number correctly named without cues; identification score, the number of items producing specific identifying information, usually after an omission; TOT score (see Table 4).

The neuropsychological evaluation was conducted entirely by a psychologist paying attention to the behavior of the subjects under testing. All the evidences of unexpected behavioral response during testing were registered and taken into account.

The study was approved by the Clinical Research Ethical Committee of Asturias and all subjects gave informed written consent for the participation in this study. The cases were part of a project, still ongoing.

Table 3 Neuropsychological test data

Tests	Mean scores (SD)			
	Evaluation		Follow-up 2 years later	
	MCI-non-AD	MCI-AD	MCI-non-AD	MCI-AD
MMSE	26.94 (2.51)	24.75 (1.83)	26.14 (2.85)	22.00 (2.00)
MoCa	21.41 (3.81)	17.25 (2.60)	20.43 (3.65)	
Clock Test				14.13 (2.95)
Copy	9.38 (1.15)	8.75 (2.12)	9.93 (0.27)	
Order	9.35 (1.37)	8.50 (1.69)	8.93 (1.69)	
Total	18.74 (1.90)	17.25 (3.33)	17.43 (5.33)	7.94 (2.48)
CERAD				7.00 (1.93)
Word list	12.65 (4.29)	11.00 (1.93)	11.93 (5.21)	14.94 (2.34)
Word list delayed recall	2.18 (2.16)	0.50 (0.53)	1.57 (2.62)	
Word list recognition	7.35 (2.76)	7.00 (2.45)	7.43 (2.62)	
Boston naming test	11.71 (2.11)	11.13 (1.96)	11.14 (2.03)	7.38 (1.60)
Famous faces	11.94 (4.52)	8.38 (2.97)	10.21 (5.65)	0.38 (0.74)
				6.38 (3.25)
				8.75 (4.13)
				4.38 (3.16)

SD standard deviation. *MCI-non-AD* mild cognitive impairment which did not convert to AD 2 years later. *MCI-AD* MCI which converted to AD 2 years later. *MMSE* Mini Mental State Examination. *MoCA* Montreal Cognitive Assessment. *CERAD* Consortium to Establish a Registry for Alzheimer's Disease

Table 4 Famous Faces Test data

	Naming score mean (SD)	Identification score mean (SD)	Tip of the Tongue Mean (SD)
MCI-non-AD	11.94 (4.52)	9.24 (4.75)	0.94 (1.43)
MCI-AD	8.38 (2.97)	12.63 (2.72)	1 (1.85)
MCI-non-AD follow-up	10.21 (5.65)	10.79 (5.45)	0.21 (0.80)
MCI-AD follow-up	4.38 (3.16)	17.63 (3.16)	0.00 (0.00)

MCI mild cognitive impairment which did not convert to AD 2 years later. *MCI-AD* MCI which converted to AD 2 years later; *SD* standard deviation

Results

Data analysis

Statistical analyses were conducted using a statistical software package (SPPS 22, SPSS Inc., Chicago, Ill., USA).

The MCI-non-AD and MCI-AD were compared on each neuropsychological variable using separate Mann–Whitney *U* tests. Due to the small sample sizes, effect sizes were also calculated for each analysis using Cohen's *d* effect sizes. The same statistical analysis was conducted for the Famous Faces Naming Test.

Results

MCI-AD performed significantly worse on MMSE (Mann–Whitney $U = 34.50$, $p = 0.049$, $d = 0.45$), MoCA (Mann–Whitney $U = 25.00$, $p = 0.011$, $d = 0.54$) and Famous Faces Naming Test (Mann–Whitney $U = 34.00$, $p = 0.049$, $d = 0.42$) than did MCI-non-AD. According to Cohen [32], an effect size of 0.5 is medium, 0.8 is large and 0.2 is small. Medium to small effect sizes were found for MMSE ($d = 0.45$), MoCA ($d = 0.54$) and Famous Faces Naming Test ($d = 0.42$) (see Table 5).

In the naming task, there was a significant difference in the scores for MCI-non-AD and MCI-AD groups (Mann–Whitney $U = 34.00$, $p = 0.049$, $d = 0.42$). Neither in the identification task (Mann–Whitney $U = 38.50$, $p = 0.086$, $d =$—0.42) nor in the TOT phenomenon (Mann–Whitney $U = 65$, $p = 0.887$, $d =$—0.02) there was a significant difference between the two groups (see Table 6) and the *p* values were also not significant. Anyway, it is worth mentioning that the identification score was better for MCI-AD than for MCI-non-AD.

Table 5 MCI-non-AD vs MCI-AD scores on neuropsychological battery

	U	*Z*	*P*	Effect size (Cohen's *d*)
MMSE*	34.50	− 1.971	0.049	0.45
MoCa*	25.00	− 2.516	0.011	0.54
Clock test				
Copy	62.50	− 0.373	.745	0.18
Order	47.50	− 1.446	.238	0.27
Total	50.50	− 1.084	.315	0.26
CERAD				
Word List	48.00	− 1.210	0.262	0.24
Word list delayed recall	36.00	− 1.933	0.066	0.47
Word list recognition	57.50	− 0.621	0.549	0.07
Boston naming test	55.50	− 0.737	0.475	0.14
Famous faces*	34.00	− 1.989	0.049	0.42

MCI-non-AD mild cognitive impairment which did not convert to AD 2 years later; MCI-AD MCI which converted to AD 2 years later

MMSE Mini Mental State Examination; *MoCA* Montreal Cognitive Assessment; *CERAD* Consortium to Establish a Registry for Alzheimer's Disease

*$p < 0.05$

Discussion

Growing evidence suggests that the cognitive deficits in early AD are not limited to episodic memory, with a number of studies showing semantic memory deficits, especially for knowledge of people.

Proper names are more difficult to retrieve than common nouns because of the weak and arbitrary links between a proper noun and its reference [21–23, 33]. This is consistent with previous studies where MCI patients performed significantly worse than the control group on Boston Naming Test and on Famous Faces Naming Test [34]**.** Anomia and TOT phenomenon are common in very early stages of Alzheimer's disease due to the deterioration of the semantic processing and circumlocutions—descriptions—are used as compensation strategy [35]. In this line, we have found that MCI-AD patients named less

Table 6 MCI-non-AD vs MCI-AD scores on famous faces task

	U	Z	*p*	Effect size (Cohen's d)
Naming score*	34.00	− 1.989	0.049	0.42
Identification score	38.50	− 1.728	0.086	− 0.40
TOT	65.00	− 0.211	0.887	− 0.02

*$p < 0.05$

and describe more items than the MCI-non-AD patients. Nevertheless, Thompson et al. [17] also suggested that patients with MCI-non-AD show a selective loss of personal knowledge in a very early stage and consider that this loss might be a predictor of progression to AD**.** In this line, a more recent study reported that MCI patients who converted to AD 2 years later performed significantly worse on a famous face recognition task compared to MCI patients who did not convert over that period [33]**.** Our study supports those findings and demonstrated once again that memory impairment of famous faces is common in mild AD and may exist prior to the clinical diagnosis. The results imply that assessment of semantic memory is relevant in the evaluation of patients with suspected AD.

The notion that a semantic deficit together with the hallmark episodic deficit may categorize MCI merits to further study. However, we do not mean to suggest that semantic difficulties are specific. Instead, we confirm early semantic impairment and suggest semantic impairment as a point of emphasis in clinical testing, where the majority of clinical tests emphasize episodic memory [12, 14, 17]. With this regard, we have found statistically significant differences between MCI-non-AD and MCI-AD in the Famous Faces Naming Test—a measure of remote semantic memory—but not in the World List subtest of the CERAD—a measure of remote episodic memory—, suggesting that the semantic memory impairment could even precede episodic memory impairment [36]. These results imply that assessment of semantic functions should be central in the neuropsychological testing of suspected AD. Such tests can easily be implemented in everyday clinical practice.

In the future, it would be interesting to follow up performance on the different neuropsychological tests to map the progression of MCI patients who convert to AD and those who remain stable or revert to normal functioning. Further comparisons between MCI patients and other organic, as well as non-organic, patient groups with memory disorders are also required to establish the selectivity of these measures to early AD. Also, a further study might look into using the tests in conjunction with imaging and biomarkers to help consolidate research into the structure and to improve the accuracy of identifying cases of MCI.

The identification of persons at risk of developing Alzheimer's disease is of major economic importance, especially if preventive strategies or therapeutic actions are to be developed.

The present study has some limitations in terms of methodological approaches. First, the experiment for naming famous people in this study is not standardized, so there is insufficient data for comparison along with restrictions from the viewpoint of reliability and feasibility. Second, as the sample size is relatively small, the findings reported here could not be significantly generalized. Therefore, further research is needed to secure the reliability and feasibility of an experiment task.

Funding This work has been supported by the FC-15-GRUPIN14-021 project from the Asturias Regional Government and the CTQ2014-58826-R project from the Spanish Ministry of Economy and Competitiveness (MINECO).

Compliance with ethical standards

Conflict of interests The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

Appendix

1. Felipe VI
2. Pablo Iglesias
3. Carmen Sevilla
4. Antonio Banderas
5. Belén Esteban
6. Isabel Preysler
7. Fernando Alonso
8. José María Aznar
9. Leticia Ortiz
10. Concha Velasco
11. Matías Prats
12. Mariano Rajoy
13. Ana Rosa Quintana
14. Lolita Flores
15. Raphael
16. Ramón García
17. Juan Carlos I
18. Esperanza Aguirre
19. Carmen Lomana
20. Francisco Álvarez Cascos
21. Sofía
22. Iker Casillas

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