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Extent, Pattern, and Correlates of Remote Memory Impairment in Alzheimer's Disease and Parkinson's Disease

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Content and contextual memory for remote public figures and events was assessed with a modified version of the Presidents Test in patients with Alzheimer's disease (AD) or Parkinson's disease (PD). Contributions of executive functioning, semantic memory, and explicit anterograde memory to remote memory abilities were also examined. The AD group had temporally extensive deficits in content and contextual remote memory not accountable for by dementia severity. The PD group did not differ from the control group in remote memory, despite anterograde memory impairment. These results support the position that different component processes characterize remote memory, various mnemonic and nonmnemonic cognitive processes contribute to remote memory performance, and anterograde and remote memory processes are dissociable and differentially disrupted by neurodegenerative disease.

Remote memory impairments occur in both Alzheimer's disease (AD) and Parkinson's disease (PD), but the extent, pattern, and correlates of these deficits have not yet been fully delineated. The remote memory impairment in AD is generally characterized as temporally extensive, spanning decades (Hodges, Salmon, & Butters, 1993; Wilson, Kaszniak, & Fox, 1981). Overlaying the extensive remote memory deficit is a temporal gradient, with recall of recent events being more severely impaired than recall of more remote events (Beatty, Salmon, Butters, Heindel, & Granholm, 1988; Kopelman, 1989; Sagar, Cohen, Sullivan, Corkin, & Growdon, 1988; Squire & Cohen, 1984, but see Hodges et al., 1993; Wilson et al., 1981). By contrast, the remote memory impairment in PD has generally been characterized as temporally limited, with a gradual decline in performance across only the most recent decades (Sagar et al., 1988). However, a more temporally extensive remote memory deficit has been reported in PD patients with dementia relative to PD patients without dementia (Freedman, Rivoira, Butters, Sax, & Feldman, 1984; Huber, Shuttleworth, & Paulson, 1986).

Previous research has identified many processing and material-specific memory dichotomies, including episodic versus semantic memory (Tulving, 1972, 1983), content versus contextual memory (Sagar, Cohen, Corkin, & Growdon, 1985; Sagar et al., 1988), and public versus autobiographical memory (Kopelman, 1989). Different patterns of impairment across component processes can occur, depending on the neural systems disrupted in a specific disorder (Cohen & Squire, 1981; Sagar, 1990). The particular extent and pattern of remote memory deficits are related to the extent and location of the brain damage sustained (Cohen & Squire, 1981). These disease-related differences in performance provide evidence for the presence and dissociability of memory components.

Studies investigating component processes of remote memory have reported that AD participants were impaired in memory for photographs depicting historical events (content memory) and for the dates on which these events occurred

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(contextual memory), whereas PD participants were selectively impaired in contextual memory. That is, PD patients could accurately identify the event (content) but not when it occurred (context; see Sagar et al., 1988). Temporal gradients, favoring more remote events, occurred for content but not context in the PD and control groups, and gradients were more pronounced for event recall than recognition.

Remote memory for public events is usually tested by asking participants to identify specific events or persons from the past (content) and to identify the date at which the event occurred or the person was prominent (context). The Presidents Test used in the current study is a modification of one devised by Hamsher and Roberts (Hamsher & Roberts, 1985) and differs from other public events measures because it assesses memory for public figures whose notoriety is less temporally specific than the historical one-time events used as test stimuli in previous studies (Sagar et al., 1988). That is, although presidential candidates and elections are reminiscent of a specific time period, items from public events tests (e.g., the raising of the American flag in Iwo Jima) are discrete events that occurred at a single time and place in history. These test measures differ in that an individual may be able to recall where he or she first saw the image of the raising of the flag at Iwo Jima (more an episodic memory) but would unlikely be able to recall where he or she learned of the presidential candidates of an election (more a semantic memory). Overall, the Presidents Test may have greater item equivalency than other remote memory measures (cf. Brandt & Benedict, 1993; Squire & Cohen, 1982; Warrington & Sanders, 1971) because all test items refer to a common category of events, presidential elections (albeit some presidents were more prominent figures than others in history). In addition, the continued exposure, likely across modalities (seeing candidates in newspapers and other media, depending on the time era, reading information from newspapers, talking about candidates with other people), lends confidence that individuals have been exposed to this information for more than a brief time period. Extensive remote memory deficits may reflect not only a retrograde memory impairment but also deficits in other cognitive abilities important in the retrieval or access of such memories. For example, frontal–executive function deficits (e.g., sequencing, planning) have been hypothesized to underlie the temporally extensive remote memory impairment found in amnesic patients with etiologies other than AD or PD (Kopelman, 1991, 1992; Shimamura, Janowsky, & Squire, 1990; Squire & Cohen, 1982). Impairment on tasks requiring sequencing and temporal ordering are also observed in patients with focal frontal lobe lesions (Mangels, Gershberg, Shimamura, & Knight, 1996; Milner, 1971; Milner, Corsi, & Leonard, 1991; Perani et al., 1993). An impaired frontally based mediational system was proposed to underlie the contextual memory deficit observed in PD patients (Sagar & Sullivan, 1988). In contrast, a more general semantic memory deficit has been proposed to underlie the remote memory deficits observed in AD (Flicker, Ferris, Crook, & Bartus, 1987; Hodges et al., 1993). Few studies, however, have focused on whether factors such as sequencing or semantic memory deficits contribute to remote memory deficits in AD and PD (Hodges, 1995).

There were two principal aims of this study. The first was to characterize the pattern of remote memory for period-specific public events and the dissociations between different components of remote memory (content vs. contextual memory) for these events in AD and PD. On the basis of past research, we hypothesized that (a) AD patients would have a temporally extensive remote memory deficit, encompassing both content and contextual information, and (b) PD patients would show a temporally limited remote memory impairment with a selective deficit in contextual memory, as assessed by dating past public events, but intact content memory, as assessed by recall and recognition of candidate names. Because degenerative diseases, such as AD and PD, result in impairments in multiple mnemonic and nonmnemonic processes that could differentially affect component processes of remote memory, the second study aim was to examine the relationships between remote memory content and contextual measures and measures of executive function, semantic memory, and explicit anterograde memory. We hypothesized that (a) memory for remote past public figures would be associated with semantic memory (cf. Hodges, 1995; Hodges et al., 1993), and (b) date recognition performance would be associated with frontal–executive functioning, particularly sequencing abilities, in PD (cf. Sullivan, Sagar, Gabrieli, Corkin, & Growdon, 1989).

Method

Participants

Study participants included 15 patients diagnosed with AD, 20 patients with PD, and 38 age-appropriate normal control (NC) participants (see Table 1). The AD patients were recruited from the Geriatric Psychiatry Rehabilitation Unit and the National Institute of Mental Health Aging Clinical Research Center, both housed at the VA Palo Alto Health Care System. All AD patients met the National Institute of Neurological and Communicative Diseases and Stroke–Alzheimer's Disease and Related Disorders Association criteria for probable AD (Khachaturian, 1985; McKhann, Drachman, Folstein, & Katzman, 1984). Of the 5 probable AD participants autopsied, 4 cases were confirmed AD and 1 case was neuropathologically categorized as Pick's disease. All 15 clinically diagnosed AD patients were included in the subsequent analyses. The PD patients were screened and tested at the VA Palo Alto Health Care System as part of a neuropsychological protocol. All the PD patients were evaluated by a physician, displayed at least two of the three cardinal features of the disease (tremor, rigidity, bradykinesia), and were taking antiparkinsonian medications with favorable response. The NC participants were primarily recruited by advertisements distributed throughout the community or by word of mouth and were paid for their participation. Potential control participants who scored below 25 on the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) were excluded from the study. Screening for all participants (AD, PD, and NC) included a psychiatric interview and medical examination. Participants were excluded for significant history of psychiatric or neurological disorder not related to their diagnosis, past or present alcohol or drug abuse or dependence, or serious medical condition. Informed consent was obtained from all participants.

Table 1
Participant Demographics

Group and measure	Age (years)	Education (years)	Duration of diagnosis (years)	NART IQ	Vocabulary (age scaled score)	MMSE (max = 30)
Normal control (n = 38)						
M	65.3	16.6		115.1	13.4	29.0
SD	7.0	2.5		6.0	2.4	1.1
Alzheimer's disease (n = 15)						
M	69.4	15.4	4.9	104.9	9.4	20.4
SD	4.3	2.8	5.3	8.3	2.1	3.2
Parkinson's disease (n = 20)						
M	63.1	16.0	6.8	112.9	12.6	27.4
SD	7.1	2.7	5.9	5.7	2.1	2.6
One-way ANOVA	$p = .025$	$p = .32$		$p = .0001$	$p = .0001$	$p = .0001$
Group comparisons (t tests, $p \leq .05$)	N = P < A	*ns*	*ns*	N = P > A	N = P > A	N > P > A

Note. NART = National Adult Reading Test (Nelson, 1982); MMSE = Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975); max = maximum; ANOVA = analysis of variance; N = normal control; P = Parkinson's disease; A = Alzheimer's disease.

Neuropsychological Measures

Participants received tests of overall cognitive functioning, premorbid intellectual level, remote and anterograde memory, executive functions, and confrontation naming. Overall current cognitive functioning was assessed with the MMSE, premorbid intelligence was estimated with the National Adult Reading Test (NART; Nelson, 1982) and the Vocabulary subtest of the Wechsler Adult Intelligence Scale—Revised (WAIS-R; Wechsler, 1981; also, Lezak, 1983; Paque & Warrington, 1995; but see Stebbins, Wilson, Gilley, Bernard, & Fox, 1988; Stebbins, Wilson, Gilley, Bernard, & Fox, 1990, for evidence of dementia-related decline in NART scores). Not all participants had all tests.

Presidential Candidates Test

This test, modified from Hamsher and Roberts (1985), required participants to name all the Democratic and Republican presidential candidates (elected and defeated candidates) dating back to 1920. We added a verbal recognition trial. The test comprised four parts, presented in the following order.

Candidate Recall. Participants were given a sheet of paper divided into columns and were asked to write down, within a 5-min time limit, the names of all the Democratic and Republican presidential candidates since 1920, to identify which political party they were affiliated with, and to identify the year(s) the candidates ran for office. Last names of the candidates were deemed sufficient for credit.

Candidate and Date Recognition. Each item of this subtest consisted of six names (two of which were presidential candidates who ran against each other in a particular election) and three dates (one of which was the correct year the election involving these two presidential candidates was held). The remaining four names were those of high-profile individuals who had been politically or socially active in the same era as the presidential candidates. The remaining two dates were balanced across items such that one of the incorrect dates was ± 4 years and the other incorrect date was ± 12 years from the correct election year. Participants had to identify which two of the six candidates ran against each other in a particular election and to choose the year that election occurred. For example, one item included the names George Patton, Franklin Roosevelt, Henry Wallace, Arthur Vandenburg, James Forrestal, Thomas Dewey, and the years 1956, 1944, and 1940. The correct choices for this item are presidential candidates Franklin Roosevelt, Thomas Dewey, and 1944.

Candidate Sequencing. Participants then sequenced the names of presidential candidates within a single political party. Three sets of index cards, each card containing the name of a candidate, were presented in a random order (fixed across participants) for each political party (Set 1 = 1920–1940, Set 2 = 1944–1964, and Set 3 = 1968–1988). For example, the last set of Democratic candidates included cards with the names Walter Mondale, Jimmy Carter, George McGovern, Michael Dukakis, Jimmy Carter, and Hubert Humphrey, and participants were asked to place the candidates in chronological order from the earliest to the most recent. Final sequence scores were based on the number of cards placed in the correct serial position, with a range of 0–6 points for each of the six sets of cards. Because there are presidential candidates who ran for office more than one time, trials contained cards that are scored correct in more than one position. For example, Jimmy Carter's name is on two cards (representing the 1976 and 1980 elections). Each of these cards was counted as correct as long as it was in one of the two correct positions, which, for this particular sequence, were the third and fourth positions (correct sequence being Humphrey, McGovern, Carter, Carter, Mondale, and Dukakis).

Photo Naming. Participants were shown 22 black and white photographs (3.5 × 4.5 in. or 9 × 11 cm) of all presidential candidates from the elections of 1920–1980 and were asked to give the candidate's name, political party affiliation, and year(s) of the election(s) in which he participated. Naming extended only to 1980, whereas free recall, recognition, and sequencing included elections through 1988. Participants received credit for naming as long as the correct last name of the candidate was given.

Other Cognitive Measures

To further examine the component processes of remote memory, we examined the relationships between the different subtests of the Presidents Test and select explicit anterograde memory, semantic memory, and executive function measures.

Explicit anterograde memory. The Recognition Memory Test (Warrington, 1984) assessed the recognition of words and faces separately, and the Wechsler Memory Scale—Revised (WMS-R; Wechsler, 1987) provided several indices of immediate memory (verbal and visual) and an assessment of memory after a short delay.

Semantic memory. The Modified Boston Naming Test (BNT; Huff, Collins, Corkin, & Rosen, 1986) used 42 line drawings of common objects, plants, and animals taken from the original

85-item BNT (Kaplan, Goodglass, & Weintraub, 1976). The WAIS–R Vocabulary subtest (Wechsler, 1981) assessed ability to define increasingly difficult words.

Executive functions. On the Wisconsin Card Sorting Test (WCST; Milner, 1963), all participants attempted to sort all 128 cards into predetermined categories. Scores used in this study were number of categories correctly sorted and number of perseverative responses committed (Heaton, 1981). Studies have shown these test parameters to be sensitive to frontal lobe dysfunction (cf. Milner, 1963; Sullivan et al., 1993). WAIS–R Picture Arrangement assessed the ability to sequence the events of an action or a story and is considered an executive function measure (cf. McFie & Thompson, 1972; Sullivan & Sagar, 1989).

Statistical Analysis

Group comparisons were based on one-way and repeated measures analysis of variance (ANOVA). Temporal gradients were assessed with a repeated measures ANOVA across designated time periods. Follow-up t tests were used when analyses revealed significant group differences. Analysis of covariance (ANCOVAs) controlling for age were run to confirm ANOVA results because of the age difference between the AD group and the PD and NC groups. Relationships between measures were examined with Pearson product–moment correlations, multiple regression, and Spearman rank order correlations (when sample sizes were small [≤ 15] or when data were ordinal).

Results

Presidents Test

Candidate Recall

Two one-way ANOVAs revealed group differences for recall of elected, $F(2, 69) = 30.10, p < .0001$, and defeated, $F(2, 69) = 6.70, p < .003$, candidates. Follow-up comparisons showed that the AD group recalled significantly fewer elected and defeated candidates than either the PD (elected $p < .0001$, defeated $p < .005$) or NC (elected and defeated $p < .0001$) groups, whereas no significant group differences were found between the PD group and NC group in free recall of either elected or defeated candidates (see Figure 1). For these analyses, as well as all subsequent analyses, we conducted ANCOVAs, controlling for age, to ensure that the age difference between groups did not account for the group differences found on the neuropsychological measures. Unless otherwise stated, results for the ANCOVAs were consistent with the reported ANOVA results, as they were here for candidate recall. In addition, the results reported in this study were the same for the AD group with or without the individual who had been neuropathologically diagnosed with Pick's disease.

Candidate Recognition

Similar to free recall, groups differed in ability to recognize elected, $F(2, 68) = 10.41, p < .0001$, and defeated, $F(2, 68) = 31.25, p < .0001$, candidates. The AD group performed significantly below the PD (elected $p < .005$, defeated $p < .0001$) and NC (elected $p < .01$, defeated $p < .0001$) groups, which did not differ from each other.

Free recall versus recognition performance. To test for differences between free recall and recognition, we performed two 3 (group: AD, PD, NC) × 2 (condition: free recall, recognition) repeated measures ANOVAs, one for elected candidates and one for defeated candidates. For elected candidates, the group effect, $F(2, 68) = 33.33, p < .0001$, and condition, $F(1, 68) = 427.75, p < .0001$, and the Group × Condition interaction, $F(2, 68) = 19.55, p < .0001$, were significant. Three 2 × 2 (Group × Condition) repeated measures ANOVAs tested the source of the interaction and indicated significant Group × Condition interactions between the AD and PD groups, $F(1, 31) = 15.92, p < .0005$, and the AD and NC groups, $F(1, 50) = 45.27, p < .0001$, where the AD group showed relatively better recognition to recall performance than either the PD or the NC groups. Caution is necessary in interpreting this interaction because the PD and NC groups were at ceiling level for recognition of elected presidential candidates. Nonetheless, the AD group did show a substantial increase in performance from free recall to recognition of elected presidential candidates.

Results comparing recall and recognition of defeated candidates indicated significant main effects for group, $F(2, 68) = 16.63, p < .0001$, and condition, $F(1, 68) = 903.38, p < .0001$, but no interaction, $F(2, 68) = 0.06, p = .54$. All groups performed significantly better on recognition than recall of defeated candidates ($p < .0001$ for all groups).

Recognition of elected versus defeated candidates. A 3 × 2 repeated measures ANOVA (Group × Candidate) tested whether participants recognized a greater number of elected than defeated candidates. The significant effects were for group, $F(2, 68) = 34.59, p < .0001$, candidate, $F(1, 68) = 258.70, p < .0001$, and their interaction, $F(2, 68) = 17.18, p < .0001$. Although the Group × Candidate interaction could be interpreted as indicating that the AD group was better able than the PD and NC groups to identify elected candidates relative to defeated candidates, recognition performance by the PD and NC groups was at ceiling for the elected candidates, thus making it difficult to interpret this interaction, as was the case when comparing recall and recognition performance of elected candidates. Follow-up analyses indicated significantly better performance by all groups for recognition of elected versus defeated candidates ($p < .0001$ for all groups). Because of the restricted range and nonnormal distribution of the number of correctly recognized elected candidates, nonparametric procedures (Kruskal–Wallis tests) were applied and confirmed significant between group differences for elected candidate ($p < .0001$) and defeated candidate ($p < .0005$) recognition performance.

Election date–candidate pairs. When examining dating accuracy, only elections for which a participant correctly recognized both presidential candidates were included. We reasoned that unless participants could accurately identify both candidates, we could not be sure that they were dating the intended election. For example, if someone chose Franklin Roosevelt but did not correctly identify a candidate he ran against, there would be no way to know which election was being dated (1932, 1936, 1940, or 1944).

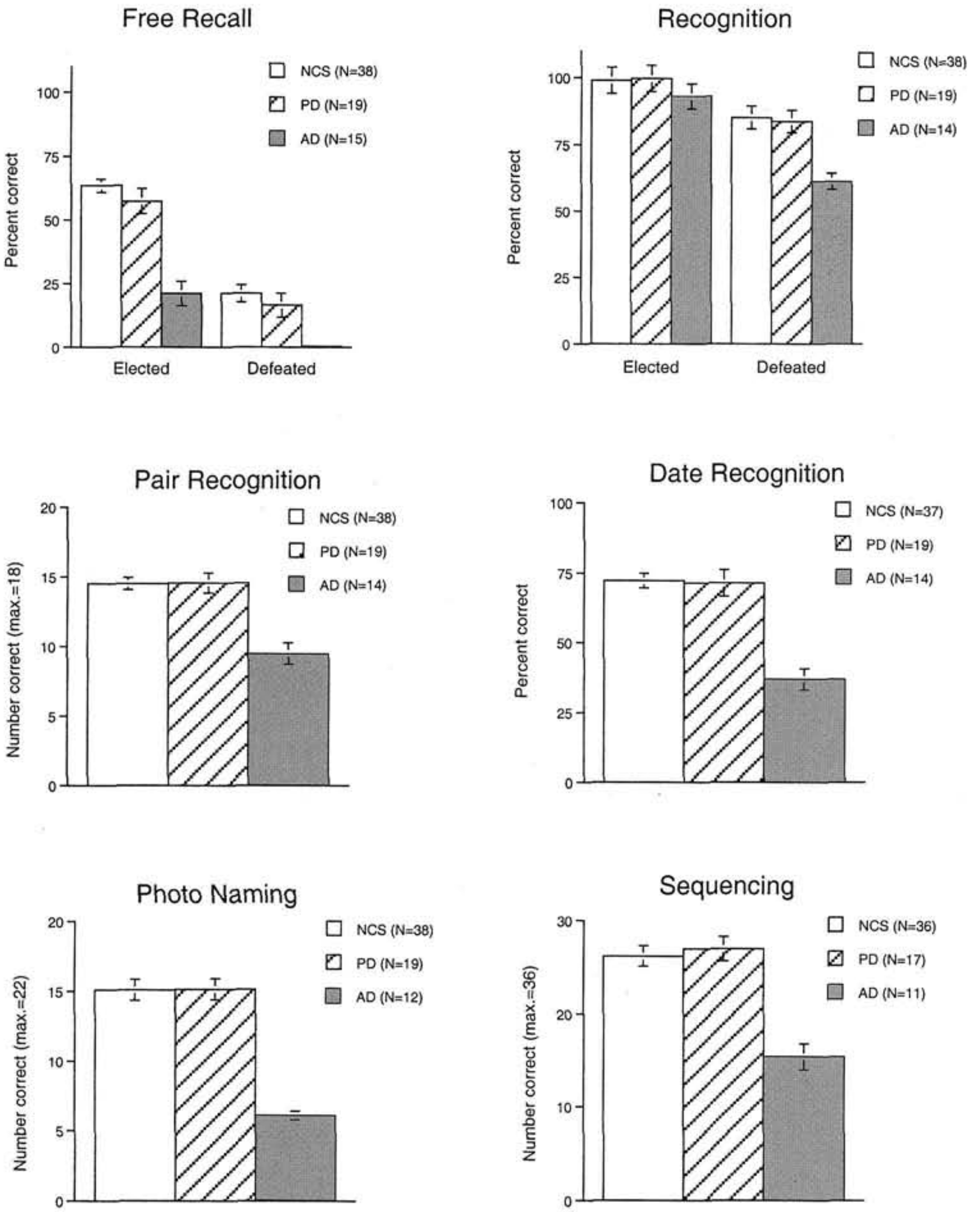

Figure 1. Bar graphs depicting participant group means and standard errors (error bars) for each subtest of the Presidents Test. NCS = normal controls; PD = Parkinson's disease; AD = Alzheimer's disease.

Significant group differences were found for both candidate pair recognition (i.e., number of items in which a participant accurately identified the elected and defeated candidates from the six choices presented), $F(2, 68) = 22.02$, $p < .0001$, and recognition of election year, $F(2, 67) = 22.87$, $p < .0001$, (see Figure 1). Follow-up t tests for both candidate pair and date recognition indicated that the AD group performed significantly worse than the PD ($p < .0001$) and NC ($p < .0001$) groups, which, again, did not differ from each other.

Performance level as a function of chance. A chance level of performance was 1 out of 15 (7%) for each candidate pair recognition item and 1 out of 3 (33%) for each election date recognition item. Parametric and nonparametric procedures, analyzing the difference between participants' actual performance and chance level, indicated that all three participant groups performed significantly above chance level for candidate pair recognition ($p < .0001$). For recognition of election dates, the PD and NC groups performed significantly better than chance level ($p < .0001$ for both groups), but the AD group did not ($p = .360$).

Performance across time periods. A 3 (group) × 3 (time period: 1920–1940, 1944–1964, 1968–1988) repeated measures ANOVA examined candidate pair recognition performance over time and yielded significant main effects for group, $F(2, 68) = 22.02$, $p < .0001$, and time period, $F(2,$

136) = 57.40, $p < .0001$, and a significant Group × Time Period interaction, $F(4, 136) = 5.28$, $p < .001$ (see Figure 2). The AD, but not the PD, group showed a significant decline in ability to recognize candidate pairs in the most recent time period relative to the middle time period.

A 3 (group) × 3 (time period: 1920–1940, 1944–1964, 1968–1988) repeated measures ANOVA examined date recognition and yielded a significant main effect for group, $F(2, 64) = 19.50$, $p < .0001$, but not for time period, $F(2, 128) = 0.61$, $p = .55$, and a significant Group × Time Period interaction, $F(4, 128) = 3.40$, $p < .02$. Group differences were evident on the middle and most recent time periods, $F(2, 67) = 13.18$, $p < .0001$, and $F(2, 66) = 33.94$, $p < .0001$, respectively, with the AD group performing significantly worse than the PD and NC groups. No group differences were found for date recognition at the earliest time period, $F(2, 65) = 1.26$, $p = .29$ (see Figure 2). When the last two time periods were compared, the PD group showed a trend toward a decline in date recognition ability compared with the NC group for the most recent time period: Date × Group interaction, $F(1, 54) = 3.29$, $p < .08$.

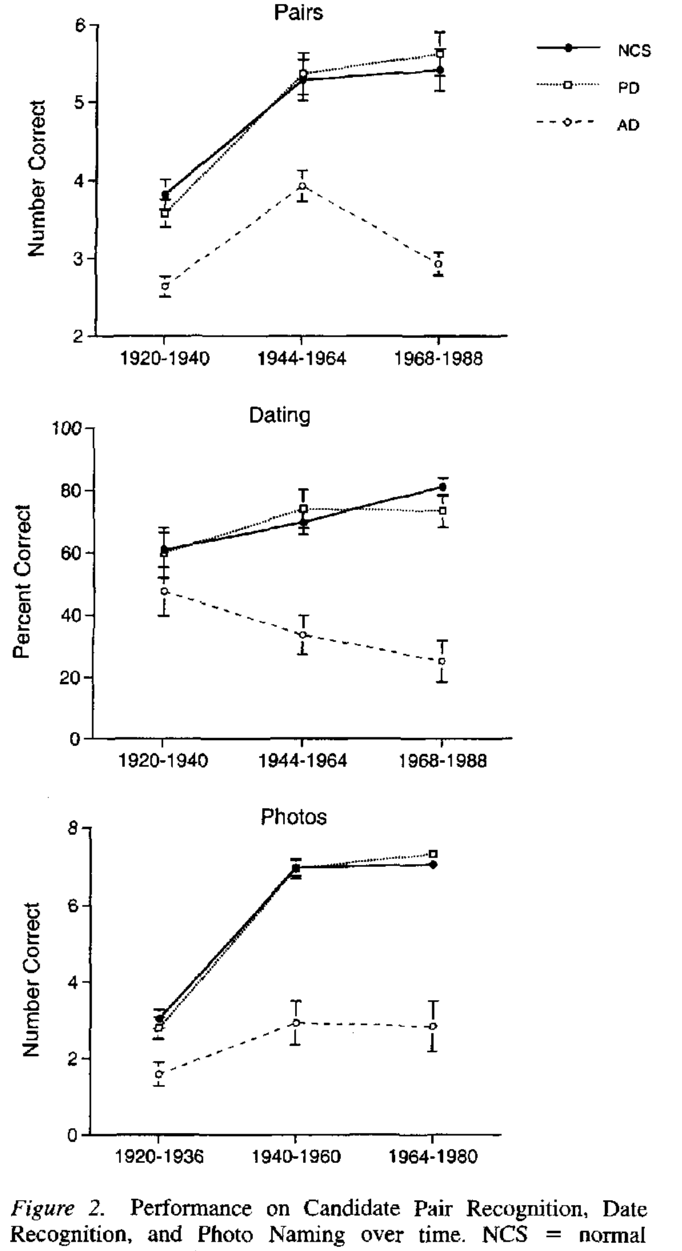

Figure 2. Performance on Candidate Pair Recognition, Date Recognition, and Photo Naming over time. NCS = normal controls; PD = Parkinson's disease; AD = Alzheimer's disease.

Photo Naming

The groups differed in photograph naming, $F(2, 66) = 43.18$, $p < .0001$. The AD group performed worse than the PD ($p < .0001$) and NC ($p < .0001$) groups (see Figure 1).

To examine photo naming over time periods, we used a 3 (group) × 3 (time period: 1920–1936, 1940–1960, 1964–1980) repeated measures ANOVA, and it indicated significant main effects for group, $F(2, 66) = 42.71$, $p < .0001$, time period, $F(2, 132) = 223.54$, $p < .0001$, and their interaction, $F(4, 132) = 15.91$, $p < .0001$ (see Figure 2). In the AD group, photo naming score for the middle time period compared with the earliest time period did not increase to the level of the PD and NC groups. All three groups identified significantly more photographs from the most recent time periods relative to the earliest time period (all groups, $p < .02$). Unlike the decline in performance for the most recent time period for recognition of candidate pairs, the AD group showed no drop-off in photograph naming. It is unknown, however, whether this difference in performance is related to the fact that photographs extended only through the 1980 election, whereas the items on candidate recognition extended through the 1988 election.

Candidate Sequencing

The groups differed significantly in overall sequencing ability, $F(2, 61) = 16.40$, $p < .0001$, with the AD group performing worse than the PD ($p < .0001$) and NC ($p < .0001$) groups (see Figure 1). There was no significant group difference between the PD and NC groups.

Relationship to Demographic Variables

Education level was generally not associated with Presidents Test performance in the AD and NC groups. In the PD group, however, more years of education were related to higher Date Recognition ($r = .57$, $p = .01$) and Candidate Sequencing scores ($r = .52$, $p < .04$). Neither age nor MMSE was significantly associated with performance on the Presidents Test within any of the participant groups. The PD and NC groups scored at ceiling on the MMSE, limiting ability to observe relationships between that measure and remote memory abilities in those participant groups. Higher NART IQ scores were associated with better Date Recognition scores ($r = .38$, $p < .025$) in the NC group and better Photo Naming scores (Spearman $\rho = .65$, $p < .025$) in the AD group.

Other Cognitive Measures

Group differences on the measures of explicit anterograde memory, semantic memory, and executive functions are presented in Table 2. The AD group scored significantly below the PD and NC groups on all measures of explicit anterograde and semantic memory. Although the AD group completed fewer categories on the WCST than the NC group, they did not differ from the PD group on this parameter. The PD group scored significantly below the NC group on a number of explicit memory measures, although they performed at the level of the NC group on semantic memory measures. In addition, the PD group scored significantly below the NC group on two of the three executive function variables (Picture Arrangement score and number of completed categories on the WCST).

Cognitive Correlates of the Presidents Test

The correlations between each President Test subtest and the other neuropsychological measures administered are presented in Table 3. Because of the number of correlations run, we adopted a significance level of .01 with correlations at the $p < .05$ level reported as trends. In the AD group, the number of correctly named photographs correlated significantly with scores on the modified BNT ($\rho = .82, p < .005$; see Figure 3). A trend toward significance was observed between photo naming scores and Vocabulary scores of the WAIS–R ($\rho = .65, p < .05$). The only unpredicted correlation, which reached the .05 level of significance, indicated that patients who recognized a greater number of presidential candidate pairs also completed more categories on the WCST ($\rho = .73, p < .04$).

Free-recall scores in the PD group were significantly correlated with a number of WMS–R indices, scores on the WCST, and Picture Arrangement of the WAIS–R. However, the concomitant scatterplots indicated that there was a statistical outlier; an individual who scored 26 out of 28 points on the free-recall portion of the Presidents Test, over 3 *SD*s above the PD mean, with the next highest PD score at 15. With this individual removed from correlational analyses, no correlations between free-recall and the other neuropsychological measures met significance criteria. In light of this statistical outlier, we report the free-recall correlations (see Table 3) with this individual removed. No such outliers were encountered in any other subtest of the Presidents Test.

In the PD group, dating scores were significantly correlated with Picture Arrangement scores ($r = .68, p < .002$) and number of perseverative responses on the WCST ($r = -.59, p < .01$; see Figure 4). Photo Naming was significantly correlated with Vocabulary scores ($r = .60, p < .007$; see Figure 5). Trends toward significance were observed between Candidate Recognition and Face Recognition ($r = .51, p < .03$) and Candidate Sequencing and Vocabulary scores ($r = .57, p < .02$). Statistical trends were also noted between Date Recognition scores and several WMS–R indices (Verbal Index, $r = .55, p < .02$; Logical Memory, $r = .46, p < .05$; and General Memory, $r = .54, p < .02$) and Vocabulary scores ($r = .51, p < .025$).

PD Participants With Impaired MMSE Scores

There were 4 PD participants who scored in the impaired range (below 25 points) on the MMSE; their scores ranged

Table 2
Group Performance on Ancillary Neuropsychological Tests

Tests	Normal control *M*	Normal control *SEM*	Alzheimer's disease *M*	Alzheimer's disease *SEM*	Parkinson's disease *M*	Parkinson's disease *SEM*	Post hoc *t* tests*
				Explicit memory			
Recognition Memory							
Words	47.3	0.41	29.9	1.07	44.7	1.07	A < P < N
Faces	43.4	0.69	31.4	1.42	42.8	1.47	A < P = N
WMS–R							
Immediate Recall							
Verbal	111.2	2.32	61.2	2.88	94.6	3.18	A < P < N
Visual	117.1	1.90	79.7	4.22	102.3	4.80	A < P < N
Logical Memory	27.5	1.11	6.2	1.20	19.5	1.42	A < P < N
Delayed Memory Index	116.3	2.60	58.6	2.37	97.8	4.07	A < P < N
General Memory Index	116.0	2.16	62.4	3.51	96.3	4.11	A < P < N
				Semantic memory			
Boston Naming Test	38.8	0.43	27.9	2.68	38.1	0.80	A < P = N
Vocabulary	13.4	0.40	9.4	0.57	12.6	0.47	A < P = N
				Executive functions			
WCST							
Categories completed	6.9	0.57	1.7	0.41	3.9	0.87	A = P < N
Perseverative responses	22.8	2.54	54.4	14.30	35.3	6.69	A > N A = P; P = N
Picture Arrangement	12.5	0.40	7.8	0.49	10.2	0.49	A < P < N

Note. A = Alzheimer's disease; P = Parkinson's disease; N = normal control; WMS–R = Wechsler Memory Scale—Revised (Wechsler, 1987); WCST = Wisconsin Card Sorting Test (Heaton, 1981).
$^{*}p \leq .05$.

Table 3
Correlations Between the Presidents Test and Other Neuropsychological Measures

Test	Free recall of candidates	Recognition of candidate pairs	Dating	Sequencing	Photo naming
		Alzheimer's patients			
Warrington Words	−.09	.55	.31	.11	.20
Warrington Faces	.16	.22	−.16	−.31	.03
WMS–R Verbal Index	.34	.49	−.32	−.19	.02
WMS–R Visual Index	.46	.42	.50	.60	−.13
WMS–R Logical Memory	.49	.65	−.31	.09	−.02
WMS–R Delayed Index	−.35	−.21	−.23	−.08	−.25
WMS–R General Memory	.32	.62	.20	.19	.02
Boston Naming Test	.51	.48	−.09	.17	**.82****
WAIS–R Vocabulary	.18	−.02	−.07	.45	.65*
WCST	.41	.73*	−.59	.07	.29
WCST perseverations	.00	−.68	.26	−.11	−.07
WAIS–R Picture Arrangement	−.22	.39	−.16	.11	.11
		Parkinson's patients			
Warrington Words	.28	.02	.08	.14	.07
Warrington Faces	.41	.51*	.42	.38	.21
WMS–R Verbal Index	.19	.37	.55*	.21	.03
WMS–R Visual Index	.29	.30	.44	.40	.35
WMS–R Logical Memory	.19	.45	.46*	.17	−.12
WMS–R Delayed Index	.22	.26	.34	.42	.27
WMS–R General Memory	.23	.36	.54*	.33	.18
Boston Naming Test	.29	.29	.33	.07	−.07
WAIS–R Vocabulary	.09	.32	.51*	.57*	**.60****
WCST	.45	.27	.41	.28	−.05
WCST perseverations	−.32	−.28	**−.59****	−.36	−.11
WAIS–R Picture Arrangement	.45	.35	**.68****	.48	.33
		Control participants			
Warrington Words	.20	.06	.28	.29	.28
Warrington Faces	−.04	.03	.12	.19	.32
WMS–R Verbal Index	.38*	.17	.35*	.18	.25
WMS–R Visual Index	.25	.08	.21	.21	.26
WMS–R Logical Memory	.30	.12	.34*	.16	.17
WMS–R Delayed Index	.36*	.18	.26	.21	.40*
WMS–R General Memory	.37*	.16	.34*	.21	.29
Boston Naming Test	.14	.32	.27	.43*	.30
WAIS–R Vocabulary	.22	.36*	**.50****	.32	.27
WCST	.23	.29	.39*	.24	.31
WCST perseverations	−.37*	−.40*	−.38*	−.35*	**−.46****
WAIS–R Picture Arrangement	.23	.25	.40*	.13	.15

Note. Correlations appearing in bold reached the $p \leq .01$ level. WMS–R = Wechsler Memory Scale—Revised (Wechsler, 1987); WAIS–R = Wechsler Adult Intelligence Scale—Revised (Wechsler, 1981); WCST = Wisconsin Card Sorting Test (Heaton, 1981).
$^{*}p \leq .05$. $^{**}p \leq .01$.

from 22 to 24 points (PD− group). We used Mann–Whitney *U* statistics to examine whether these individuals performed similarly to the other 16 PD participants who scored in the unimpaired range on the MMSE or whether they performed at a comparable level with AD participants scoring within the same MMSE range ($n = 3$). The PD− group scored significantly worse than the PD group on the WMS–R Visual Memory Index ($Z = 2.22$, $p < .03$), Delayed Memory Index ($Z = 2.08$, $p < .04$), and BNT ($Z = 2.36$, $p < .02$). No group differences were observed on any of the remote memory measures. When the PD− group was compared with the MMSE-comparable AD group, the only group differences were observed on remote memory variables: recognition of candidate pairs ($Z = 2.12$, $p < .04$) and photo naming ($Z = 2.12$, $p < .04$), with the PD− group scoring better than the AD group on both measures. No group differences were found on any other memory measures.

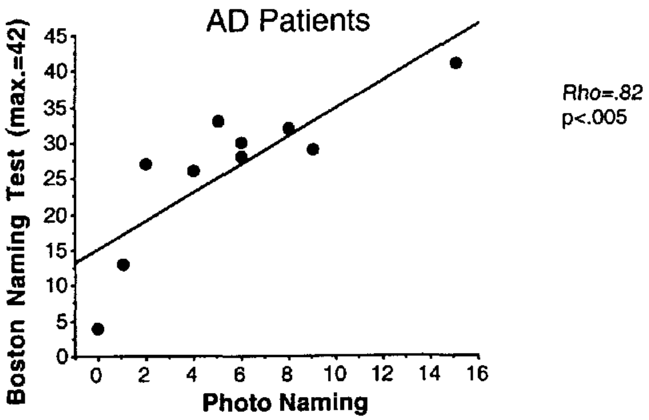

Figure 3. Scatterplot of Photo Naming and the Boston Naming Test (Huff, Collins, Corkin, & Rosen, 1986) in the Alzheimer's disease (AD) patients. max. = maximum.

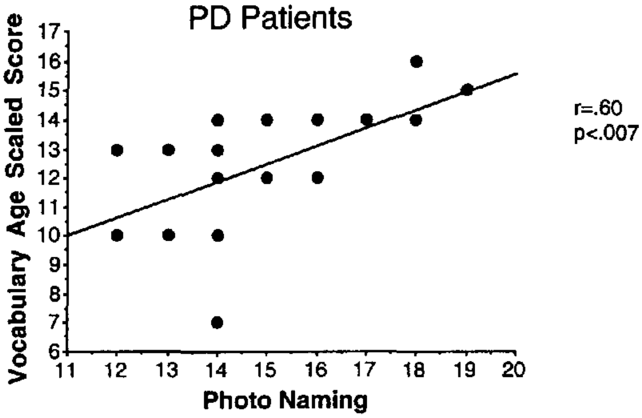

Figure 5. Scatterplot of Photo Naming and Vocabulary scores in Parkinson's disease (PD) patients.

Discussion

This study revealed that the AD patients had severe, temporally extensive deficits in content and contextual memory for remote public events, which did not occur at a single time or place, that is, not one-time episodes. In contrast to the AD patients, the PD patients showed normal performance in both content and contextual components of remote memory as assessed by our version of the Presidents Test. Despite the normal level of remote memory performance, the PD group exhibited predictable relationships between contextual remote memory measures and sequencing abilities.

Deficits in remote memory for public events were most evident in the AD group on free recall of presidential candidates. Recognition performance was substantially better than free recall, providing evidence of retrieval difficulties in AD. Despite this performance difference, the AD group was still impaired in recognition, possibly reflecting an access problem or an actual loss of information (perhaps from semantic memory) over and above any general retrieval deficit (cf. Dopkins, Kovner, Rich, & Brandt, 1997; Greene & Hodges, 1996a, 1996b; Hodges, 1995). Although recognition of candidates was above chance level, the AD group did not perform above chance for recognition of election dates, suggesting that the processing systems involved in the retrieval of the content of remote memories are distinct from the contextual processing systems involved in the organization (i.e., dating) of memories (cf. Becker, Wess, Hunkin, & Parkin, 1993; Kopelman, 1989; Sagar et al., 1988).

Photo naming in the AD group was strongly related to general confrontation naming, even after accounting for Vocabulary performance, another semantic memory measure. These results indicate that the retrieval processes necessary to successfully access a name of an object or face on visual presentation of the object or face are impaired in AD (cf. Laakso et al., 1998), and further that a deficit in naming that is characteristic of AD, may either underlie or at least substantially contribute to impairments in remote memory requiring naming ability.

As a group, the PD patients performed at the level of the NC group on all remote memory measures (Candidate Recall, Candidate Recognition, Candidate Sequencing, and

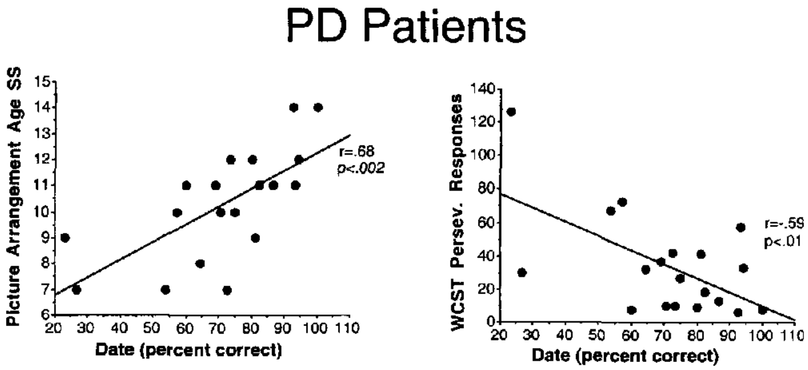

Figure 4. Scatterplots of Date Recognition scores and Picture Arrangement scores and the number of perseverative (persev.) responses on the Wisconsin Card Sorting Test (WCST; Heaton, 1981). PD = Parkinson's disease; SS = scaled score.

Photo Naming of presidential candidates). These findings are particularly striking in light of the impaired performance the PD group showed on the Warrington's Word Recognition Test and WMS–R subtests relative to the NC group. These anterograde memory deficits remained even when the 4 PD participants who scored in the mild dementia range on the MMSE were excluded from the analyses. The relative sparing of remote memory for period-specific past public figures and events in the face of impaired explicit anterograde memory tasks provides additional evidence for the dissociability of anterograde and remote memory processes, previously documented in other clinical populations (Shimamura & Squire, 1986). Performance differences could also reflect differences in test sensitivity or difficulty between the remote and anterograde memory measures, but this is unlikely to completely explain the differences between anterograde and remote memory measures in the PD group. Although the PD participants with mild dementia were significantly worse than the unimpaired PD participants on anterograde but not remote memory measures, the AD participants with comparable MMSE scores to the PD participants with mild dementia scored worse than this PD group on remote but not anterograde memory measures. If the differences between the remote and anterograde measures were simply a reflection of test sensitivity or difficulty, one could expect that the AD and PD participants matched for dementia severity would perform at a similar level to each other, but this was not the case. The association between anterograde memory impairment and disease-specific neural dysfunction in PD is further enhanced by the fact that anterograde memory, but not remote memory, function declined with disease severity.

The dissociability between anterograde and remote memory in PD likely reflects the underlying neuropathological substrates associated with this disease. The anterograde memory impairment may result from disruption of the mesolimbic pathways and associated dopaminergic depletion (Alexander, DeLong, & Strick, 1986), whereas the relatively less compromised cortical regions may be able to successfully mediate remote memory functions in PD. By contrast, the neuropathology of AD involves hippocampal formation abnormalities, which underlie the anterograde deficits (Deweer et al., 1995; Fama et al., 1997; Killiany et al., 1993; Laakso et al., 1995) and cortical association areas, particularly temporal and posterior cortical association areas, which likely contribute to the remote memory deficits observed. The relationship between remote memory impairments and cortical abnormalities have been reported by a number of researchers (Damasio & Damasio, 1993; Squire, Knowlton, & Musen, 1993; Kapur et al., 1994; Kapur, Ellison, Smith, McLellan, & Burrows, 1992; see Kopelman, 1993, for a review). In particular, studies of focal lesions and of frontotemporal dementia have shown associations between impaired memory for remote events (Kapur et al., 1992, 1994; Kapur, Young, Bateman, & Kennedy, 1989) and for semantic knowledge (Hodges, Patterson, Oxbury, & Funnell, 1992) and the temporal neocortex. Thus, differences between the AD and PD groups on remote memory measures, despite similarly impaired anterograde memory performance, may reflect the different pattern and severity of cortical abnormalities associated with these two diseases. Relative to PD, AD generally results in more diffuse cortical abnormalities, particularly in the posterior cortical regions that may underlie the remote memory impairment observed in the AD group.

In contrast to previous studies (cf. Sagar et al., 1988), the PD group did not differ significantly from the control group in dating of public events, although there was a slight drop in the percentage of correctly dated elections in the most recent time period relative to more remote periods. Thus, unlike the AD patients, the PD patients were generally able to make use of externally organized contextual information available in the regularity of presidential elections and of cues gleaned from the time-associated foils on the recognition trials to make judgments about dates and sequences of the presidential candidates. In addition, compared with the PD group in the Sagar et al. (1988) study, our PD patients appeared more cognitively intact; 4 out of 20 PD patients scored below 25 points on the MMSE but only in the mildly impaired range (22–24 points), whereas 3 of the 23 PD patients in Sagar et al.'s study met *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., American Psychiatric Association, 1980) criteria for clinically detectable dementia and an additional 7 patients scored in the impaired range on the Blessed Dementia Scale (Blessed, Tomlinson, & Roth, 1968). However, although discrepancies between studies may be due to the differences in level of dementia severity of the PD groups, we found that our mildly impaired PD patients performed at the level of the unimpaired PD group on remote memory measures but performed significantly worse on a number of anterograde memory measures. By contrast, these mildly impaired PD patients scored at the level of their AD counterparts (similar MMSE scores) on anterograde memory measures but scored significantly better than these AD participants on the remote memory measures. It may be that the differences in performance in the PD patients between the present study and that of Sagar et al. are, at least partially, a result of the differences in task demands of the two remote memory measures rather than simply a result of differences in dementia severity of the participants.

Date recognition in the PD group showed associations with frontal–executive functioning and explicit memory functioning. Although these results are consistent with previous studies (Beatty & Monson, 1990; Sagar et al., 1988; Sullivan & Sagar, 1989; Sullivan et al., 1989) reporting relationships between contextual memory and tests of sequencing and temporal ordering, contextual memory was also associated with anterograde episodic memory tasks. Consistent with Kopelman's (1989) finding with AD and Korsakoff's participants, we did not observe a selective association between impairment on frontal tasks and contextual memory in our PD participants. Overall, contextual memory impairment appears to be both reflective of executive dysfunction and primary memory dysfunction in this PD group.

Limitations of a remote memory study such as this include the inability to assess how interest in presidential elections and exposure to such material affect individual performance. This limitation, however, is shared with any nonautobiographical remote memory measure.

This study provides evidence for the position that remote memory comprises multiple component processes and further that a variety of mnemonic and nonmnemonic processes contribute to content and contextual remote memory performance in AD and PD. The pattern of sparing of remote memory and impairment of anterograde memory in PD also substantiates a dissociability of these mnemonic processes. To the extent that this Presidents Test assesses established semantic memory, the results of this study provide further evidence for either the inaccessibility or actual degradation of semantic knowledge in AD and its relative preservation in PD.

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