

# Neuropsychological Predictors of Everyday Memory and Everyday Functioning in Patients With Mild Alzheimer's Disease

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## ABSTRACT

The contributions of executive function, naming, visuoception, and delayed recall to everyday memory abilities and everyday living activities were examined in a sample ( $n = 24$ ) of mildly impaired Alzheimer's disease (AD) patients. Everyday memory was rated independently by the patient and by a caregiver, and everyday functioning was rated by a caregiver. For patient-rated everyday memory, verbal recall accounted for 23% of the variance, while naming performance alone accounted for 56% of the variance in caregiver-rated everyday memory. Executive function was a unique and significant predictor of caregiver-rated functional daily living skills, accounting for 40% of the variance. Clinician's ratings of patient unawareness of deficit correlated with the discrepancy between caregiver and patient rating of memory. Caregiver reports of memory impairment appear to be influenced by naming abilities, indicating that language dysfunction may be misinterpreted as reflecting memory impairment. Helping caregivers distinguish between these two abilities may result in more accurate reporting of patients' impairments. (*J Geriatr Psychiatry Neurol* 2003; 16:84–89)

**Keywords:** dementia; Alzheimer's disease; everyday functioning; memory

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Ratings of everyday memory abilities and everyday functioning are routinely gathered about Alzheimer's disease (AD) patients. These ratings help clinicians and researchers measure the impact of AD on the everyday activities of patients in contexts that are difficult to simulate in the laboratory or clinical setting. This is crucial in the diagnosis of dementia, which requires impairment both in cognition and in everyday function, as well as in assessing the practical impact of dementia on patients and their families. Ratings of everyday abilities are typically gathered from caregivers because of concerns that patients' cognitive impairments and lack of insight might interfere with self-reports.

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Caregivers are generally regarded as accurate sources of information about patients. For example, caregivers of dementia patients have been found to provide valid and reliable data about patients' memory and functional abilities.<sup>1-4</sup> Although caregivers may overestimate or underestimate functional abilities relative to performance-based measures,<sup>5,6</sup> they have been found to be significantly more accurate raters of functioning than patients themselves, who may overestimate their abilities.<sup>7</sup> Relative to caregiver reports, dementia patients also often overreport memory abilities.<sup>8-10</sup> For example, in a study by Ott and colleagues,<sup>11</sup> AD patients reported a similar number of memory complaints as normal controls did, while their caregivers reported significantly more memory problems in the same patients. AD patients also endorsed more items than their caregivers did, suggesting flawless memory. Caregiver reports, but not patient reports, correlated significantly with performance on a neuropsychological measure of verbal learning and memory.

Thus, there is converging evidence that caregiver reports of dementia patients' memory and functional abilities are more valid than are self-reports. Self-reports from patients vary widely, but in general, they appear to significantly underreport memory and functional problems. It is possible that caregiver and patient perceptions

of patients' abilities could be influenced by different factors and that these factors affect the validity of the ratings.

Very little is known about the relationships between neuropsychological functioning and reports of everyday adaptive functioning from caregivers and patients. Better understanding of the factors that contribute to patient and caregiver ratings may help to clarify important differences between the 2 sources of data. It is important to understand factors that influence ratings from caregivers and AD patients because, as mentioned previously, these ratings are routinely gathered for clinical, diagnostic, and research purposes. For example, caregiver ratings of memory are important outcome measures for clinical trials for dementia and are often used to measure impairment in clinical evaluations of patients. In addition, previous studies have not examined how nonmemory abilities (e.g., executive functions) might influence patient and caregiver ratings.

The purpose of the current study was to investigate the influence of different neuropsychological measures on caregiver and AD patient ratings of everyday memory abilities. The cognitive domains that were investigated were memory, executive functions, language, and visuospatial judgment. The contribution of these cognitive abilities to caregiver reports of performance on everyday activities of daily living (ADLs) also was investigated, to determine if different cognitive abilities are differentially associated with caregiver reports of memory and functional impairments. Based on previous findings,<sup>10,12</sup> we predicted that measures of delayed recall would best predict everyday memory abilities, as rated by both caregivers and patients, and that executive functioning would best predict performance on functional activities of daily living.<sup>13,14</sup> Measures of language and visuospatial functioning were not expected to significantly predict performance on the everyday memory and functioning measures.

## METHODS

### Subjects

Twenty-four individuals (14 women, 10 men) participated in this study. Subjects were referred from a university-based Alzheimer's disease and memory disorder clinic and were recruited to participate in a memory-training study.<sup>15</sup> Data collected at the baseline assessment, prior to the memory-training intervention, were used in the current study. All subjects were diagnosed with probable AD by a senior staff neurologist according to the criteria developed by the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association.<sup>16</sup> Other possible causes of dementia were ruled out through extensive medical and laboratory testing and neuroimaging studies. Subjects had a mean age of 75.3 ( $\pm$ 7.1) years and a mean educational level of 13.1 ( $\pm$ 3.0) years. The mean Mini-Mental State Examination (MMSE)<sup>17</sup> score of the subjects was 24.2 ( $\pm$ 2.0).

### Materials

As part of the baseline neuropsychological assessment, all subjects completed a short battery of tests. The following tests were selected so as to broadly represent 4 domains of cognitive functioning: memory, executive function, language, and visuospatial function.

**Hopkins Verbal Learning Test-Revised (HVLT-R).**<sup>18</sup> Subjects were administered version 1 of this test. The primary outcome measure of interest was the total number of words recalled after the 20-minute delay.

**Controlled Oral Word Association Test (COWAT).**<sup>19</sup> In this test, subjects orally generated words beginning with the letters F, A, and S in 1-minute periods. The total score was the sum of the number of words generated across the 3 trials.

**Boston Naming Test (BNT).**<sup>20</sup> A shortened version of the BNT (30 items, odd numbered) was administered.

**Judgment of Line Orientation.**<sup>21</sup> Visuospatial reasoning was assessed by asking the subjects to match angled line pairs to 11 numbered radii forming a semicircle. Form H was administered, and subjects completed odd-numbered items.

In addition to the neuropsychological tests given to the subject at the baseline assessment, the patient's primary caregiver was asked to complete the following questionnaires.

**Everyday Memory Functioning.** The Everyday Memory Questionnaire<sup>22</sup> was completed by the caregiver (EMQ-C) and by the subject (EMQ-S). This questionnaire rates the frequency of memory failures on a number of functional domains. Thirty-five items are rated on a scale ranging from 0 (never) to 5 (several times in a day), resulting in a score ranging from 0 to 175, with higher scores reflecting greater impairment.

**Activities of Daily Living (ADL) Questionnaire.** A modified version of the Instrumental Activities of Daily Living and Physical Self-Maintenance Scale<sup>23</sup> was administered as a caregiver rating of functional abilities. This questionnaire addresses 6 physical or "basic" activities of daily living, such as dressing, grooming, and toileting (maximum score = 12), and 8 instrumental activities of daily living, such as medication administration, financial management, and use of transportation (maximum score = 16). Each of the 14 activities was scored on a 3-point scale, reflecting independence (2 points), need for assistance (1 point), or dependence (0 points). Higher scores reflect better functioning.

Finally, because patient insight has been shown to impact ratings of memory functioning,<sup>8,10</sup> we sought to examine the relationship between level of insight and

**Table 1. Performance of the AD Patients on Neuropsychological Tests**

Test	M	SD	Range
Hopkins Verbal Learning Test-Revised recall	1.2	2.4	0-10
Boston Naming Test	20.3	6.1	7-29
Controlled Oral Word Association Test	26.3	6.3	15-38
Judgment of Line Orientation	8.2	3.3	1-15

everyday memory. Eighteen of the 24 subjects (75%) had Clinical Insight Ratings (CIR). The CIR is a 4-item scale in which awareness of situation, memory deficit, functional deficits, and disease progression are each rated by a clinician on a 3-point scale (0 to 2) to yield scores ranging from 0 (fully aware) to 8 (totally unaware). This scale was administered by a senior staff neurologist during an interview with the patient and caregiver. The CIR has demonstrated high interrater reliability ( $r = 0.91$ ) and good internal consistency (Cronbach's alpha = 0.85).<sup>24</sup> The scale has been used in several previous studies of insight in AD.<sup>10,11,25</sup>

**RESULTS**

**Neuropsychological and Functional Measures**

Neuropsychological test scores are presented in Table 1. On the EMQ-C, the patients earned a mean score of 62.67 (range, 29-132). When rated by the patient, the mean score was 50.79 (range, 9-109). A paired *t* test revealed no significant difference between the EMQ-C and the EMQ-S,  $t(23) = -1.7, P = .11$ . The correlation between the EMQ-C and EMQ-S was nonsignificant ( $r = 0.28, P = .18$ ). The mean score of the AD subjects on the ADL measure was 19.21 (range, 6-26) out of a possible 28 points.

**Correlational Analyses**

Pearson product-moment correlations (2-tailed) between the neuropsychological and everyday functioning measures are presented in Table 2. The EMQ-C correlated significantly with BNT but with no other neuropsychological measure. The EMQ-S correlated significantly with HVLTR delayed recall but not with any other neuropsychological measures. The ADL measure correlated significantly with COWAT but with no other neuropsychological measures. To determine if there was any multicollinearity between the neuropsychological measures, bivariate correlations among the neuropsychological measures were also examined with Pearson correlations (2-tailed). These analyses (Table 2) revealed that none of the neuropsychological measures correlated significantly with any other neuropsychological measure in this study (all *P*s > .05).

**Regression Analyses**

To address the first hypothesis, that delayed recall performance would best predict ratings on the EMQ, 2 separate stepwise regressions were conducted. The first

**Table 2. Correlation Matrix Displaying the Bivariate Relationships Between the Neuropsychological and Everyday Functioning Measures**

Measure	Neuropsychological Measure			
	COWAT	BNT	HVLTR	Judgment of Line Orientation
Lawton and Brody Activities of Daily Living Questionnaire	0.64**	0.36	0.21	-0.01
Caregiver-rated Everyday Memory Questionnaire	-0.30	-0.76**	-0.34	-0.02
Subject-rated Everyday Memory Questionnaire	0.14	-0.30	-0.48*	0.09
Controlled Oral Word Association Test (COWAT)		0.21	0.00	0.09
Boston Naming Test (BNT)			0.38	-0.12
Hopkins Verbal Learning Test-Revised (HVLTR)				-0.18

examined the proportion of variance accounted for by the neuropsychological measures in EMQ-C scores. The second regression examined the proportion of variance accounted for by the neuropsychological measures in EMQ-S scores. For the EMQ-C, BNT entered the regression model at step 1, accounting for 56% of the variance ( $P < .0001$ ). No other neuropsychological measures entered the equation. The second multiple regression revealed that HVLTR delayed recall was a significant predictor of EMQ-S, accounting for 23% of the variance in this measure ( $P < .05$ ). No other measures entered the regression model.

To address our second hypothesis, that executive function would account for a greater proportion of variance in ADLs than other measures of cognitive functioning, a stepwise multiple regression analysis was conducted, with the ADL measure as the dependent variable and the 4 neuropsychological measures entered as independent variables. COWAT entered the equation at step 1, accounting for 41% of the variance in ADLs ( $P = .001$ ). No additional measures entered the regression model.

**Insight Ratings**

To investigate possible sources of discrepancy between the caregiver and subject-reported EMQ scores, an additional analysis was conducted to examine the association between insight and discrepancies between EMQ reports. We evaluated the relationship between subjects' insight and the discrepancy between EMQ-C and EMQ-S scores. In the current study, the mean CIR score for the sample was 2.78 ( $\pm 2.4$ ). An EMQ difference (EMQ-D) score was calculated by subtracting the EMQ-S score from EMQ-C score. A higher score thus indicates that the caregiver reported greater memory problems than the subject. The mean EMQ-D score was 12.3 ( $\pm 34.0$ ), suggesting that on average, caregivers rated the subject as having more memory problems than the subject did. Correlational analyses revealed that high scores on the CIR (lack of awareness)

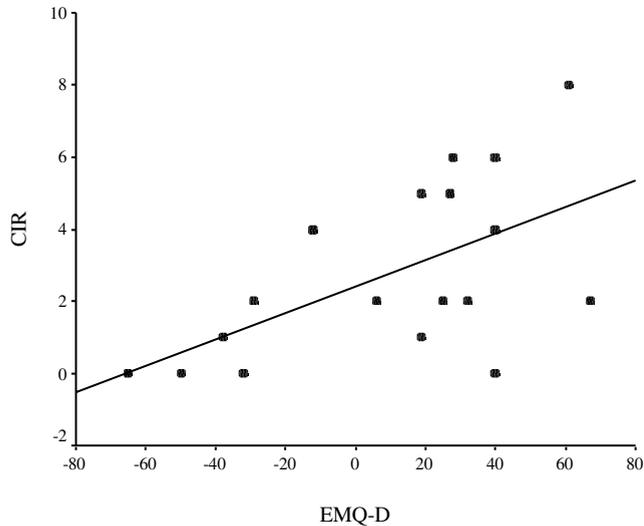


Figure 1. Correlation between the Clinical Insight Rating (CIR) and Everyday Memory Questionnaire Difference Score (EMQ-D) ( $r = 0.58$ ,  $P = .012$ ).

correlated significantly with the EMQ-D score ( $r = 0.58$ ,  $P < .05$ ). This relationship is depicted in Figure 1. There was no significant correlation between the CIR and either the EMQ-C or EMQ-S scores. The CIR did not correlate significantly with any neuropsychological measure or with ADLs.

## DISCUSSION

Caregiver and patient reports of everyday abilities are important sources of information gathered in the assessment and diagnosis of dementia. Understanding the factors that influence an individual's rating of such abilities has important implications for research studies that depend on caregiver reports of functional skills as outcome measures. Few studies have examined the relative influence that patients' cognitive abilities have on these reported skills. The results of this study suggest that evaluation of everyday abilities by the patient or by a caregiver may be influenced by patient deficits on representative cognitive tasks. The EMQ-C and EMQ-S scores did not correlate significantly with one another. Furthermore, correlational and regression analyses revealed that the neuropsychological functions that influence the EMQ score are different. In particular, caregivers appeared to be more influenced by language or word-finding difficulties than by actual memory deficits, as seen in the strong relationship between the BNT score and the EMQ. Indeed, the caregiver-reported EMQ did not correlate significantly with any other neuropsychological measure, and BNT accounted for a substantial portion of variance in this measure. In contrast, patient-reported EMQ scores did appear to be more affected by actual memory performance, as the EMQ score correlated significantly with the patients' performance on a verbal delayed-recall measure. This finding appears to stand in contrast to many previously-reported findings

showing that AD patients have diminished insight into their deficits, even in the early stage of the disease,<sup>26,27</sup> as well as to findings that caregivers are more reliable raters of a patient's behavior.<sup>7</sup>

There are several explanations for the discrepant findings on the EMQ measure. It may be that mildly impaired patients estimate more accurately their memory abilities than caregivers do, as their ratings appeared to be more influenced by actual memory performance than by other cognitive factors. However, numerous studies have shown that AD patients often underreport cognitive deficits.<sup>7-9,11</sup> Further support for the finding that the patients in this study made relatively accurate ratings of their memory abilities comes from examination of the subjects' insight into their deficits. These analyses revealed that patients with better insight were also more likely to rate their memory performance close to that of their caregiver. In a previous study, insight, as rated by the CIR, also was correlated significantly with discrepancies between self- and caregiver-rated memory in AD and between self- and caregiver-rated functioning in AD.<sup>10</sup> In contrast to the current findings, however, Ott and colleagues<sup>10,11</sup> reported that caregiver memory ratings were significantly correlated with memory performance but patient memory ratings were not associated with memory performance. A possible explanation for the different findings is that the mean MMSE score of the current sample (24.2) was somewhat higher than that reported in the Ott et al study (mean MMSE score = 21.1). Furthermore, the mean CIR rating in our sample was low, indicating relatively preserved insight, on average. The mean CIR rating was not reported by Ott et al so comparison to their sample is not possible.

In contrast to the AD subjects, the caregivers appeared to place more emphasis on a patient's word-finding difficulties than on actual memory performance when rating the patient's memory. It may be that caregivers mistake word-finding difficulties for memory or retrieval problems. It is also possible that memory impairments are attributed to normal aging by caregivers until additional cognitive impairments, such as word-finding difficulties, emerge. Finally, it is possible that the EMQ is heavily biased by language-based problems. There are in fact many items that do reflect word-finding problems, such as "Forgetting the names of common things or using the wrong names," and "Finding a word is 'on the tip of his tongue'." In the original validation study of the EMQ,<sup>22</sup> verbal memory, but not visual memory, tests correlated with the EMQ in a sample of long-term head-injured patients. Interestingly, vocabulary and semantic processing variables did not correlate with the EMQ, suggesting that the EMQ does not simply reflect semantic knowledge deficits but rather is related more strongly to measures of immediate and delayed recall.

The results of the ADL analyses are generally consistent with previous findings that deficits in functional

daily living skills, particularly instrumental ADLs, are strongly influenced by executive functioning.<sup>13,14,28</sup> Such a relationship has been reported both in neurological disorders<sup>14,29-31</sup> and in normal aging.<sup>13,28</sup> The current findings are similar to those reported in a normal, community-dwelling sample in which verbal fluency significantly predicted caregiver-rated ADLs.<sup>32</sup> Boyle and colleagues<sup>14</sup> have reported that the Initiation/Perseveration subtest of the Dementia Rating Scale, which is heavily weighted by a fluency task, also correlated significantly with ADLs in a sample of AD patients. Direct observation through a structured occupational therapy assessment of daily functioning in older adults has also shown to be strongly related to executive functioning.<sup>13</sup> There is thus considerable agreement across studies and across patient groups that executive functioning is an important predictor of functional disability.

The proportion of variance accounted for in functional status by the neuropsychological measures is similar in magnitude to what has been reported previously in the literature in different samples of healthy and neurologically impaired individuals.<sup>13,14,29</sup> While these studies all indicate that neuropsychological tests may play some role in predicting functional impairment, the relatively modest variance accounted for, albeit significant, suggests that there are other factors that may contribute additional information. While other variables such as demographic characteristics, health status, and neuropsychiatric impairment have also been examined as potential contributions to the prediction of functional status, their relationship to everyday functioning is inconsistent across studies.<sup>13,14,28,31</sup> Together, these studies demonstrate that further exploration into the predictors of functional impairment is needed.

There are a number of limitations to the current study that deserve mention. First, the generalizability of our findings is limited due to the small sample size and to the fact that all patients were enrolled in a Memory Disorder Clinic and had been recruited for a memory intervention study. Future studies, with larger and more representative samples are needed. In addition, some subjects had trouble completing the EMQ form independently and required some assistance from study personnel to adequately understand the test instructions. It is therefore possible that the patient-rated EMQ form is not the most reliable instrument for patients whose dementia interferes with their ability to adequately respond to items. Finally, formal assessment of mood functioning was not obtained for either patients or caregivers, so it is not possible to determine the effect that depression might have had on cognitive abilities or functional ratings in these patients.

In summary, the findings from this study reveal that several factors may influence caregivers' ratings of everyday abilities in AD patients. Researchers and clinicians need to be aware of such biases when everyday question-

naires are completed. Our findings indicate that caution must be taken in evaluating caregiver reports of everyday memory problems to ensure that word-finding and semantic knowledge deficits are not misreported as memory impairment. Performance-based evaluation of daily functioning may offer a less biased assessment of the patient,<sup>5,6</sup> however, the structure inherent in the assessment itself may reduce real-world demands on such skills as initiation and response generation.<sup>32</sup> The development of reliable and valid instruments for predicting everyday success in dementia patients is an important undertaking and has implications for the assessment, diagnosis, and treatment of patients with dementia. One recent study<sup>12</sup> showed that the Problems in Everyday Living test was a good predictor of ADLs in AD patients and could be used as a screening measure for identifying patients at risk for functional impairment. Such measures hold promise for helping health care providers identify those patients that require a higher level of care and for helping to implement interventions that may prolong independence.

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