

# ASSESSMENT OF PROCESSING SPEED AND EXECUTIVE FUNCTIONS PERFORMANCE WHEN DISCRIMINATING BETWEEN MILD COGNITIVE IMPAIRMENT AND DEMENTIA STATES



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## Introduction

The progressive ageing of population, especially relevant in the last years, will keep going on and the number of elderly will become very considerable in the next decades. This situation makes necessary the approach and the design of methods to assess early cognitive impairment (Bruna, 2006). Actually there exists an increasing demand in relation to the neuropsychological explorations in the beginning stages of cognitive impairment due to the highest sensitization of general population to the cognitive and behavioral changes related to ageing such as mild cognitive impairment (MCI) and dementias. Identify the initial cognitive changes in very mild cognitive impairment can allow implementing precociously more effective programs of intervention, as for memory, prevention and treatment, that may allow a better evolution of the patient as well as also improve his quality of life (Kurz, Pohl, Ramsenthaler, & Sorg, 2009).

Among the principal changes related to ageing and cognitive impairment, the most worrying tend to be those linked to emotional experience and behavior. Neurodegeneration is the most common cause of neuropsychological impairment in adults and, within this, Alzheimer's disease (AD) is the prime example (Woods & Clare, 2008). In cognitive impairment, some functions tend to stay whereas others do tend to decline progressively (Junqué & Barroso, 2001).

**Executive functions** can be conceptualized as having four components: volition, planning, purposive action and effective performance; each of it necessary for an appropriate, responsible and effectively adult conduct (Lezak, Howieson, & Loring, 2004). In early stages of cognitive impairment, practical reasoning and problem resolution tend to be preserved whereas more complex issues as logical analysis and organization of abstract structures tend to be damaged (Claver, 2006). In the beginning stages of AD deficits in executive functions related to use of information, formation of new concepts and problem resolution have been described (Salmon & Bondi, 2009). **Memory impairment** associated both, to ageing and to cognitive impairment, has been broadly described in the scientific literature (Bäckman & Small, 2007; Petersen, 2004; Tirapu, Rios & Maestú, 2008). The 'uncertain' area between 'normal' ageing and dementia has attracted a great number of attempts to define diagnostic categories. These still remain controversial although the use of the MCI category in particular is increasing. There exists a great dial of variation in the impact of ageing on memory functioning within the general population, so it is hard to set out a general profile of cognitive impairment in MCI and AD. In this way, an alternative technique to assess memory is exploring processing speed. This kind of tests use time instead of content in order to evaluate reaction time when a concrete stimulus is given. This methods have demonstrated high sensibility even to small changes in perceptual and cognitive speed and have also confirmed their utility when assessing disorders related to executive functions or parieto-temporal disorders among others (Wiig, Nielsen, Minthon, & Warkentin, 2002).

In everyday clinical practice, cognitive impairment is usually assessed with neuropsychological batteries to demonstrate decline in cognitive functions in order to distinguish between MCI and dementia states. However, sometimes these assessments take too much time and are not enough sensitive. In the present study processing speed and executive functions were evaluated to determine the effectiveness to discriminate between patients with MCI from those with diagnosis of dementia.

## Participants and Methods

Executive functions and perceptual and cognitive speed were evaluated in 86 cognitive impaired outpatients with MCI or dementia. A control group composed by 25 normal subjects was also assessed. All patients were classified into groups according to Petersens MCI criteria (MCI Group) or DSM-IV-TR and NINDS-ADRDA criteria for dementia (Alzheimer's disease/Vascular disease). Executive functions assessment included tests to evaluate verbal fluency (FAS), Similarities and Digit Backwards (WAIS) and Rhythms (Lurias Neuropsychological Assessment). Perceptual and cognitive speed was assessed with the A Quick Test of Cognitive Speed (AQT). Mini-Mental State Examination (MMSE) was also administered as a criterion to evaluate general impairment. The main information about the participants is summed up in table 1.

## Results

To assess if the AQT and the other tests were enough sensitive among the different groups an One-Way ANOVA was made. The results determined that existed highly differences ( $p=0.000$ ) between the different tests. Games-Howell *post hoc* test concluded that, although executive functions measures could discriminate quite sensitively between MCI and Dementia groups ( $F=4.860$ ;  $p<.05$ ), perceptual and cognitive speed measures were remarkably more sensitive to these changes ( $F=18.571$ ;  $p<.001$ ). The results can be compared in table 2 and partially seen in figure 1.

ANOVA (F)	MCI vs. AD	MCI vs. VD/MD
MMSE	7,976***	9,705***
Digit Backwards	1,04*	1,177**
Similarities	3,128**	ns
Rhythms	ns	4,860*
AQT - Color 1	-18,571***	ns
AQT - Form	-35,717***	-22,55552*
AQT - Color-Form	-39,706*	ns
AQT - Color 2	-13,363***	-9,802**
AQT - Number	-14,620*	ns
AQT - Color-Number	-42,063*	-25,454*

Table 2. Differences between MCI Groups and Dementia Groups  
\*  $p < 0,05$  MCI = Mild Cognitive Impairment  
\*\*  $p < 0,01$  AD = Alzheimer's Disease  
\*\*\*  $p < 0,001$  VD = Vascular Dementia  
ns = non significant MD = Mixed Dementia

Diagnostic Groups (n=86)	Normal ageing (n=25)		MCI*		AD**		VD/MD***	
	Men	Women	Men	Women	Men	Women	Men	Women
Gender (%)	47,6	52,4	40,9	59,1	52,2	47,8	55,0	45,0
Age (yr.)	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	69,52	9,532	79,68	8,026	81,00	6,339	82,30	6,225
Manual-Preference (%)								
Right Handed		76,2		84,7		100,0		100,0
Left Handed		9,5		5,3		--		--
Ambidextrous		14,3		--		--		--
Clinical Data	Mean	SD	Mean	SD	Mean	SD	Mean	SD
MMSE	29,67	,483	26,45	,963	18,48	5,607	16,75	6,769

Table 1. Data of the 86 cognitive impaired outpatients with MCI or dementia and from the Control Group.  
\* MCI = Mild cognitive impairment // \*\* AD = Alzheimer's Disease // \*\*\* VD/MD = Vascular Dementia or Mixed Dementia  
SD = Standard Deviation

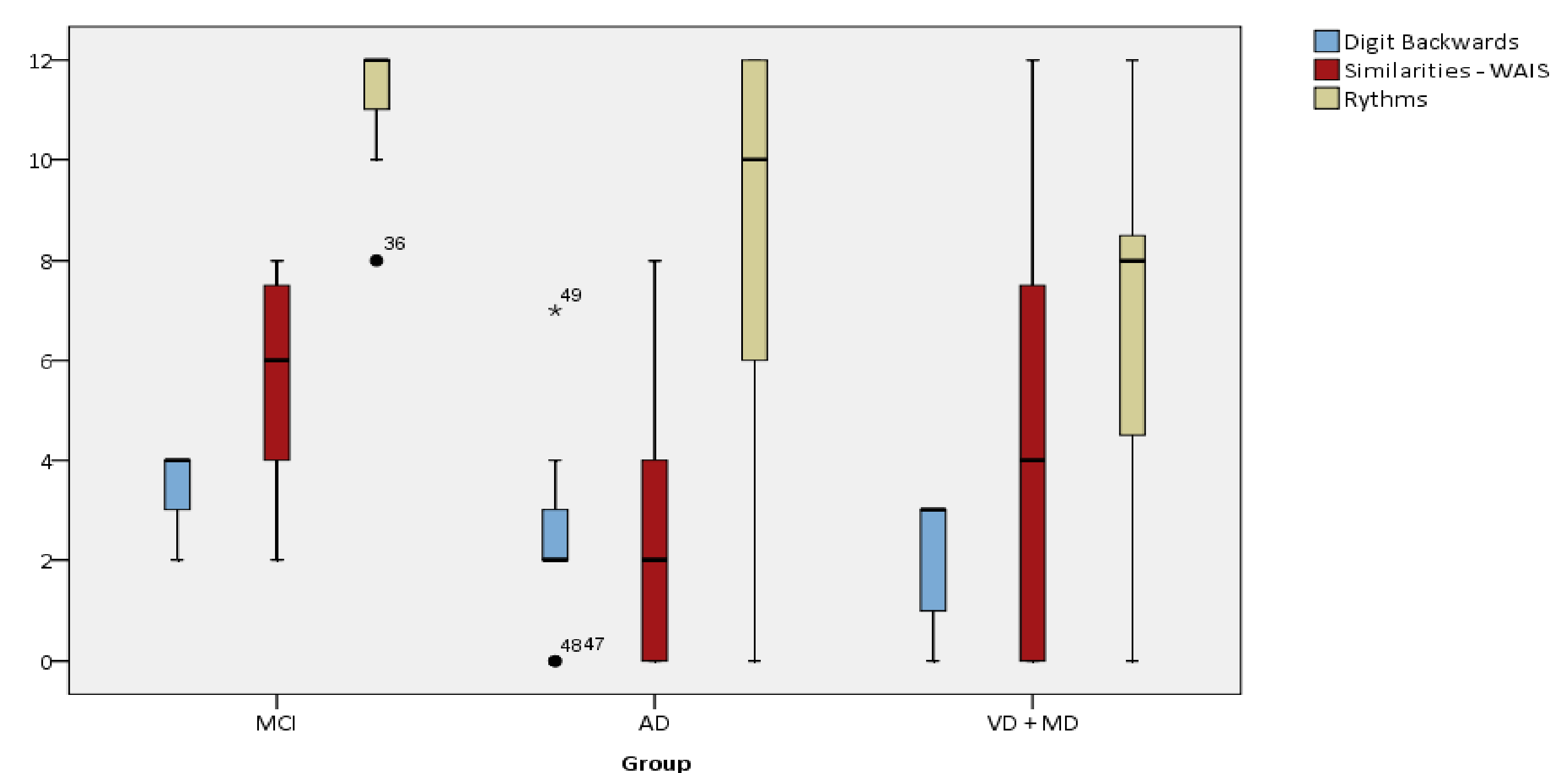


Figure 1. Visual comparison of significant differences among executive functions results when assessing MCI and dementia groups.

## Discussion

According to the results above showed, we can bring to a close that generally the punctuations obtained are lower as higher is the cognitive impairment from the subjects. This result agrees with previous studies in which the same assessment instruments have been used (Strauss, Sherman & Spreen, 2006; Subirana, Bruna, Puyuelo & Virgili, 2009). The *post hoc* test proved that both the AQT and the tests that assessed executive functions were highly sensitive when discriminating between patients with mild cognitive impairment and Alzheimer's disease, Vascular dementia or Mixed dementia.

In the case of the AQT which assessed for processing speed, this results coincide with the same obtained for the author of the test (Wiig et al., 2002). In a general way the pattern of punctuations obtained in each subgroup shows an outline of impairment for this test: the time necessary to respond to each subtests raises as higher the cognitive impairment is, except for those patients with VD or MD whose times are a little lower than those from the patients with AD. From the administered tests and from the punctuations obtained, we can also set up a pattern of cognitive impairment; the tests that evaluated executive functions such as Rhythms, Similarities or Digit Backwards show similar punctuations among groups: less punctuation as more impairment. The profile of the patient with cognitive impairment shows, in a general way, memory impairment [mainly episodic one], a little decline of the intellectual capacity with impairment of executive functions, lessening in verbal fluency among others. Our results chase the same patterns.

The results of the present study stand that tests measuring perceptual and cognitive speed and executive function should be used for first-line or complementary screening for progressive cognitive impairment.