

Does Memory Predict Decline in Activities of Daily Living in Older Adults with Alzheimer's Disease?

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Abstract

Neuropsychologists need to make accurate recommendations regarding cognitive and functional decline in individuals with Alzheimer's disease (AD). Since memory impairment is the hallmark of AD, this study examined whether auditory and visual memory could significantly predict deficits in self-care activities. Participants were older adults diagnosed with AD, who received a neuropsychological battery assessing their functional decline and memory. Immediate auditory memory was significantly correlated with reported declines in financial and medication management; none of the auditory memory measures were significantly correlated with reported declines in driving, dressing, grooming, or feeding abilities. The Rey Complex Figure Test (RCFT) was significantly correlated with reported declines in financial management, and the RCFT and immediate visual memory were significantly correlated with reported declines in medication management. The RCFT and delayed visual memory were significantly correlated with reported declines in driving and dressing abilities. None of the visual-spatial measures were significantly correlated with reported declines in grooming or feeding. Measures of memory were found to be more effective in predicting declines in reported Instrumental Activities of Daily Living (IADLS) than basic Activities of Daily Living (ADLS).

Introduction

The ability of neuropsychological tests, specifically memory, to predict daily self-care skills remains an important and under-researched area of study, especially since neuropsychologists are often asked to make predictions and recommendations regarding older adults' abilities to care for themselves. The older adult population is one of the most rapidly growing age-groups in the United States. As people age, their risk for developing AD drastically increases, with about 10% of the population 65 and older being diagnosed with some form of dementia (Mahurin, DeBettignies, & Pirozzolo, 1991). This increase in the prevalence of AD will make the accuracy of diagnosis and recommendations after diagnosis even more important.

AD is a progressive neurodegenerative disease in which both cognitive and functional deficits are present (Buccionea et al., 2006; Kurz et al., 2003; Nourhashemi et al., 2008). Since

diagnosis of dementia requires cognitive decline, which interferes with a person's ability to work, engage in social activities, and relationships with others as well as self care, it is important that neuropsychologists assess all of these domains (Buccionea et al., 2006; Bucks, Ashworth, Willock, & Siegfried, 1996). One of the domains that may be the most difficult to assess is functional decline (Buccionea et al., 2006; Nourhashemi et al., 2008). Functional decline is defined as the inability or restriction in performing an action within the normal manner or range for a human being (Kurz et al., 2003). Functional decline or activities of daily living (ADLs) can be divided into basic and instrumental skills (Sikkes, de Lange-de Klerk, Pijnenburg, Scheltens, & Uitdenhaag, 2009). Basic ADLs include such tasks as bathing, dressing, toileting, and self-maintenance, while instrumental activities of daily living (IADLs) include meal preparation, managing finances, driving, and shopping (Sikkes et al., 2009).

Since IADLs require higher level cognitive skills, they have been found to decline earlier in the course of dementia, and older adults with AD commonly require assistance in these areas before they would need assistance with ADLs (Cahn-Weiner et al., 2007; Farias, Harrell, Neumann, & Houtz, 2002; Kurz et al., 2003; Nourhashemi et al., 2008). This may be true because basic ADLs do not require higher levels of cognitive functioning and are more frequently rehearsed behaviors, so they are usually preserved until further along in disease progression (Cahn-Weiner et al., 2007; Kurz et al., 2003).

Currently, the most widely utilized methods of assessing behavioral functions are self or collateral report or observing individuals perform specific tasks (Farias et al., 2002). Due to cognitive decline and lack of insight, which are often characteristic of individuals with AD, relying completely on their perspective can lead to inaccurate recommendations (Bucks et al., 1996; Zank & Frank, 2002). Research has also shown that the memory complaints made by an older adult with suspected AD are not significantly correlated with cognitive measures, suggesting that older adults with AD are not accurate reporters of cognitive or functional decline (Ganguli et al., 2004). Regarding caregiver reports, research has found that information received from these individuals may be biased by caregiver burden, by closeness of contact, and by the emotional state of the patient (Zank & Frank, 2002). They often underestimate the abilities of the individual with AD to perform self-care activities independently (Zank & Frank, 2002). Additionally, caregivers may give less accurate reports of the patient's functional decline when the decline is less pronounced, especially when the patient is in the early stages of AD (Ganguli et al., 2004).

Another way to assess functional decline is by using in-office measures, such as watching the person engage in a task, but little research has been conducted as to whether these are more accurate assessments than self or others' reports (Farias et al., 2002). These measures in which the neuropsychologist watches the patient complete the task do not encompass all IADLs/ADLs (Farias et al., 2002). Thus, the most accurate way for a neuropsychologist to assess ADLs or IADLS, like driving performance, may be to ride along in a car with a patient suspected of having AD, which is impractical and possibly risky.

Memory Measures

A few studies have examined the ability of neuropsychological measures assessing memory to predict declines in ADLs and IADLs. A study by Richardson, Nadler, and Malloy (1995) found that measures of visual and auditory memory were correlated with medication administration, money management, and safety (Richardson et al., 1995). The researchers asserted that neuropsychological tests were better at predicting more complex IADLs than more

basic ADLs (Richardson et al., 1995). A study by Farias et al., (2002) compared measures of memory to specific ADLs and found that auditory memory measures, both immediate and delayed, predicted deficits in driving, financial management, and dressing ability (Farias et al., 2002). Visuospatial measures of memory were found to correlate with financial management deficits (Farias et al., 2002).

Executive Functioning Measures

Since one of the measures used in this study is the Rey Complex Figure Test (RCFT), which measures visual-spatial memory as well as organization and planning (executive functions), the literature on the relationship between executive functioning and declines in IADLs/ADLs was briefly reviewed. In the course of decline in AD, impairments in executive functioning generally emerge slightly after memory decline (Lezak et al., 2004). The most common executive functions to become impaired in patients with AD are cognitive flexibility, sequencing ability, inhibition, perseveration, as well as a decrease in self-awareness (Lezak et al., 2004). Overall, a multitude of research has found executive functioning to be one of the strongest predictors of ADL decline (Farias et al., 2002; Richardson et al., 1995). More specifically, prior research has shown complex figure drawing measures, similar to the RCFT, to be correlated with declines in safety, medication management, cooking, shopping, and money management (Farias et al., 2002; Richardson et al., 1995). The RCFT has been found to correlate with financial management deficits and overall IADL decline (Farias et al., 2002).

Present Study

Since memory impairment is a central deficit of AD and eventually leads to functional decline (Cahn-Weiner et al., 2007; Kurz et al., 2003; Nourhashemi et al., 2008), this study attempted to determine if memory deficits predicted decline in daily living skills. Few research studies have examined the abilities of memory measures to predict ADLs, and past research has used tests which are now out-dated. It was hypothesized that the auditory immediate and delayed memory indexes and subtest scores would significantly predict reported impairments in financial and medication management, driving, and dressing abilities but not grooming and feeding abilities. Theory postulates that auditory memory measures would predict decline because auditory memory is needed to perform certain IADLs and ADLs (Cahn-Weiner et al., 2007; Kurz et al., 2003; Nourhashemi et al., 2008).

It was hypothesized that visual-spatial immediate and delayed memory indexes and subtest scores would significantly predict reported declines in medication and financial management but not driving ability, dressing, grooming, and feeding abilities. This study explored the role of visual memory in performance of ADLs and IADLs, exploring the role of memory, specifically divided into visual and auditory memory, in performance of IADLs and ADLs (Farias et al., 2002; Richardson et al., 1995). Visual, like auditory, memory deficits mark the beginning of cognitive decline in individuals with AD, and many IADLs and ADLs require visual-spatial memory ability (Cahn-Weiner et al., 2007; Kurz et al., 2003; Nourhashemi et al., 2008). Since decline in visual-spatial and auditory memory occurs earlier in disease progression than decline in other cognitive abilities, they were predicted to correlate with declines in self care skills, which occur earlier, such as financial management, medication management, but not driving, dressing, feeding and grooming ability.

Methods

Participants. Participants were 54 adults ranging in age from 66 to 93 years ($M=78$, $SD= 5.20$). All identified as Caucasian; 57% were female, and 82% were right-handed. The level of education ranged from 9 to 20 years with a mean of 14.53 ($SD= 2.67$) years. Participants were referred by a neurologist for a neuropsychological evaluation. Subjects were selected for the study from a de-identified database. In order for participants' data to be used for the study, the older adult must have been diagnosed with AD, English must have been the participants' language of origin, and they must have received an initial interview and have been administered the WMS-III and the RCFT.

Evaluations. The ADLs and IADLs were assessed using a structured interview, and memory was assessed using the Wechsler Memory Scale – Third Edition (WMS-III) and the RCFT. In the interview, the individual suspected of having AD, and the person's spouse, family member, or home healthcare aid (collateral reporter) were questioned about the individual's ability to perform ADLs and IADLs. The ADLs and IADLs included driving ability, financial management, medication management, dressing ability, grooming ability, and feeding ability (Razani et al., 2007; Searight et al., 1989). The ADLs and IADLs were either rated as intact or needing assistance (impaired). As part of a four-hour comprehensive battery, the WMS-III was used to assess short and long term visual and auditory memory. The auditory memory tests included the WMS-III's Auditory Memory Index, immediate and delayed, and the subtests Logical Memory I and II, Verbal Paired Associates I and II, and Word List I and II. The visual memory scales from the WMS-III included the Visual Memory Index, immediate and delayed, and the subtests Faces I and II and Family Pictures I and II. The RCFT Copy was utilized to assess visual-spatial skills. The copy portion of the RCFT requires the participant to copy the image as accurately as possible.

Procedure. The neuropsychological data, demographic information, IADLs, and ADLs were extracted from the licensed psychologist's database by a computer program which then coded the information into a separate computer spreadsheet. All of the participants in the database received an initial interview by a licensed psychologist to collect demographic and historical information. All participants were then tested by the licensed clinical psychologist or by a doctoral level student, who was supervised by the licensed clinical psychologist. Participants received a standard four hour battery of testing, which assessed memory, intelligence, pre-morbid functioning, executive functioning, picture naming, sensory and motor functioning, and mood.

Results of testing were interpreted in conjunction with the client's medical, educational, social, and family history, previous testing results (if applicable), collateral report, and behavioral observations made during testing. Clinical diagnoses were determined by the licensed clinical psychologist based on criteria in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-Text Revision (DSM-IV-TR).

Results

All analyses were conducted at the .05 level of significance. Point biserial correlations were utilized to examine the relationship between measures of visual and auditory memory and IADLs and ADLs. The first hypothesis asserted that auditory immediate and delayed memory

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index and subtests scores would significantly predict reported impairment in financial and medication management, driving, and dressing abilities but not grooming and feeding abilities. As can be seen in Table 1, the auditory immediate memory tests, Logical Memory I and Word List I, significantly predicted reported declines in financial management and medication management.

Table 1

Correlations of Auditory Memory Measures and ADLs and IADLs in Individuals with AD.

	Finance	Medication	Driving	Dressing	Grooming	Feeding
AMI	-0.14	-0.10	0.07	-0.15	0.00	-0.02
ADI	-0.25	-0.22	-0.13	0.02	-0.22	-0.22
LM1	-0.36**	-0.23*	0.07	0.10	-0.21	-0.11
LM2	-0.22	-0.24	0.03	0.10	-0.16	-0.16
VPA1	-0.24	-0.28	-0.23	-0.23	-0.21	-0.09
VPA2	-0.27	-0.25	-0.09	-0.09	0.06	-0.09
WordList1	-0.43*	-0.40*	0.20	0.16	-0.13	-0.13
WordList2	-0.06	-0.09	-0.10	-0.10	-0.20	-0.20

Note: AMI is the Auditory Immediate Index. ADI is the Auditory Delayed Index. LM is the Logical Memory subtest and VPA is the Verbal Paired Associates subtest. * $p < .05$, ** $p < .01$.

Auditory Immediate and Delayed Indexes, Logical Memory II, Verbal Paired Associates I and II, Word List II did not significantly predict reported impairment in financial management or medication management. This was partially consistent with Hypothesis I because it was theorized that both immediate and delayed memory measures would predict decline in financial management. Only two immediate memory measures were found to significantly correlate with reported decline in financial management and medication management. None of the auditory memory tests significantly predicted reported impairments in driving, dressing, feeding, or grooming abilities.

The second hypothesis asserted that visual-spatial immediate and delayed memory indexes and subtest scores would significantly predict reported declines in medication and financial management but not driving ability, dressing, grooming, and feeding abilities.

As can be seen in Table 2, the RCFT significantly predicted reported declines in financial management.

Table 2

Correlations of Visual Memory Measures and ADLs and IADLs in Individuals with AD

	Finance	Medication	Driving	Dressing	Grooming	Feeding
VII	-0.39	-0.19	0.08	0.08	0.06	0.00
VDI	-0.05	0.02	0.33*	0.32*	0.25	0.00
Faces1	-0.21	-0.27*	-0.15	-0.16	0.20	0.00
Faces2	-0.04	-0.04	0.20	0.16	0.19	0.00
FP1	-0.16	-0.12	0.20	0.09	0.09	0.00
FP2	-0.13	-0.25	0.18	0.18	0.18	0.00
RCFT	-0.39**	-0.42**	-0.39**	-0.25*	-0.12	-0.08

Note: VII is the Visual Immediate Index. VDI is the Visual Delayed Index. FP is the Family Pictures subtest. RCFT is the Rey Complex Figure Test. * $p < .05$, ** $p < .01$.

The visual memory tests, Immediate and Delayed Indexes, Faces I and II, Family Pictures I and II, did not significantly predict reported impairment in financial management. This was partially consistent with Hypothesis II because it was hypothesized that measures of visual memory, both immediate and delayed, would predict reported declines in financial management. Only an immediate visual memory measure predicted reported declines in financial management.

The RCFT and Faces I significantly predicted reported impairments in medication management. This was partially consistent with Hypothesis II because it was postulated that both immediate and delayed visual memory measures would predict reported decline; only two immediate measures predicted reported decline. The RCFT and Visual Delayed Index (VDI) significantly predicted reported impairments in driving ability and dressing, which was not consistent with Hypothesis II because it was theorized that visual memory measures would not significantly predict reported declines in driving ability or dressing ability. None of the visual memory tests significantly predicted reported declines in grooming or feeding ability, which was consistent with Hypothesis II.

Discussion

Memory impairment is the hallmark feature of AD and has been identified as the first area of cognitive functioning to evidence a decline (Avila et al., 2004; Binetti et al., 2000). Although a multitude of neuropsychological research has examined cognitive decline in AD, functional decline has remained one of the most difficult domains to assess (Buccionea et al., 2006; Nourhashemi et al., 2008). The purpose of this study was to assess whether memory measures predicted decline in IADLs and ADLs in order to expand the literature and aid neuropsychologists in making recommendations for care of older adults with AD.

It was hypothesized that auditory and immediate and delayed memory index and subtest scores would significantly predict reported declines in financial and medication management, driving, and dressing abilities, but not grooming and feeding abilities. The second hypothesis of the study stated that visual-spatial immediate and delayed memory index and subtest scores would significantly predict reported declines in financial and medication management, but not driving, dressing, grooming and feeding abilities. Upon analysis, it was found that only two immediate auditory memory measures (the Logical Memory I and Word List I subtests) significantly predicted reported declines in financial and medication management. Immediate auditory memory was inversely correlated to financial and medication management. Results also found that the RCFT predicted reported declines in financial management, and the RCFT as well as Faces I predicted reported declines in medication management. The RCFT and VDI predicted declines in driving and dressing abilities.

A possible explanation for these results may be that as AD progresses, the ability to manage one's finances or medications, both complex tasks, becomes more difficult, and people are more likely to require assistance. Thus, memory and these IADLs may be correlated because they decline around the same stages of AD. The finding that the immediate measures of auditory memory (Logical Memory I and Word List I subtests) significantly predicted reported declines in financial and medication management was congruent with the hypothesis and past research, which found immediate auditory memory measures to be among the best cognitive predictors of declines in financial and medication management (Richardson et al., 1995). Additionally, the RCFT was negative and weakly correlated with financial management; the RCFT had an inverse relationship with financial management. Similarly, the RCFT and Faces I subtest were negative and weakly correlated with medication management; these memory measures were inversely related to reported deficits in medication management. These findings that visual-spatial memory significantly predicted declines in financial and medication management were congruent with the hypothesis and past research (Richardson et al., 1995).

Contrary to the hypothesis, none of the delayed auditory memory measures significantly predicted reported declines in financial or medication management, which was partially congruent with past research. Past studies have yielded disparate results when examining the role of delayed memory in predicting declines in these IADLs (Farias et al., 2002; McCue et al., 1990; Richardson et al., 1995). The reason that delayed auditory memory measures did not yield significant results may have been because in the progression of AD, delayed memory may become impaired earlier in disease course before these IADLs become impaired. Immediate memory measures may be declining around the same stage as these IADLs, while delayed memory may have already declined. This theory is supported by the mean scores for Logical Memory I ($M=12$) and Logical Memory II ($M=9$) and Word List I ($M=8$) and II ($M=5$); each of which represents a full standard deviation decline. Similar to financial management, this theory is supported by the mean scores for Logical Memory I ($M=12$) and Logical Memory II ($M=9$)

and Word List I ($M=8$) and II ($M=5$), all of which significantly differ by a full standard deviation between immediate and delayed memory. The decline in immediate auditory memory may cause a decline in financial and medication management abilities in that the underlying mechanisms of auditory immediate memory may be necessary in financial management activities, such as balancing a check book and tracking one's finances or managing a pillbox and taking a complex regimen of medications.

In terms of delayed visual memory, additional follow-up analyses were conducted post hoc to determine if the delayed memory measure of the RCFT significantly predicted declines in financial management. The delayed recall of the RCFT was significantly negatively correlated with reported declines in financial management ($r= -0.46, p=0.01$), and the delayed recall of the RCFT was significantly negatively correlated with declines in medication management ($r= -0.39, p=0.04$). These results supported the hypothesis that both immediate and delayed visual-spatial memory measures significantly predicted reported declines in financial and medication management. This finding was congruent with past research (Farias et al., 2002; McCue et al., 1990; Richardson et al., 1995). Visual-spatial memory and decline in these IADLs may be correlated because they decline around the same time in disease progression; the higher level cognitive skills required to draw the RCFT from memory may be necessary for completing these IADLs (Cahn-Weiner et al., 2007; Farias et al., 2002; Kurz et al., 2003; Nourhashemi et al., 2008). The RCFT may be a slightly more difficult measure of visual-spatial memory than the WMS-III visual memory tests, which may be why the RCFT was significant and the WMS-III indexes and subtests were not, specifically since financial management is a complex IADL.

None of the measures of auditory memory were significantly correlated with reported declines in driving ability, which is contrary to the hypothesis and past research. Upon examination of past studies, many have assessed older adults' abilities to utilize public transportation (Farias et al., 2002) and not their abilities to drive. In this study, the person was questioned about his or her own ability to drive. The ability to drive a car and to use public transportation may require different areas of the brain. For example, the ability to utilize public transportation may be a more verbally mediated task; driving a car may be a more visually mediated task. In support of this the RCFT and VDI were weakly correlated with reported declines in driving ability, which was not congruent with the hypothesis or past research. Driving is most likely mediated by visual-spatial skills and memory more so than the ability to use public transportation. This may explain the discrepancy between prior research and the current study.

None of the auditory memory tests were significantly correlated with reported declines in dressing ability, which was contrary to the hypothesis. This finding was partially congruent with past research. Some studies have found memory to be a significant predictor of decline in dressing ability (Farias et al., 2002; McCue et al., 1990), while other studies have not obtained significant results (Richardson et al., 1995). There may be a few reasons that the results of this study were disparate with past research. Research that has found memory to be correlated with declines in dressing ability has not examined visual and auditory memory separately as was done in this study; therefore, the significant results in those studies may have been due to declines in visual memory (McCue et al., 1990). In support of this theory, the RCFT and VDI were weakly correlated with reported impairments in dressing ability. As AD advances, both visual-spatial memory and dressing ability decline. Thus, visual-spatial immediate and delayed memory measures may be correlated with the dressing ability because they are needed to perform this activity. This finding was incongruent with the hypothesis. Few, if any studies, have specifically

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examined the ability of visual memory to predict declines in dressing ability in AD. However, the results of this study appear to be congruent with findings that visual memory and visual-spatial deficits are correlated with dressing deficits in individuals with neurodegenerative diseases (Davous et al., 1996; Hemphill & Klein, 1998; Mahurin et al., 1991).

Auditory memory measures were not hypothesized to predict reported declines in grooming or feeding abilities nor were visual-spatial memory measures; this assertion was supported by the results of this study and past research (Farias et al., 2002; Richardson et al., 1995). Most prior studies, including this one, have used individuals with AD who are in the early to possibly moderate stages (Farias et al., 2002; Lowenstein et al., 1992; Richardson et al., 1995; Searight et al., 1989), and most individuals earlier in the disease's progression do not yet show deficits in grooming or feeding abilities (Cohen-Mansfield et al., 1995).

The findings of this study support previous research (Farias et al., 2002) in that declines in ability to manage finances, medications, drive, and dress oneself begin during the early stages of AD. This study can aid neuropsychologists in assessing a person's daily functioning using neuropsychological measures which are already given, instead of administering additional tests or questionnaires. When examined in the context of overall patterns of memory decline, auditory immediate and visual immediate and delayed memory measures significantly predict reported declines in financial and medication management. Thus, if patients in the early stages of AD present with these patterns of memory deficits, they may begin to evidence deficits in financial and medication management if they have not already. Similarly, visual-spatial immediate and delayed memory in combination, but not auditory memory, are the best memory predictors of decline in driving and dressing abilities. Thus, if an individual presents with this pattern of decline, he or she may also begin to evidence declines in driving and dressing. Overall, the RCFT was the best predictor of decline in IADLs and ADLs. If the RCFT is impaired, neuropsychologists should be aware that self-care is likely to be impacted. Of course, each individual presents differently and does not experience declines in behavioral functioning at the exact same times, so neuropsychological measures alone should not be used in making recommendations.

One of the main limitations of this study was that the correlations between the memory measures and the IADLs and ADLs fell within the small to medium ranges, which could signify that another factor is better accounting for or influencing ADL and IADL decline. Many of the memory measures used require other cognitive skills, such as organization ability, which aided in recalling information. Thus, another cognitive variable, such as executive functioning, which has been found in previous research (Boyle et al., 2003; Cahn-Weiner et al., 2003; Razani et al., 2007) to predict declines in IADLs and ADLs, could be accounting for some of the variance between cognitive decline and IADL/ADL performance. Another possible reason was the small sample size used for this study, which can affect the strength of the correlations. Larger sample sizes could increase the magnitude of the correlations between the memory measures and the IADLs and ADLs. An additional limitation, for reasons previously stated in this paper, was the use of self report to define impairment in IADLs and ADLs. In order to off-set the limitations of self-report, a collateral source was also interviewed. Future research should administer in-office measures so a clinician can directly gauge an individual's abilities in IADLs and ADLs.

A missing element of this study and most of the current literature on this topic is the inclusion of participants in the moderate to late stages of AD. Although older adults in the earlier stages do show declines in IADLs and ADLs, they are still able to do some basic daily activities, such as grooming and feeding. Thus, there remains a paucity of research on

individuals with deficits in basic ADLs. One of the reasons for this lack of research is the fact that people in the later stages may have floor effects on measures making neuropsychological assessment of those who have greater impairment more difficult. Also, people further along in disease progression have difficulty completing full neuropsychological batteries.

This study was unique in that it examined memory deficits as predictive factors in IADL and ADL decline. The results of this study found that memory can be useful in predicting functional decline earlier in disease progression rather than relying solely on executive functioning measures. Overall, this study supported the theory that memory, especially immediate memory, can be used to guide clinical decision making in an individual's ability to complete IADLs and ADLs.

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