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Normal Aging and Prospective Memory

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We develop a laboratory paradigm for studying prospective memory and examine whether or not this type of memory is especially difficult for the elderly. In two experiments, young and old subjects were given a prospective memory test (they were asked to perform an action when a target event occurred) and three tests of retrospective memory (short-term memory, free recall, and recognition). From the perspective that aging disrupts mainly self-initiated retrieval processes, large age-related decrements in prospective memory were anticipated. However, despite showing reliable age differences on retrospective memory tests, both experiments showed no age deficits in prospective memory. Moreover, regression analyses produced no reliable relation between the prospective and retrospective memory tasks. Also, the experiments showed that external aids and unfamiliar target events benefit prospective memory performance. These results suggest some basic differences between prospective and retrospective memory.

Prospective memory is memory for activities to be performed in the future, such as remembering to purchase a loaf of bread on the way home or remembering to give someone a telephone message. This type of memory contrasts with retrospective memory, which is memory for past events, such as remembering the characters from a movie or remembering the words from a list learned in an experiment. One often noted deficiency in the memory literature is that, unlike retrospective memory, we know very little about prospective memory (Baddeley & Wilkins, 1983; Ceci & Bronfenbrenner, 1985; Harris, 1983). This lack of research on prospective memory is a serious gap in the literature because many memory situations are prospective (Dobbs & Rule, 1987; Meacham & Leiman, 1982). For older adults, who often have special needs such as remembering to take medication and meeting health-related appointments, prospective memory functioning is of utmost importance.

Beyond filling a gap in the literature, there are strong theoretical reasons for investigating prospective memory in the elderly. A consistent finding in the aging and memory literature is that many types of memory tests show age-related declines, whereas others do not (Craik & McDowd, 1987; Mitchell, 1989). A challenge for theories of aging is anticipating which memory tasks are especially difficult for older subjects. One currently influential theory of aging (Craik, 1986) suggests that prospective memory should be particularly problematic for the elderly. This suggestion follows from Craik's view that remembering involves resurrecting prior mental states and that reinstatement of these states can be prompted from internal and/or external sources. Whereas external cues (such as contextual cues) often guide the reconstruction of an event, these types of cues are not always available. In the absence of external cues, reconstruction of an event relies mainly on self-initiated cues or processes. In trying to account for why aging disrupts performance on some types of memory tasks more than others, Craik proposed that aging interferes mainly with self-initiated retrieval processes. Craik marshalls support for this theory by finding larger age-related decrements for free and cued recall tasks than for recognition tasks (Craik, 1986; Craik & McDowd, 1987).

According to Craik's (1986) taxonomy, prospective memory is the memory task that requires the greatest degree of self-initiation. This is so because prospective memory requires that persons remember to remember in the first place. In this sense, it differs from retrospective memory tasks, in which the experimenter initiates or requests remembering. Thus, Craik's theory predicts large age-related decrements in prospective memory. At present, however, this prediction is difficult to evaluate because few studies have investigated age differences in prospective memory. Moreover, the few studies that have been conducted have not produced a clear pattern of results, possibly because they were conducted in natural settings where there is little control over the aids and strategies that subjects use.

The typical procedure used to study prospective memory has involved asking subjects to perform some action in naturalistic settings (such as telephoning the experimenter or sending in a questionnaire) at specified times in the future. For example, West (1988, Experiment 1) asked young and old subjects to call the experimenter on the telephone at a particular time one evening and also to send in a postcard on a specified date. For both of these tasks, there were no reliable differences between young and old subjects. (Similar results with a telephone calling procedure were obtained by Poon & Schaffer, 1982.) Somewhat different results were obtained in an experiment by Dobbs and Rule (1987). During an inter-

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view session, subjects were asked to write the date and time in a certain location on a take-home questionnaire that they were to return later. The results showed no age-related differences when the experimenters used a strict criterion for scoring memory (writing both the date and time in the correct location), but they showed a reliable decrease in prospective memory with age when a lax criterion (writing either the date or time in any location) was used.

The paucity and inconsistency of findings on age-related differences and prospective memory suggest the need for further research. Craik's (1986) theory predicts large age-related decrements only when there are few or no external cues to prompt or guide retrieval. In natural settings, age-related deficits in prospective memory may not emerge because subjects may use external cues to help guide retrieval. In remembering to send something on a given day or to make a phone call at a given time, subjects have available a variety of external cues, like calendars and notes, to help them remember. When external cues are available, subjects do not have to rely on self-initiated retrieval processes, and therefore age-related decrements may not be present. To test this possibility directly, our first experiment examined age-related prospective memory performance with and without external memory aids.

Another, and perhaps more basic, issue concerning prospective memory is whether or not prospective memory and retrospective memory are related. This is an important question because to the extent that there are similarities between the two types of memory, we can benefit from the extensive retrospective memory literature in understanding and improving prospective memory processes. As it now stands, the evidence on this issue is equivocal (see Loftus, 1971, for data suggesting that similar processes underlie prospective and retrospective memory and see Meacham & Leiman, 1982, and Wilkins & Baddeley, 1978, for data supporting an opposing perspective). We study this issue in the present research by including three measures of retrospective memory (short-term memory capacity, free recall, and recognition), in addition to a measure of prospective memory. These three retrospective measures were chosen on the basis of Underwood, Boruch, and Malmi's (1978) research showing that these tasks are not highly related and therefore represent a broad variety of retrospective memory tasks.

Experiment 1

One factor that has no doubt contributed to the scarcity of research on prospective memory is the lack of an accepted experimental paradigm for studying prospective memory. The groundbreaking research in prospective memory involved having subjects return postcards from home (Meacham & Leiman, 1982; Meacham & Singer, 1977). West (1988), in the area of aging, asked subjects to telephone the experimenter at a certain time. Although these studies proved stimulating, they suffer from a variety of control problems. As mentioned above, these methods are problematic in the sense that they do not allow strict control or assessment of the memory strategies that subjects use. Additionally, there is no control over compliance. Subjects may remember, but for one reason or another (e.g., they happen to be busy or tired on that particular day) they may not comply with the instructions.

Because of these problems, our approach was to develop a laboratory method for studying prospective memory. The essential characteristic of our paradigm was to have subjects busily working on one task, while at the same time requiring them to perform an activity at future specified times. Toward this end, the prospective memory portion of our experiment was embedded within a short-term memory task. This task involved presenting subjects with a set of words on each trial and then having them recall the words. At the start of the experiment, subjects were also given the prospective memory instruction that if they happened to see a particular word (hereafter called the *target event*), they were to press a response key on the keyboard in front of them. Three of these target words appeared across the 42 short-term memory trials, and our measure of prospective memory was the number of times subjects remembered to press the response key (and the latency of responding) when the target event occurred.

The purpose of the present research was to investigate age-related issues in prospective memory. In the first experiment, we compared the prospective memory of young and elderly subjects, and we varied whether or not they were allowed to create and use an external memory aid.

Method

Design and subjects. The design was a 2 × 2 between-subjects factorial, with age of the subjects (young, old) and the opportunity to form an external aid (no aid, external aid) as the factors. Twelve subjects were assigned to each of the four groups. The young subjects were 17- to 24-year-old students at Furman University who participated either as a course requirement or for money. The older group of subjects consisted of 65- to 75-year-old alumni of Furman University who volunteered to participate in the research. The older subjects, whose mean age was 68.83, were recruited through mailings to Furman University alumni residing in a 30-mile vicinity of the campus. All elderly subjects were community dwelling, and they drove to campus to participate in the research. Subjects were tested individually, and each session lasted between 45–60 min.

All subjects were given the Weschler Adult Intelligence Scale-Revised (WAIS-R) vocabulary test, and the elderly (M = 57.88) scored significantly higher than the young (M = 50.17), $F(1, 46)$ = 30.89, MS_e = 23.09.[1]

Materials and procedure. This experiment, which was advertised to subjects as an experiment on increasing short-term memory capacity, consisted of presenting subjects with a variety of tasks. Initially, subjects were given the WAIS-R vocabulary test. Next, subjects were seated in front of an NCR Decision Mate V monitor and keyboard (which controlled the presentation activities for all of the memory tasks) and were given the short-term memory instructions. Subjects were reminded that the major purpose of the experiment was to study the extent to which they could improve their short-term memory capacity, and they were then given an overview of the short-term memory procedure. Subjects were told that they would be presented with a set of words for immediate recall on each of 42 trials. In order to focus attention on this task, they were told that recent research

[1] Standardized scores indicate that both young and elderly subjects performed above the national average for the WAIS-R verbal test. For age groups 18–19, 20–24, 55–64, and 65–67, the national average raw scores are 38–42, 44–48, 41–47, and 36–40, respectively.

had shown that short-term memory capacity can be dramatically enhanced by using a chunking strategy, and they were given an example of how this could be done with a set of words. Next, subjects were asked to read instructions on the cathode-ray tube (CRT) that described the elements of the short-term memory trials. Each trial consisted of (a) a "Prepare for Trial" signal that appeared in the middle of the computer screen for 1.5 s, (b) the presentation of a set of words in the center of the computer screen for a period of time equal to 0.75 s per item (the set of words appeared simultaneously), and (c) the presentation of a "Recall" signal, which was the prompt for subjects to recall the words orally and in order. The recall period allowed 1.5 s per item, and this period was tape-recorded. After reading the instructions, subjects were presented with three practice trials and then given the opportunity to review the instructions and to repeat the practice trials.

The prospective memory test was embedded within this short-term memory task. After the short-term memory instructions, subjects were told that we had a secondary interest in their ability to remember to do something in the future. Specifically, they were told that we wanted them to press a response key on the computer keyboard whenever a particular target event occurred. For all subjects, the target event was the word *rake*, and it appeared three times across the 42 test trials. Subjects were not told how often the target event would appear across the test trials. Subjects in the no-aid condition were simply told to press the response key whenever they saw the word *rake*. Subjects in the external-aid condition were given 30 s to formulate some type of memory aid. To facilitate the creation of an external aid, we had rubber bands, paper clips, Scotch tape, erasers, paper pads, scissors, a stapler, and pens in front of subjects. These objects were present for all subjects, but only external-aid subjects were allowed to use them. At the end of 30 s, the experimenter recorded the particular memory aid constructed by the subjects. Subjects who did not use an obvious external aid were asked at the end of the experiment to describe any internal strategies that they may have used.

Pilot research suggested that introducing a delay between the prospective memory instructions and the actual short-term memory trials was helpful for producing sufficient prospective memory forgetting. Thus, after receiving the prospective memory instructions, subjects were told that they would be performing several other memory tasks prior to receiving the short-term memory test trials. Subjects were then given intentional learning instructions for a free recall task. The free recall procedure involved presenting subjects with a 36-item categorized list, consisting of 6 items from each of 6 categories selected from the Battig and Montague (1969) norms. Each item was presented for 4 s in the center of the CRT, and the presentation order was randomly determined for each subject. After all items had been presented, subjects were given 3 min to recall orally, and their recall was tape-recorded. Next, subjects were given intentional learning instructions for a recognition test and presented with a 56-item unstructured list, which was constructed by selecting one familiar item from each of the 56 categories in the Battig and Montague norms. Each of these items was presented for 2 s in the center of the CRT, and each subject received a random order. Next, subjects were given the recognition test, consisting of the 56 old items randomly intermixed with 56 new items (the distractors were selected in the same manner as the target items). Subjects were allowed 5 min to circle the old items.

After performing these two tasks, which together lasted about 15 min, subjects were told that they would now be presented with the short-term memory trials. The short-term memory instructions were summarized, and we again encouraged them to use organizational and chunking strategies to improve their short-term memory capacity. To focus their attention on this task and to motivate them to try chunking techniques, we described the improvements reported by Ericsson and Chase (1982). No mention was made of the prospective memory task.

Subjects were then presented with three new short-term memory practice trials, and these were followed by the 42 test trials. The 42 test trials consisted of 7 blocks of 6 trials each, with 10-s rest periods between blocks. The word sets for the 42 test trials were randomly selected from a pool of 26 one- and two-syllable familiar words. The number of words in each of the 42 word sets varied from 4 to 9 for the younger subjects and 3 to 8 for the elderly subjects. This variation across age was selected because pilot research indicated that this equated the functional difficulty of the short-term memory task for the two age groups. The target events occurred as the second, third, or fourth word within a word set for all subjects. For half the subjects, the target items appeared in Blocks 1, 4, and 6, and for the other subjects, they appeared in Blocks 2, 5, and 7. Otherwise, the positions of the word sets containing the target events were determined randomly, with the restriction that these word sets appear in the middle two trials of a block of trials.

Following the short-term memory trials, subjects were given a questionnaire asking them to rate the degree to which they thought about the prospective memory task during different parts of the experiment.

Results and Discussion

Unless otherwise indicated, the rejection level for all analyses was set at .05. For most dependent measures, we performed a 2 × 2 between-subjects analysis of variance (ANOVA), including the variables of subject age and memory-aid condition. Despite the fact that the memory-aid variable applies only to the prospective memory measure, we included this variable in all of the analyses because it allows parallel comparisons of retrospective and prospective memory tests. Below, we first report the analyses associated with the retrospective memory measures and then those associated with prospective memory. Next, we present multiple regression analyses that examine the relation between prospective and retrospective memory, and finally, we present analyses performed on the questionnaire data.

Retrospective memory. We scored free recall for the proportion of items correctly recalled. As can be seen in Table 1, there was a main effect of age—young subjects recalled more items than did elderly subjects, $F(1, 44) = 8.19$, $MS_e = 0.020$. There was no effect of memory-aid condition ($F < 1$), and the lack of an interaction between the variables ($F < 1$) indicated that the age-related deficit in free recall occurred for both the no-aid and memory-aid conditions. Similar results emerged with recognition performance. To adjust for guessing, we computed a recognition score based on hits and false alarms (Zechmeister & Nyberg, 1982). As shown in Table 1, the young subjects outperformed the elderly on this measure of recognition, $F(1, 44) = 7.62$, $MS_e = 0.024$.[2] Neither the

[2] Ostensibly, the age-related deficit in recognition seems to be at odds with studies reporting small or no age differences in recognition (Craik, 1986; Craik & McDowd, 1987). For example, Craik (1986) found large age-related deficits with a free recall task and none with a recognition test. In his paradigm (see also Craik & McDowd, 1987), the presentation parameters were identical, regardless of the type of criterial task. On the other hand, in our experiment, the acquisition list for recognition contained more and different items and was presented more rapidly than the acquisition list for free recall.

Table 1
Retrospective and Prospective Memory Measures as a Function of Age and Memory Aid Condition in Experiment 1

	Young		Elderly	
Dependent measure	No aid	Memory aid	No aid	Memory aid
WAIS-R	52.00	48.33	58.67	57.08
Free recall[a]	.58	.54	.46	.43
Recognition score[b]	.69	.73	.58	.60
Short-term memory—trials[c]	.30	.32	.43	.33
Short-term memory—items[d]	.70	.70	.71	.65
Prospective memory[e]	.47	.83	.47	.69

Note. WAIS-R = Wechsler Adult Intelligence Scale-Revised.
[a] Probability of recall.
[b] p(hits) − p(false alarms)/1 − p(false alarms).
[c] Proportion of trials correctly recalled.
[d] Mean proportion of items per trial.
[e] Proportion of correct responses.

main effect of memory-aid condition ($F < 1$) nor the interaction ($F < 1$) approached significance.

To examine short-term memory performance, we calculated the proportion of trials on which subjects recalled all items correctly and in order. As can be seen in Table 1, older subjects recalled a greater proportion of word sets than did younger subjects, $F(1, 44) = 4.59$, $MS_e = 0.014$. This result is understandable in light of the fact that the word sets were shorter for elderly subjects. There was no reliable effect of memory-aid condition, $F(1, 44) = 1.48$, and the interaction between age and memory-aid condition did not reach the a priori significance level, $F(1, 44) = 3.22$. Short-term memory performance was also scored by computing the average proportion of items recalled on each trial. As shown in Table 1, these proportions were similar in each group, and the analysis of these data produced no reliable effects of age, memory-aid condition, or the interaction, $F < 1$, $F(1, 44) = 1.51$, $MS_e = 0.008$, $F(1, 44) = 1.64$, respectively.

Prospective memory. Initially, two measures were used to analyze prospective memory performance. One was the proportion of correct prospective memory responses, which was the number of times out of three that subjects remembered to press the response key when the target event occurred. For this measure, a response was considered correct if it occurred sometime between the presentation of the target event and the end of that block of trials. The other measure was the latency between the onset of the target item and the occurrence of a correct response. Subjects who failed to make a response before the end of the block of trials were given a response time of 29.25 s (the minimum time possible between the onset of a target and the end of the block of trials). In all of our analyses, these two measures yielded the same conclusions, mainly because subjects tended to remember immediately after the occurrence of the target item or not at all. There were very few intermediate latencies; consequently, we report the proportion of correct responses measure because it is a more straightforward characterization of subjects' performances.

As can be seen in Table 1, there was no effect of age on prospective memory ($F < 1$). There was, however, a main effect of memory-aid condition, $F(1, 44) = 6.55$, $MS_e = 0.156$: Using a memory aid produced higher prospective memory. Importantly, there was no reliable interaction between the age and memory-aid variables ($F < 1$), indicating that the benefits of the memory aid were similar for the young and the elderly.

It was not the case that all subjects remembered the prospective memory task either on all three trials or not at all. Fifty percent of the young and 38% of the elderly remembered on all three trials, and 21% of the young and 29% of the elderly forgot on all three trials. Twenty-nine percent of young and 33% of elderly subjects remembered the prospective memory task on one or two of the prospective memory trials but not on all three trials.

Most subjects in the memory aid condition (83% of the elderly and 75% of the young) used an external strategy, which we defined as some manipulation of the external environment. The few subjects who did not use an external aid reported to us that they used an internal strategy such as rehearsal. We expected a good deal of variability in the type of external aids developed; however, all of the subjects using an external strategy wrote the target event on a piece of paper, and most taped this piece of paper to the CRT. In short, young and old subjects did not differ in the nature of the aids developed.

Relations between prospective and retrospective memory. We performed several multiple regression analyses to examine the relations among the various memory tasks used in the present study. Multiple regression analyses were performed rather than zero-order correlations because several of the memory measures were influenced by different variables, and these influences could obscure detection of relations. For example, age affected retrospective memory performance, and the memory-aid variable influenced prospective memory. A separate multiple regression analysis was performed for each of the following dependent measures: proportion of correct prospective memory responses, proportion of trials correctly recalled from the short-term memory task, proportion of items recalled from the free recall test, and recognition score. For each analysis, all of the above variables were included as predictor variables (except when the variable was a criterion variable) plus the dichotomous variables of age and strategy condition, and all predictor variables were entered simultaneously. The standardized beta coefficients and the percentage of explained variance in each analysis are listed in Table 2. As can be seen, prospective performance was related to memory-aid condition, but is was not related to performance on any of the retrospective memory tasks. There were relations, however, among the retrospective memory measures, with recall performance being significantly related to recognition performance and vice versa. Performance on the short-term memory task was not significantly related to any of the other

Whereas Craik's (1986) acquisition procedures were selected to compare directly the roles of self-initiated processes in recall and recognition, our procedures were borrowed from Underwood et al. (1978) and were intended to produce a diverse set of retrospective tasks.

Table 2
Standardized Beta Coefficients for Regression Analyses Predicting Prospective Memory, Short-Term Memory, Free Recall, and Recognition Performance in Experiment 1

	Criterion variable			
Predictor variable	Prospective memory	Short-term memory	Free recall memory	Recognition memory
Age	−.03	.36*	−.27**	−.16
Memory aid	.34*	−.16	−.15	.12
Prospective memory	—	.14	.00	.20
Short-term memory	.13	—	.21	−.11
Free recall	.00	.28	—	.46*
Recognition	.26	−.15	.47*	—
R^2	.21	.18	.39	.39

Note. Each column represents a separate multiple-regression analysis.
* $p < .05$. ** $p < .06$.

memory measures. The relations (or the lack thereof) among the retrospective memory tasks are consistent with other correlational analyses of retrospective memory tasks (Underwood et al., 1978).

Questionnaire. To examine factors related to prospective memory performance, we analyzed subjects' responses to the monitoring questionnaire. This questionnaire contained four items, which asked subjects to estimate (on a 7-point scale, with 1 indicating *not at all* and 7 indicating *all the time*) the degree to which they monitored or thought about the prospective memory task during various phases of the short-term memory trials (i.e., during the "Prepare for Trial" signal, during the presentation of the word set, during the recall periods, and during the rest periods between blocks of trials). These ratings were included in a 2 × 2 × 4 mixed ANOVA, with age and mnemonic aid as the between-subjects variables and short-term memory phase as the within-subjects variable.

The means for the various cells in this design are shown in Table 3. As indicated by a main effect of phases, $F(3, 132) = 12.42$. $MS_e = 2.26$, subjects tended to think about the prospective memory task more often during word set presentation ($M = 3.33$) than during the other phases ($M = 1.86$). Also, elderly subjects indicated that they thought about the prospective memory task less often than did young subjects, $F(1, 44) = 4.58$, $MS_e = 6.23$, but this effect was qualified by a marginally significant interaction between age and memory-aid condition, $F(1, 44) = 3.86$, $MS_e = 6.23$, $p < .20$. This interaction reflects the finding that monitoring levels were very similar for young ($M = 2.19$) and old ($M = 2.13$) subjects in the no-aid condition but that these ratings were much higher for young ($M = 3.04$) than old ($M = 1.56$) in the memory-aid condition. For some reason, external aids increased the frequency (or at least, rated frequency) of thinking about the prospective memory task more for young subjects than elderly subjects. No other effects approached significance (all $Fs < 1.01$).

Correlations performed between monitoring ratings during each phase of the short-term memory task and prospective memory performance revealed that rated frequency of thinking about the prospective memory task during word-set presentation was highly correlated with prospective remembering, $r(46) = .59$, $p < .01$. Monitoring ratings during the other short-term memory phases were not correlated with prospective memory performance (all $rs < .19$).

To summarize, the results of Experiment 1 run counter to the view that prospective memory should be especially problematic for elderly subjects. Young and old subjects did not differ on prospective memory, and this was the case even in the no-aid condition. The failure to find age differences in the no-aid condition suggests one of two possibilities. Either memory deficits in the elderly are not entirely due to problems in self-initiated retrieval, or certain kinds of prospective memory situations incorporate or have retrieval cues embedded in them. Inasmuch as the action that is to be performed in our task is appropriate only when a target event occurs, this latter view seems reasonable. We explore some implications of this analysis in Experiment 2 by varying the characteristics of the target event (i.e., retrieval cue).

Experiment 2

The goals of Experiment 2 were to test again the effects of age on prospective memory and to test the idea that retrieval cues are present and play a role in certain prospective memory situations. By our analysis, two components are necessary for successful prospective memory performance (see Dobbs & Rule, 1987, for a similar view). Specifically, one must remember the activity that is to be performed, and one must also remember to perform the activity at the appropriate time. For example, when asked to give someone a message, one must remember the message and the person to whom it is to be given, *and* one must remember to do this at the appropriate time. If remembering occurs after the person has left, then it is too late, and forgetting has occurred. The first component (remembering what one is supposed to do) is usually quite simple and is usually not forgotten. Although we sometimes forget what we planned to do (e.g., sometimes we find ourselves in the kitchen and have forgotten why we walked there in the first place), most often it seems that we forget to perform the action at the proper time. In other words, the problem is that the target event did not prompt the memory. This interpretation is consistent with informal reports from subjects in Experiment 1, as well as from subjects in our pilot experiments. Subjects who forgot were asked at the end of the

Table 3
Prospective Memory Monitoring Ratings During the Different Phases of the Short-Term Memory Task in Experiment 1

	Young		Elderly	
Phases	No aid	Memory aid	No aid	Memory aid
Prepare for trial	1.67	2.83	2.42	1.50
Word-set presentation	3.42	4.50	2.83	2.58
Recall periods	1.67	2.08	1.58	1.08
Rest periods	2.00	2.75	1.67	1.08

Note. Monitoring ratings were made on a scale from 1 to 7, with 7 indicating more frequent monitoring.

experiment to tell us why they forgot. Nearly all subjects reported that they remembered what they had to do, but they simply forgot (did not think) of the action to be performed when the target event occurred.

From this perspective, successful prospective memory depends on the triggering of the action by the target event. If this is the case, then varying the nature of the target event should influence prospective memory performance. Specifically, common and familiar target events have many preexisting associations, and these may interfere with prospective memory performance. By contrast, uncommon and unfamiliar target events have few preexisting associations and therefore might be expected to provide little interference with the prospective memory task. As an example, compare the task of giving a good friend a message versus giving a stranger a message. When you see your friend, you are likely to think of good times, how much you like your friend, and these thoughts are likely to interfere with remembering to give your friend the message. When you see a stranger, you do not have all these preexisting associations to interfere with the memory. These expectations about the familiarity of an event are based on past theoretical work in the retrospective memory literature by Watkins and Watkins (1975) and Anderson (1985). In general, these theories predict that the more ideas are associated with an event, the less efficacious that event will be for retrieval of those ideas.

Another potentially important aspect to unfamiliar and uncommon target events may be relevant for prospective memory performance. Ordinarily, uncommon events are distinctive with respect to the local context. This distinctiveness may alert the subject to view the target event as something other than part of the ongoing task—that is, alerting subjects that it is also a cue for remembering to perform an action.

These ideas suggest that prospective memory should be better with an uncommon and unfamiliar target event than with a common and familiar target event. In the present experiment, we varied the familiarity of the target event, with the target event always appearing in the context of mainly familiar items. Half the subjects were asked to press a response key whenever a familiar target event (*rake*, *method*) occurred, and half the subjects were asked to press a response key when an unfamiliar target event occurred (*sone*, *monad*).

Method

Subjects and design. The design of this experiment was a 2 × 2 between-subjects factorial, in which the variables of age (young, elderly) and familiarity of the target event (familiar, unfamiliar) were varied. The 24 elderly subjects in this experiment were 60- to 78-year-old Furman University alumni whose mean age was 67.33. As in the first experiment, these were community-dwelling subjects who drove to campus to participate in the research. The young subjects were 17- to 24-year-old college students who received course credit or money for their participation. All subjects were tested individually, and experimental sessions lasted between 45 and 60 min.

All subjects were administered the WAIS-R vocabulary test. Consistent with the results of the first experiment, vocabulary scores were higher for elderly (M = 56.92) compared with young (M = 51.92 subjects, $F(1, 46) = 8.27$, $MS_e = 36.30$.

Materials and procedure. The sequence of events and the procedures for this experiment were identical to those of the first experiment, except for the following changes in the short-term memory/prospective memory portion of the experiment. First, all subjects were given what is equivalent to no-aid instructions; that is, their prospective memory instructions involved simply telling them to press a response key whenever they saw the target event. Second, the word sets for the short-term memory trials ranged in size from five to seven items for young subjects and from four to six items for old subjects. This change was made because subjects in Experiment 1 had difficulty recalling larger word sets. Third, word sets for the short-term memory trials contained both familiar and unfamiliar items. As in the first experiment, items for the word sets were randomly selected from a pool of 26 items, but the pool of items contained 21 familiar words and 5 unfamiliar words. The words were selected from the Toglia and Battig (1978) norms, with familiar words selected from Clusters 4–8 and unfamiliar words selected from rare words contained in Cluster 1. Fourth, half of the subjects in the familiar condition were given the word *rake* as a target event, and the others were given the word *method*. In the unfamiliar condition, the target event for half of the subjects was the word *sone*, and for the other half it was the word *monad*.

Results

Retrospective memory. The retrospective memory data are presented in Table 4 as a function of subject age and target-event familiarity. Analyses of the free recall and recognition data yielded patterns similar to those obtained in the first experiment, with young subjects outperforming elderly subjects. For free recall, there was a reliable effect of age, $F(1, 44) = 8.59$, $MS_e = 0.017$, and neither the effect of target-event familiarity nor the interaction was reliable, $F < 1$, and $F(1, 44) = 3.09$, respectively. Similarly, analysis of the recognition scores (using the formula described in Experiment 1) yielded only a main effect of age, $F(1, 44) = 9.04$, $MS_e = 0.032$ (all other Fs < 1).

As can be seen in Table 4, the proportion of short-term memory trials correctly recalled was roughly equal in the different conditions. There were no reliable effects of age or familiarity condition, and there was no interaction between these variables, $F < 1$, $F < 1$, and $F(1, 44) = 1.71$, MS_e =

Table 4
Retrospective and Prospective Memory Measures as a Function of Age and Cue Familiarity in Experiment 2

	Young		Elderly	
Dependent measure	Familiar	Unfamiliar	Familiar	Unfamiliar
WAIS-R	53.33	50.50	57.42	56.42
Free recall[a]	.58	.51	.41	.47
Recognition score[b]	.76	.68	.55	.58
Short-term memory—trials[c]	.47	.38	.38	.43
Short-term memory—items[d]	.86	.82	.76	.80
Prospective memory[e]	.28	.83	.36	.94

Note. WAIS-R = Wechsler Adult Intelligence Scale-Revised.
[a] Probability of recall.
[b] p(hits) − p(false alarms)/1 − p(false alarms).
[c] Proportion of trials correctly recalled.
[d] Mean proportion of items per trial.
[e] Proportion of correct responses.

0.043, respectively. When short-term memory performance was analyzed in terms of the proportion of items recalled on each trial, however, there was a reliable main effect of age, $F(1, 44) = 4.65$, $MS_e = 0.010$, with the young performing better than the elderly. The effect of familiarity ($F < 1$) and the interaction, $F(1, 44) = 1.87$, were not reliable. Overall, these analyses indicate that the short-term memory task was fairly equal in difficulty for both age groups, and if anything, it was slightly more difficult for the elderly.

Prospective memory. Prospective memory was scored for the proportion of correct responses and the latency to respond on each trial. As in the first experiment, these measures produced identical conclusions, and we present only the proportion of correct responses measure. As shown in Table 4, prospective memory was nearly three times higher with an unfamiliar target event than with a familiar target event, $F(1, 44) = 31.29$, $MS_e = 0.124$. Also, there was no effect of age ($F < 1$) and no interaction between age and target-event familiarity ($F < 1$). In general, these results are consistent with those of the first experiment in showing that prospective memory is not affected by age. Moreover, they support the theoretical ideas presented earlier suggesting that uncommon and unfamiliar target events produce better prospective memory.

As in the first experiment, the majority of subjects remembered the prospective memory task either on all three trials (46% of the young and 54% of the elderly remembered on all three trials) or not at all (37% of the young and 25% of the elderly forgot on all three trials). A sizeable percentage of subjects, however, (17% of the young and 21% of the elderly) remembered the prospective memory task on one or two of the prospective memory trials but not on all three trials.

Relations between prospective and retrospective memory. To test for similarities between prospective and retrospective memory processes, we performed multiple regression analyses like those described in Experiment 1. A separate multiple regression analysis was computed for the criterion measures of proportion of correct prospective responses, proportion of trials correctly recalled from the short-term memory task, proportion of items recalled from the free recall task, and corrected recognition score. These variables, as well as the dichotomous variables of age and familiarity condition were included as predictors in each analysis (clearly, a particular variable was not included as a predictor when it was a criterion variable), and all variables were entered simultaneously. As can be seen in Table 5, the results were highly consistent with those of Experiment 1. That is, prospective memory performance was not reliably associated with performance on any of the other retrospective memory tasks, short-term memory performance was not related to performance on any of the other memory tasks, and free recall scores were positively related to recognition scores. Once again, the observed relations among the retrospective memory measures are consistent with previous findings (Underwood et al., 1978).

Questionnaire. Subjects rated (on a scale from 1, *not at all*, to 7, *all the time*) the frequency with which they thought about the prospective memory task during each of four phases of the short-term memory task ("Prepare for Trial" signal, word-set presentation, recall period, and rest periods between blocks). These monitoring ratings were included in a 2 × 2 × 4 mixed ANOVA, with age and target-event familiarity as the between-subjects variables, and short-term memory phase as the within-subjects variable. The means for each condition are shown in Table 6.

Consistent with the results of Experiment 1, there was a main effect of phases, $F(3, 132) = 19.22$, $MS_e = 2.71$, indicating that subjects thought more about the prospective memory task during presentation of the word sets ($M = 3.83$) than during the other phases ($M = 1.74$). There was also a Familiarity × Phases interaction, $F(3, 132) = 5.52$, $MS_e = 2.71$, indicating that unfamiliar target events increased monitoring ratings relative to familiar target events but only during word-set presentation. Neither the main effect of age ($F < 1$) nor the interactions (Fs < 2.64) involving age were reliable. This failure to find age effects on monitoring is consistent with the results of the no-aid instructions in Experiment 1.

To determine if the rated frequency of thinking about the prospective memory task was related to prospective memory, correlations were performed between monitoring ratings during each phase and prospective memory performance. The monitoring ratings during the presentation of the word sets were highly correlated with prospective memory performance,

Table 5
Standardized Beta Coefficients for Regression Analyses Predicting Prospective Memory, Short-Term Memory, Free Recall, and Recognition Performance in Experiment 2

	Criterion variable			
Predictor variable	Prospective memory	Short-term memory	Free recall memory	Recognition memory
Age	.10	.03	−.12	−.26*
Familiarity	.64*	−.16	−.02	.06
Prospective memory	—	.18	−.06	.00
Short-term memory	.11	—	−.03	.18
Free recall	−.05	−.04	—	.44*
Recognition	.00	.27	.50*	—
R^2	.44	.08	.32	.39

Note. Each column represents a separate multiple-regression analysis.
* $p < .05$.

Table 6
Prospective Memory Monitoring Ratings During the Different Phases of the Short-Term Memory Task in Experiment 2

	Young		Elderly	
Phases	Familiar	Unfamiliar	Familiar	Unfamiliar
Prepare for trial	2.58	1.83	1.58	1.42
Word-set presentation	2.58	4.58	3.08	5.00
Recall periods	1.50	1.00	1.33	3.08
Rest periods	2.25	1.42	1.33	1.63

Note. Monitoring ratings were made on a scale from 1 to 7, with 7 indicating more frequent monitoring.

$r(46) = .68$, $p < .05$. These correlations were much lower and not reliable when prospective memory performance was correlated with monitoring ratings during the other phases, all $rs(46) < .26$.

Given that monitoring ratings were performed by subjects at the end of the experiment, the ratings need to be interpreted carefully. For example, rather than indicating the degree to which subjects thought about the prospective memory task, the monitoring ratings may simply reflect subjects' perception of how well they did on the prospective memory task. The idea that subjects' prospective memory performance was influencing their monitoring ratings, however, is not consistent with the finding that the ratings were consistently phase sensitive (i.e., monitoring ratings were related to memory performance only during the word-set presentation phase). Overall, then, monitoring ratings seem to be a reasonable index of the frequency with which subjects thought about the prospective memory task.

General Discussion

We have developed what appears to be a sensitive laboratory paradigm for studying prospective memory. The advantage of a laboratory task for studying prospective memory is that it allows clear levels of control when evaluating the influence of variables. With this paradigm, our major finding was the lack of age-related deficits in prospective memory. This was the case regardless of the availability of external aids and regardless of the familiarity of the target event. Thus, prospective memory seems to be an exciting exception to typically found age-related decrements in memory. Importantly, this failure to find age-related deficits in prospective memory was not due to using an especially healthy or otherwise exceptional group of elderly, because there were reliable age differences in retrospective memory performance. Moreover, this failure to find age-related deficits was not due to using an insensitive paradigm for studying prospective memory, because our method was sensitive to the memory-aid (Experiment 1) and target-event familiarity (Experiment 2) variables.

One potential problem with studying prospective memory in the laboratory is that demand characteristics could lead subjects to constantly think about (continuously rehearse) the prospective memory task, thereby producing an unrealistic prospective memory situation. If this were the case, then one might expect (a) ceiling effects, (b) overall high levels of monitoring, and (c) an association between good prospective memory and poor short-term memory performance. Our pattern of results does not correspond to these expectations. Clearly, prospective memory performance was not at ceiling because subjects on average remembered the prospective memory task about 61% of the time. Moreover, other measures suggested that successful prospective memory was not the result of subjects' constantly thinking about the prospective memory task. In both experiments, monitoring levels were very low during all phases except word-set presentation, and even during this phase, the average rating was in the middle of the scale. Additionally, as was evident from the multiple regression analyses, there was no indication that successful prospective memory came at the expense of short-term memory performance. Finally, variables that increased prospective memory performance had no influence on the concurrent short-term memory task.

One possible reason for the failure to find age-related differences in prospective memory is that the elderly were more motivated than the young to perform the memory tasks. This interpretation, however, is not consistent with the finding that the elderly performed more poorly than the young on the free recall and recognition tests. Nonetheless, it is possible that the elderly, relative to the young, saw the prospective memory task as more important and thought about it constantly (i.e., monitored continuously during the short-term memory trials). This possibility is inconsistent with the monitoring results, which showed equivalent, and in some cases lower, monitoring levels for the elderly relative to the young.

The major theoretical impetus for the present research was Craik's (1986) theory that aging disrupts mainly self-initiated retrieval processes. This theory predicts large age-related decrements with memory tasks that place a high premium on self-initiated retrieval processes. Following Craik's classification, prospective memory should be especially difficult for the elderly because it requires that persons remember to remember. A common component of typical laboratory tests of retrospective memory (e.g., free recall, recognition, cued recall) is that the experimenter at some point prompts the subject to remember (i.e., an external source prompts initial remembering). As typically conceived, prospective memory differs from retrospective memory in that subjects themselves must prompt the remembering (i.e., an internal or self-initiated source prompts remembering). Our results were clear in showing that elderly subjects performed as well as young subjects, even when no external memory aids were available.

The view that prospective memory should be especially difficult for the elderly rests on the questionable assumption that all prospective memory tasks are alike in the sense that they are high in self-initiated retrieval. Perhaps a more reasonable view is that prospective memory tasks, like retrospective memory tasks, vary in the degree to which they require self-initiated retrieval processes for successful memory. For example, consider the tasks of "giving someone a telephone message" versus "going to a committee meeting at 4:00." Assume also that no external cues are used to help remember these prospective memory events. For the former task, which we will call an *event-based* prospective memory task, the to-be-performed action is to be done when a certain external event occurs. In this situation, there is an external cue (the person who is to receive the message) that prompts remembering, and in fact, remembering is appropriate only in the context of this external cue. By contrast, for the latter task, which we will call a *time-based* prospective memory task, subjects must remember to perform some action after a period of time has elapsed or at a certain time. In these cases, there is no obvious and specific external cue, and subjects must remember to monitor and initiate the prospective memory action on their own. From this perspective, event-based prospective memory tasks, like the one used in the present experiments (pressing a response key when a target event occurs), might not produce large age-related effects because they do contain external cues—ones that can serve to guide retrieval. On the other hand, time-based prospective memory tasks, because they involve more self-initiated retrieval than do event-based tasks, might be more likely to produce large age-related deficits. A promising direction for further research is to compare young and old subjects on event- and time-based prospective memory tasks.

Prospective and Retrospective Memory Comparisons

Our results indicate that there are no obvious relations between prospective memory and retrospective memory. In both experiments, there was no evidence that prospective memory performance was related to performance on any of the three retrospective memory tests. This lack of relation makes sense if one considers the components of a prospective memory task. Successful prospective memory requires (a) that you remember what has to be done (this includes remembering the action to be performed and the proper target event) and (b) that you remember to perform the action at the appropriate time or in response to the appropriate target event. For example, in our experiments, subjects had to remember that they were to press a particular response key on the keyboard when a particular target event occurred (the first component), and they had to remember to do this when the target event actually occurred (the second component).

Whereas the first component seems to be present in retrospective memory tasks, the second does not. If a person has access to a memory, it will be remembered on a retrospective memory test. This is so because retrospective memory tests (at least explicit tests of retrospective memory) are initiated by an experimenter, who at some point, clearly prompts the subject to recall or recognize. In a prospective memory task, the subject must recognize an event or a time as the stimulus for initiating a response. The lack of relation between prospective and retrospective memory is understandable in view of the fact that the retrospective memory component of our prospective memory task was minimally problematic for our subjects. When queried at the end of both experiments, subjects who forgot indicated that they remembered what they were supposed to do but simply didn't think of it when the target event occurred. Remembering the second, or prospective, component of the prospective memory task is what produced variability in performance, and given that this component does not exist in retrospective memory tasks (at least not in the retrospective memory tasks used in these experiments), one would not expect performance on retrospective memory tasks to be related to performance on a prospective memory task. This is not to say that prospective memory will never be correlated with retrospective memory. If the above analysis is correct, then the likelihood with which people remember to perform prospective memory tasks that have complex and difficult retrospective memory components might be expected to be related to retrospective memory ability.

The critical factor for successful prospective memory performance in our experiment, and probably in a lot of other prospective memory situations, seems to be that the target event triggers memory for the action that is to be performed. Often, when we experience certain target events, we are likely to process these events in a typical or even perfunctory fashion, and we are likely not to think of the event as a stimulus for a prospective memory action. This view is consistent with our findings that external aids and unfamiliar target events improve performance. Subjects who used external aids in Experiment 1 wrote the target event on a piece of paper and taped it in a visible location. This seemed to enhance the salience of the target event and made it more likely that subjects would think of the prospective memory task when the target event occurred.

In Experiment 2, an unfamiliar or uncommon target event benefited prospective memory performance. A familiar target event was less likely to produce successful prospective memory. There are at least two explanations for this pattern of results. First, unfamiliar events are likely to have fewer ideas associated with them, and this lack of competing associations, in turn, may increase the speed (Anderson, 1985) and/or probability of accessing any particular idea (Watkins & Watkins, 1975), including the prospective memory. With familiar target events, competing associations would be more likely to interfere with prospective memory. A second, but not mutually exclusive, explanation focuses on the local distinctiveness of the unfamiliar target event (i.e., the target event was presented in the context of mainly familiar items). From this view, the local distinctiveness may alert the subject to the special prospective memory significance of the target item. Further research is necessary to assess the relative importance of familiarity versus distinctiveness in determining the effectiveness of a prospective memory target event.

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