

# Working memory and phonological short-term memory in Alzheimer's disease

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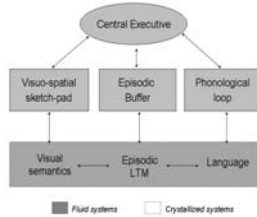
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## Introduction

In the last few years, the nature of neuropsychological deficits in Alzheimer's Disease (AD) has been intensely researched. The influence of Alzheimer's disease on working memory and short-term memory has been a research topic of increasing interest. There have been a few investigations of working memory in AD, which reported more difficulties in verbal fluency test (e.g. Martin & Fedio 1983; Martin et al. 1985; Tröster et al. 1989; Diaz et al. 2004; Astell et al. 2006; Marcziński & Kertész 2006), working memory and speech tempo (Hoffmann et al. 2009) and the process of auditory verbal working memory (Karrasch et al. 2006).



The main purpose of this research is to study working memory and phonological short-term memory in different stages of Alzheimer's Disease compared to age-matched healthy controls. We would like to map the neuropsychological profile of the participants. We used Baddeley's working memory model (2003).

## Participants and Method

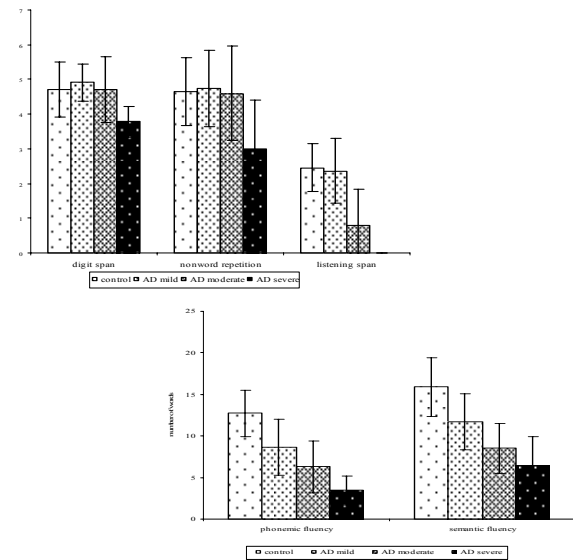
	MMSE			Age			Education		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
AD early/mild (n = 11)	24.5	1.43	23-27	75.9	7.1	62-85	11.9	3.65	8-17
AD moderate (n = 10)	19.7	1.56	18-22	76.4	6.6	58-83	11.5	3.95	8-17
AD severe (n = 9)	14.8	2.12	11-17	75.2	4.6	65-79	7.4	1.94	8-11
Control (n = 20)	29.2	0.69	28-30	73.6	8.4	56-84	10.9	3.28	8-17

In total, 50 participants participated in this study. AD persons (n=30) were sub-grouped according to the severity of the dementia syndrome: they were mildly to moderately demented as gauged by Mini Mental State Examination (Folstein et al. 1975; Addenbrook Cognitive Examination, Dudas et al. 2005). All AD participants met the DSM-IV and ICD-10 criteria for probable Alzheimer's Disease (American Psychiatric Association, 2000).

The following neuropsychological tests were used to map the verbal working memory of native Hungarian speaking participants: digit span (phonological loop), nonword repetition (phonological loop), listening span (complex working memory) and verbal fluency (phonemic and semantic).

## Results

The results of the verbal working memory tasks revealed that the AD persons performance in the listening span tasks (mild 2,36, moderate 0,80, severe 0,00 vs. 2,45±0,68), phonemic fluency (mild 8,63, moderate 6,30, severe 3,44 vs. 1,75±2,78) and semantic fluency (mild 11,72, moderate 8,50, severe 6,40 vs. 15,9±3,55) was lower than in the controls, while in the nonword repetition task (mild 4,72, moderate 4,6, severe 3,00 vs. 4,65±0,98) and in the digit span task (mild 4,90, moderate 4,70, severe 3,77 vs. 4,7±0,8) mild AD and moderate AD was close to that of the controls.



Tests	Mild AD (n=11)			Moderate AD (n=10)			Severe AD (n=9)			Control (n=20)		
	M	SD	R	M	SD	R	M	SD	R	M	SD	R
Digit span (9)	4,9	0,53	4-6	4,7	0,94	3-6	3,77	0,44	3-4	4,7	0,8	4-6
Nonword repetition (9)	4,72	0,70	3-7	4,6	1,34	3-7	3,00	1,41	0-5	4,65	0,98	3-7
Listening span (8)	2,36	0,92	0-3	0,8	1,03	0-2	0,00	0,00	0	2,45	0,68	2-3
Phonemic fluency [s]	8,63	3,41	5-15	6,3	3,12	2-11	3,44	1,74	0-6	12,75	2,78	9-20
Semantic fluency animal	11,72	3,34	7-17	8,5	2,99	4-13	6,40	3,43	2-12	15,9	3,55	11-25

## Conclusions

- Verbal working memory has been differently impaired in the different stages of Alzheimer's Disease.
- The results show impaired verbal working memory from the moderate stages of Alzheimer's disease.
- The phonological short-term memory measured by non-word repetition and digit span tasks is intact in the mild and moderate stages of the disease.
- The verbal fluency showed significant impairment from the mild stages of Alzheimer's disease.
- Central executive is decreased from the early stage of the disease.
- The capacity of the semantic memory is decreased from the mild stage of Alzheimer's Disease – there are disturbances in the connection between episodic long-term memory and language.

	Significant difference	Tendency difference	No significant difference
ADmild-NC	phonemic&semantic fluency		digit span nonword repetition listening span
ADmild-ADmoderate	listening span semantic fluency	phonemic fluency	digit span nonword repetition
ADmild-ADsevere	digit span nonword repetition listening span phonemic&semantic fluency		
ADmoderate-NC	listening span phonemic&semantic fluency		digit span nonword repetition
ADmoderate-ADsevere	digit span nonword repetition listening span phonemic fluency		semantic fluency
ADsevere-NC	digit span nonword repetition listening span phonemic&semantic fluency		

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