

# ASSESSMENT OF PROCESSING SPEED AND EXECUTIVE FUNCTIONS PERFORMANCE WHEN DISCRIMINATING AMONG MCI, AD AND VaD

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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).

**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). 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 (Wig, Nielsen, Minthon, & Warkentin, 2002). Processing speed tests can provide sensitive and objective timed-measures of cognition such as reaction time, executive functions and automacity in responding. Tests of processing speed provide measure on a continuous time scale and performance does not depend on prior education.

## 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 Petersen's 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 (Luria's 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.

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		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
	29,67	4,83	26,45	3,963	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

## 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.

ANOVA (F)	MCI vs. AD	MCI vs. VD/MD	
MMSE	7,976***	9,705***	Executive functions
Digit Backwards	1,04*	1,177**	
Similarities	3,128**	ns	Processing speed
Rhythms	ns	4,860*	
AQT - Color 1	-18,571***	ns	
AQT - Form	-35,717**	-22,5552*	
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

## 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.

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.

