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Minimized Prospective Memory Loss in Old Age

Elizabeth A. Maylor
Medical Research Council Applied Psychology Unit
Cambridge, England

I. Introduction

Remembering to execute planned actions (prospective memory) seems to be a forgotten topic (Harris, 1984). Only recently has this concept begun to appear in textbooks [5 of 450 pages in Baddeley's (1990) book on human memory; 7 of 220 pages in Cohen's (1989) book on memory in the real world]. As Sinnott (1989) noted, "The more prospective/intentional an item is, the less investigators have studied it, and the more important it is perceived by subjects to be for everyday functioning" (p. 353).

The current trend in memory research can be characterized as a move away from traditional laboratory-based retrospective tasks, on which the elderly perform rather poorly (Craik, 1977; Hultsch & Dixon, 1990; Rabbitt, 1986), toward more naturalistic everyday tasks (see volumes edited by Gruneberg, Morris, & Sykes, 1988; Poon, Rubin, & Wilson, 1989). Thus, the interest in prospective memory is likely to grow, particularly in view of preliminary reports that this ability is relatively well preserved in old age (Sinnott, 1989). However, before discussing in detail the evidence relating to age, providing some definitions and a brief overview of the issues that have been considered in work on prospective memory is necessary.

Retrospective memory tasks generally involve the presentation of information that subjects subsequently are required to recognize or recall when prompted by the experimenter. In prospective memory tasks, subjects usually are instructed to perform a particular task at some specified point in the future. To do this successfully subjects must, when the time arrives, (1) remember that *something* has to be done, (2) remember *what* has to be done, (3) perform the task, and (4) remember later that it has been performed so it is not repeated. That prospective memory is complex and may overlap with other areas should be immediately apparent. For example, some element of time monitoring is involved prior to the first component [see Harris and Wilkins' (1982) "test-wait-test-exit" framework,

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and Ceci, Baker, & Bronfenbrenner's (1988) investigation of the "temporal calibration hypothesis"]. Remembering the contents of an intention (component 2) obviously depends on retrospective memory, as indeed does the fourth component, which is the focus of a growing literature on aging and "memory for actions" (see reviews by Kausler & Lichty, 1988; Backman, 1989). Having remembered both the intention and the contents (components 1 and 2), the question of whether or not subjects actually choose to carry out the task (component 3) is the subject of research into areas such as compliance (see review by Levy & Loftus, 1984) and motivation (Meacham, 1982). This third component also may be related to "reality monitoring," that is, subjects may not perform the task because of a failure to distinguish between the memory of an action and the memory of an intention to perform that action (see Cohen & Faulkner, 1989). Finally, some factors may influence any one of the four components of a prospective memory task, for example, social context (Meacham, 1988). Note that most of the studies in this review have attempted to focus on the first component and minimize the influence of components 2–4 (for example, by making the contents of the intention trivially easy).

Clearly, prospective memory is not easy to test, particularly since "allowing the subject to know what phenomenon is being studied may so compromise ecological validity as to render results uninterpretable" (Kvavilashvili, 1987, p. 508). To date, methods of investigation have included self-rated questionnaires, tasks incorporated into laboratory testing sessions (sometimes disguised), and more naturalistic experiments (principally telephone and mailing tasks, but also simulations of routine activities such as pill-taking). Researchers have only begun to explore the many possible factors that could influence prospective memory performance, for example, anxiety (Meacham & Kushner, 1980), task importance (Kvavilashvili, 1987), precision of timing (Ellis, 1988), regularity of timing (Meacham & Leiman, 1975), nature of intervening activity (Wichman & Oyasato, 1983), and so on.

A key factor emerging from several studies seems to be the type of memory aid adopted by the subject. Harris (1980) distinguished between internal cues (the internal manipulation of information, including encoding mnemonics and retrieval strategies such as alphabetic search) and external cues (the external manipulation of the environment, such as writing notes in diaries). The distinction may be rather blurred; for example, the success of an external cue is dependent on an internal strategy to remember to consult it. Nevertheless, clear benefits exist in adopting external rather than internal cues (Meacham & Columbo, 1980), even if they are arbitrary and therefore equivalent to tying a knot in a handkerchief (Meacham & Leiman, 1975). When given the choice, approximately 80% of subjects prefer to rely on external rather than internal cues in prospective memory tasks (Meacham & Singer, 1977).

The framework for this review of the work on prospective memory is provided by the following three questions:

1. Is prospective memory affected by old age?
2. Does old age affect the use of memory aids in prospective memory tasks?
3. What are the correlates of prospective memory?

The results of the relevant studies are correspondingly summarized in Tables 1, 3, and 4.

II. Effect of Age on Prospective Memory

Table 1 shows that the effect of age on prospective memory has been investigated using self-rated questionnaires as well as experiments both within and beyond the confines of the laboratory.

A. Self-Rated Questionnaire Studies

First, in considering the questionnaire data, remember that self-ratings have low validity and may prove rather limited as tools to study aging memory for several reasons (see Cohen, 1989; Rabbitt & Abson, 1990). Of course, the obvious problem is the failure to remember memory failures! Also, self-ratings may be influenced more by a subject's self-image than by his or her actual memory ability. Note that Rabbitt & Abson (1990) observed a highly significant correlation between Beck Depression Inventory and Cognitive Failure scores in the over-50 group, suggesting "some common loading for poor self-regard" (p. 1). Another factor relates to individual differences in life-style, which result in variation in the opportunity for memory failures to occur. This factor particularly may distort the results of studies in which undergraduate students are compared with retired elderly volunteers. Thus, self-ratings can reflect only "people's assessments of their own ability to meet very complex, very disparate, and very rapidly changing social demands" (Abson & Rabbitt, 1988, p. 190). Self-ratings may be influenced by various response biases. For example, the elderly may have certain expectations of how memory changes with age or they may be especially sensitive to errors as possible signs of approaching senility. A specific concern for studies of prospective memory is that few memory failures may be reported, not necessarily because of a good memory but rather as a result of the efficient use of memory aids such as diaries and lists.

Despite these reservations, knowing what the elderly believe about their own memory performance is, nevertheless, important since it may affect their self-confidence, the way they manage their everyday lives, and the kind of tasks and activities they are willing to attempt (see Cavanaugh, 1989; Cohen, 1989). The results of questionnaire studies do at least reveal an interesting contrast between the effect of age on self-rated prospective memory ability and self-rated retrospective memory ability. Cohen and Faulkner (1984) asked young, middle-aged, and elderly subjects to rate their memory for 26 everyday items on a 5-point scale

TABLE 1
Summary of Effects of Age on Self-Rated Prospective Memory Ability (Questionnaires) and on Performance in Prospective Memory Experiments Conducted in the Laboratory and outside the Laboratory

	Effect of age		
	Positive	**None**	**Negative**
Self-rated prospective memory ability			
	Harris & Sunderland (1981; see Harris, 1984); Martin (1986; Expt. 1); current data (Figure 1)	Cohen & Faulkner (1984); Dobbs & Rule (1987)	
Performance in prospective memory experiments			
In the laboratory		Sinnott (1986); Einstein & McDaniel (1990; Expts. 1 & 2)	Schonfield & Shooter (see Welford, 1958); Dobbs & Rule (1987); Cockburn & Smith (1988, 1991); West 1988; Expt. 2)
Outside the laboratory	Moscovitch & Minde (Expts. 1 & 2; see Moscovitch, 1982); Poon & Schaffer (1982); Martin (1986; Expt. 2); Maylor (1990; external cue users)	Moscovitch & Minde (Expt. 3; see Moscovitch, 1982); West (1988; Expt. 1)	Dobbs & Rule (1987); Maylor (1990; internal cue users)

from very poor to very good. No effect of age was seen on self-rated memory for appointments, answering letters, and taking medicine (prospective memory), whereas the elderly gave lower ratings for some retrospective memory items such as telephone numbers and names of famous people. Dobbs & Rule (1987) similarly administered a metamemory questionnaire to a large number of subjects over a wide age range (30s, 40s, 50s, 60s, and 70s +). Although no effect of age group was detected on self-rated prospective memory (remembering appointments, birthdays, etc.) or retrospective memory (remembering names, where things were put, etc.), the mean ratings for overall memory problems increased significantly with age.

Harris (1984) noted that older subjects often report having better memory for everyday tasks than do younger subjects. As an example, he described a questionnaire study by Harris and Sunderland (1981) in which young subjects (mean age 26 years) were compared with preretired (55 years) and retired (74 years) elderly subjects. For 6 of 28 everyday memory items, the younger subjects

reported significantly more problems than either of the two older groups. Of these 6 items, 3 could be described as involving prospective memory: (1) completely forgetting to do things you said you would do and things you planned to do, (2) completely forgetting to take things with you, or leaving things behind and having to go back and fetch them, and (3) forgetting to tell someone something important, perhaps forgetting to pass on a message or remind someone of something. Similar results were obtained by Martin (1986), who asked 30 young and 30 old subjects to rate how good they were at remembering each of 37 items on an everyday memory questionnaire. Of the 4 items for which old subjects gave significantly better ratings than young subjects, 3 were associated with prospective memory (appointments, paying bills, and taking medicine when necessary). Young subjects gave better ratings than old subjects for names of other people, telephone numbers, and sports results (retrospective memory). This result is clearly consistent with the general pattern observed by Cohen and Faulkner (1984).

Finally, Figure 1 combines data from two independent large-scale investigations of the Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982). The CFQ consists of 25 questions relating to "minor mistakes everyone makes from time to time," including failures of memory, attention, action, and perception. Subjects rate how often each has happened in the last 6 months on a 5-point scale from never (0) to very often (4).

Data from the university students were collected by Matthews and colleagues to perform a factor analysis of the CFQ, producing an interpretable 7-factor solution (Matthews, Coyle, & Craig, 1990). Factor 3 was labeled "planned social interaction;" the highest loadings for this prospective memory factor were from 16 (.72: "Do you find you forget appointments?") and item 11 (.47: "Do you leave important letters unanswered for days?"). The same factor analytic technique applied to data collected by Rabbitt and Broadbent (unpublished data) from 3500 volunteers over the age of 50 resulted in a 5-factor solution that is summarized in Table 2. The percentage of variance accounted for by each factor is presented with a brief description, illustrated by the two CFQ items with the highest loadings on each factor.

Clearly the dominant factor is retrospective memory, which actually includes memory for the contents of both future intentions (for example, items 2 and 23) and past actions (for example, "Do you forget where you put something like a newspaper or a book?" and "Do you find you forget whether you've turned off a light or a fire or locked a door?"). Although an almost exact correspondence occurs between these factors 1–5 and factors 7, 2, 5, 3, and 1, respectively, of Matthews et al. (1990), a comparison between the factorial structures of the two data sets is not the primary concern of this chapter. Instead, these data are of interest, first, because they provide empirical evidence (albeit from self-ratings) to support the distinction between retrospective and prospective memory. [Note that the factors were rotated using an oblique method, as recommended by

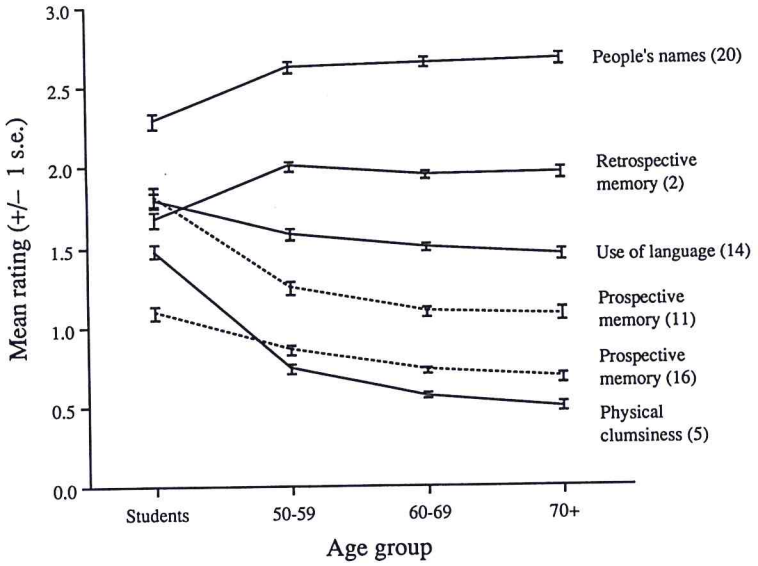

FIGURE 1

Mean scores on selected items from the CFQ, as a function of age group. Student data (N = 475) were obtained from G. Matthews (personal communication). Older subject data (N = 910, 1695, & 873 for 50–59, 60–69, and 70+ age groups, respectively) were obtained from Rabbitt & Broadbent (unpublished data). Item 2: "Do you find you forget why you went from one part of the house to the other?" Item 5: "Do you bump into people?" Item 11: "Do you leave important letters unanswered for days?" Item 14: "Do you find yourself suddenly wondering whether you've used a word incorrectly?" Item 16: "Do you find you forget appointments?" Item 20: "Do you find you forget people's names?"

Matthews et al. (1990), and a positive correlation of .42 existed between the retrospective and prospective memory factors.]

Second, the data provide a framework for considering the effects of age on self-ratings of cognitive failures. Figure 1 compares the mean ratings for the four age groups for the two main prospective memory items separately. For each of the other four factors, the mean ratings for the item with the highest factor loading are presented. The first point to note from these results is that the most striking effect of age appears in the contrast between the students and the three older groups. As indicated earlier, comparisons between markedly different cohorts may be misleading. However, for the four items in Figure 1 that show a decrease from the students to the 50–59 age group (5, 11, 14, and 16), the correlations between each item and age for the older subjects only (50s, 60s, and 70s) were all significantly negative. The second feature of Figure 1 to emphasize

TABLE 2

Summary of the Results of a Factor Analysis of Cognitive Failure Questionnaire Data from 3500 Volunteers over the Age of 50

Factor	Variance (%)	Description	Highest factor loadings	
1	25.8	Retrospective memory	.60	(Item 2: Do you find you forget why you went from one part of the house to the other?)
			.53	(Item 23: Do you find you forget what you came to the shops to buy?)
2	3.5	People's names	.77	(Item 20: Do you find you forget people's names?)
			.66	(Item 7: Do you fail to listen to people's names when you are meeting them?)
3	2.8	Use of language	.58	(Item 14: Do you find yourself suddenly wondering whether you've used a word correctly?)
			.42	(Item 8: Do you say something and realize afterward that it might be taken as insulting?)
4	1.9	Prospective memory	.60	(Item 16: Do you find you forget appointments?)
			.54	(Item 11: Do you leave important letters unanswered for days?)
5	1.6	Physical clumsiness	.69	(Item 5: Do you bump into people?)
			.56	(Item 24: Do you drop things?)

is the contrast between the positive effect of age on self-rated prospective memory ability (that is, a significant reduction in memory problems) and the negative effect of age on self-rated retrospective memory ability (an increase in memory problems, at least from students to the 50s age group).

To summarize, from Table 1, the data on self-rated prospective memory ability appear to be rather mixed with respect to the effect of age. However, the general picture emerging from this brief review of questionnaire studies is highly consistent in the sense that prospective memory ability invariably shows a more positive effect of age than retrospective memory ability. Various explanations for this apparent preservation of prospective memory in old age have been suggested. For example, Cohen and Faulkner (1984) discussed their results in terms of the meaningfulness or personal importance of the material. Dobbs and Rule (1987) suggested that "people simply do not have access to knowledge about their memory problems" (p. 220). As mentioned earlier, prospective memory situations tend to be those for which it would not be difficult to use some form of

external memory aid (Harris, 1984). Older people may be less confident in their ability to remember appointments and, therefore, may be more likely to adopt an appropriate strategy. Further, the ability to use effective strategies may develop with practice (Martin, 1986).

B. Laboratory Studies

When prospective memory is tested under laboratory conditions, the use of external memory aids can be prevented or controlled by the experimenter. Much of the evidence from such studies seems to support a more negative effect of age (see Table 1). For example, Welford (1958) described an experiment by Schonfield and Shooter in which a prospective memory element was incorporated in a perceptual judgment task so subjects had to remember to press a particular key before providing each response. The number of occasions when subjects forgot to press the key prior to responding increased steadily from teenagers to elderly subjects.

Dobbs and Rule (1987) conducted individual interviews with 228 subjects. Early in the session, subjects were told that later on "they would be asked to draw a circle and a cube. Further, when they were asked to draw the forms, they were to ask for a red pen" (p. 213). At the appropriate point, a pencil and a sheet of paper were placed in front of the subject with a request to draw a circle and a cube. The percentages of subjects in their 30s, 40s, 50s, 60s, and 70s who successfully asked for a red pen were 100, 96, 96, 94, and 73, respectively. Performance was clearly at or near ceiling for all but the 70-year-olds, who performed significantly worse than the other groups.

The Rivermead Behavioural Memory Test (RBMT; Wilson, Cockburn, & Baddeley, 1985) provides a more formal example of three laboratory tests of prospective memory embedded within a series of everyday memory tasks. The prospective memory items are (1) remembering to ask for the return of a hidden belonging; (2) remembering to ask about an appointment; and (3) remembering to take and deliver a message. In a preliminary study, Cockburn and Smith (1988) administered the RBMT to 38 subjects aged between 52 and 90, and found significant declines with age for the second and third items but not for the first. However, a larger study of 94 subjects aged between 70 and 93 demonstrated significant declines with age for all three prospective memory items (Cockburn & Smith, 1991). Further, in each case age was a significant predictor of performance "over and above the effects of intelligence."

Finally, a negative effect of age was observed in Experiment 2 by West (1988). Again, a prospective memory task was included as part of an interview. For example, in one of the experimental conditions, subjects were asked to remind the interviewer (when prompted by the verbal cue "That is the end of the passage recall test.") "to check her tape recorder and to get a pen out of a folder" (p. 122). The folder remained visible throughout the interview, providing an additional visual cue. Students (mean age of 20) were considerably more successful at remembering the prospective memory task within 2 min of the verbal cue than elderly subjects (mean age of 72), that is, 81% compared with 31%. [Note that, although cues were provided, they were controlled by the experimenter and were not particularly salient in the context of an interview involving several tests, materials, and instructions.]

Two laboratory-based studies of prospective memory have observed no significant effect of age. Sinnott (1986) tested 79 subjects, aged between 23 and 93 years, who were participating in a longitudinal study of aging. During a 3-day period at the research center (and on two subsequent occasions), subjects were given a memory test in which items were either prospective/intentional (information required for planned action) or incidental (not related to planned action and, therefore, more retrospective). The results indicated that, although age adversely affected incidental memory, no such effect occurred for prospective/intentional memory. Unfortunately, at least three aspects of Sinnott's study make interpretation of these results difficult: (1) performance appeared to be near ceiling in the prospective memory task (over 90% of items were passed), (2) prospective items were rated as significantly more important than incidental items, and (3) prospective items tested memory for information such as knowing the date of the next visit to the research center, rather than testing whether or not subjects actually turned up for their next appointment.

What are the important factors to consider when designing a laboratory study of the effect of age on prospective memory? The list of requirements should include at least (1) a large number of well-documented subjects, covering a wide age range; (2) the opportunity to compare directly the effects on prospective and retrospective memory, tested under the same experimental conditions and seen by the subjects as qualitatively similar and equally important tasks; (3) the absence of ceiling or floor effects on performance; (4) a demonstration that, even if no age effects are detected, the prospective memory task is, nonetheless, sensitive to other experimental manipulations; and (5) control over the use of external cues.

The laboratory study in Table 1 that most closely satisfies these criteria is that of Einstein and McDaniel (1990). The starting point for their research was Craik's (1986) proposal that self-initiated retrieval processes are particularly impaired by aging, as evidenced by larger age-related decrements for recall than for recognition tasks. Thus, Einstein and McDaniel argued that prospective memory should be relatively more affected by age than retrospective memory since, in the absence of external cues to prompt or guide retrieval, the former requires a greater degree of self-initiation. To investigate this hypothesis, these investigators developed an ingenious laboratory paradigm in which a prospective memory task was embedded within a retrospective memory task. Thus, subjects were presented with lists of words that they had to recall (short-term memory task). Some time before the task began, they were instructed to press a response key whenever a specified word (the target event) appeared in the list.

First, Einstein and McDaniel (1990) examined the effects of age (24 students; 24 elderly volunteers) and the opportunity to form an external aid using two conditions: no aid (in which subjects simply were told to press the response key whenever they saw the target word) and external aid (in which subjects were allowed 30 sec to form some type of memory aid out of material, such as paper and pens, that was provided). The main results follow: (1) The students performed significantly better than the older subjects on comparable tests of retrospective memory, as expected. (2) Performance in the prospective memory task was not at ceiling (mean number of responses to 3 targets = 1.8). (3) A significant effect of memory-aid condition[1] was noted, but no effect of age was seen and no interaction occurred.

In their second experiment, Einstein and McDaniel (1990) again examined the effect of age, but also manipulated target-event familiarity. They argued that prospective remembering depends on whether or not the target event triggers the action required. Familiar target events may be less successful than unfamiliar target events because the former have many more preexisting associations that may interfere with the prospective memory task. The results were as predicted. Performance was nearly three times better when the target event was an unfamiliar word rather than a familiar word.[2] As in Experiment 1, no effect of age and no interaction with target-event familiarity were seen.

The importance of Einstein & McDaniel's (1990) study lies in its demonstration of the absence of an age effect on prospective memory, in the context of both significant effects of other manipulations (memory-aid and target-event familiarity) and a significant negative effect of age on retrospective memory. Therefore, the conclusion that "prospective memory seems to be an exciting exception to typically found age-related decrements in memory" (p. 724) seems well justified, and is consistent with the review of studies of self-rated ability (Table 1), which generally demonstrated a more positive effect of age on prospective memory ability than on retrospective memory ability.

Einstein and McDaniel (1990) began by suggesting that the elderly should find prospective memory tasks particularly difficult because they make high demands on self-initiated retrieval. Their data apparently fail to support this claim. However, memory tasks, whether prospective or retrospective, vary in the degree to which they depend on self-initiated retrieval processes. In the discussion, Einstein and McDaniel made an interesting distinction between event-based and time-based prospective memory tasks, their own study being an example of the former. Whereas event-based prospective memory tasks may not produce large

[1] Note that the external-aid condition may have produced significantly better performance than the no-aid condition, not directly as a result of the external aid itself but because of the extra time (30 sec) and effort involved in its construction.

[2] The benefit may be due more to "local distinctiveness" than to unfamiliarity per se. A most effective target event would be the subject's own name, which is, of course, highly familiar to the subject.

effects of age (because they contain an external cue in the form of the target event), time-based prospective memory tasks may be more likely to produce negative effects of age. As Einstein and McDaniel note, "A promising direction for further research is to compare young and old subjects on event- and time-based prospective memory tasks" (p. 725).

C. Nonlaboratory Studies

One of the many differences between prospective memory experiments conducted inside and outside the laboratory is that the latter "naturalistic" tasks tend to be time based rather than event based. The results with respect to the effects of age are summarized in Table 1. Again, the studies (which generally involve telephone and mailing tasks) are not entirely consistent, although they would appear to favor a more positive effect of age.

Moscovitch (1982) reported three small-scale studies by Moscovitch and Minde in which old and young subjects were asked to telephone the experimenter at particular times and on specified dates. The old performed better than the young regardless of whether the time was chosen by the subject (Experiment 1) or by the experimenter (Experiment 2). This superior performance from the old subjects appeared to be due to their "use of mnemonic devices," in contrast to the young, who "trusted their memory." When subjects were asked not to use any external aids (Experiment 3), the old subjects performed no better than the young subjects. These preliminary findings led Moscovitch (1982) to conclude that the elderly may structure their environment to compensate for deteriorating memory. Poon and Schaffer (1982) used a very similar telephone task and found that old subjects remembered more calls and were more punctual and consistent than young subjects.

Although telephoning and mailing tasks have some ecological validity, they still contain an artificial element because subjects are required to communicate with someone they do not know simply because they were asked to do so. Martin's (1986) study therefore should be noted particularly because it avoids this criticism. She obtained data from attendance records at a research laboratory and found that older subjects were less prone to missing appointments unexpectedly than younger subjects (0.9% of appointments were missed, compared with 4.4%).

After an interview, subjects in West's (1988) first experiment were required to make a telephone call and mail a postcard. In each case, they also were instructed to give a strategy message explaining how they remembered each task. In the mailing task, older subjects were more likely than younger subjects to send in the postcard without the strategy message, but less likely to forget to mail the card. Similar but nonsignificant trends were noted in the telephone task. Dobbs and Rule (1987) employed a similar task. They gave subjects a questionnaire at the end of a testing session with the instructions to complete it at home, write the time and date in the top left-hand corner, and mail it back to the experimenter. In

this case, a significant decline in performance occurred with age in terms of the number of subjects who wrote either the time or the date in any location (lenient scoring). However, no effect of age was noted when performance was measured more strictly (both time and date in the correct location); however, this result may have been due to a floor effect.

Although the picture emerging from this brief summary of more naturalistic prospective memory tasks is generally positive with respect to the effect of age (Table 1), obvious discrepancies are notable. Unfortunately, of the studies reviewed so far in this section, some were pilot experiments with very few subjects, others may be contaminated by possible ceiling and floor effects, none has compared subjects' prospective and retrospective memory ability directly, and so on. Further, as well as the various features discussed in relation to laboratory studies of prospective memory, additional requirements are suggested to exist for prospective memory studies conducted outside the laboratory, including insuring that: (1) the various subject groups have an equal opportunity to carry out the prospective memory task (in other words, equivalent life-styles), (2) subjects are from similar cohorts, or at least as similar as possible without sacrificing a wide age range (note that some cohorts may place a greater emphasis on punctuality and keeping appointments than others), (3) subjects are equally well motivated (for example, student groups participating for course credits should be avoided), and (4) although the experimenter may not be able to control the use of cues, there should be some attempt to obtain the relevant information on a post hoc basis.

In Maylor's (1990) study of age and prospective memory, 222 subjects, aged 52–95, were tested. These individuals were selected from a population of middle-aged and elderly volunteers about whom much information was available, including general cognitive ability, retrospective memory scores, and other measures thought likely to influence performance. As far as possible, subject selection was restricted deliberately to females who were living alone and who previously had expressed a willingness to participate in further studies. Thus, some attempt was made to control for social and motivational factors.[3]

Subjects were required to telephone the experimenter once a day from Monday to Friday. At the end of the week, they had to complete a questionnaire and mail it back as soon as possible. One of the questions asked subjects to describe how they remembered to make the telephone calls. In both the telephone and mailing tasks, a weak but positive effect of age on performance was seen, as measured by the number of telephone calls subjects remembered to make and the speed with which the questionnaires were returned, respectively. However, the

[3] Also note that the number of what was termed "valid excuses" (that is, telephone calls missed because of prior engagements such as the dentist or hairdresser) was not related either to subject variables such as age or intelligence or to performance in the prospective memory task. In other words, at least some evidence suggested that the opportunity to perform the prospective memory task did not vary as a function of age or ability.

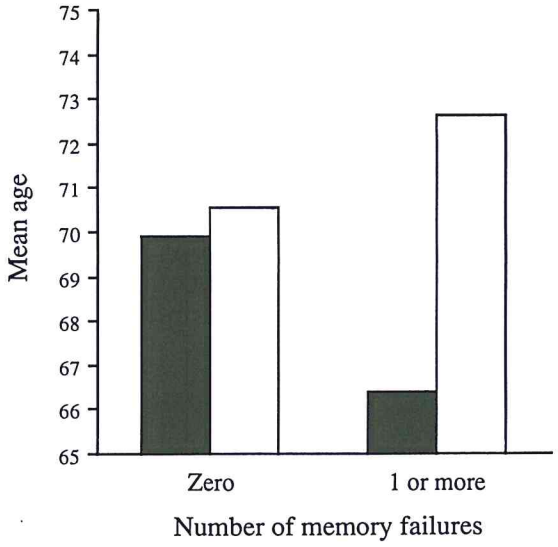

FIGURE 2

Mean ages of subjects with zero memory failures (those who successfully made five telephone calls) or one or more memory failures (those who forgot at least one of the calls) as a function of cue (external, filled; internal, open). (Data from Maylor, 1990.)

effect of age in the telephone task was influenced by the type of cue used. Most subjects adopted either an external cue (for example, a memorandum placed by the telephone) or an internal cue (for example, "relying on memory"). As illustrated in Figure 2, a significant interaction occurred so, for subjects using internal cues, those who forgot were older than those who remembered whereas, for subjects using external cues, those who forgot were younger than those who remembered.

Maylor's (1990) study could, of course, be criticized on several grounds, including artificiality of the task, as mentioned earlier. However, at least two aspects of the results are worth emphasizing. First, the rather weak effect of age on prospective memory performance contrasted sharply with the highly significant negative effects of age on the retrospective memory ability measures of digit span, learning, and free recall (all values of $p < .001$), a point that was not made explicit by Maylor (1990). Second, the study demonstrates the importance of obtaining information on how subjects attempted to remember the task. As expected, subjects who chose to use external cues in the telephone task remem-

bered more calls and were significantly more accurate and consistent than subjects using internal cues. However, the interaction shown in Figure 2 was not predicted. Superior performance by the elderly in prospective memory studies conducted outside the laboratory has been attributed to their greater use of external aids compared with the young (Moscovitch, 1982). Note, however, that Maylor's results indicate that, even for individuals using external cues, a positive effect of age was detected. We can only speculate on reasons for this result. For example, older subjects may be better at using external cues than younger subjects because they are more practiced or they may place the cues in more strategic positions. Clearly this area requires further research.

III. Prospective Memory Aids

This brings us to the question of whether or not age affects the choice of whether to use an external rather than an internal memory aid in prospective memory tasks. The few studies that have addressed this issue are summarized in Table 3.

Jackson, Bogers, and Kerstholt (1988) asked students and older adults about their use of memory aids in both prospective and retrospective everyday memory tasks. The older subjects reported that they relied more on external cues for prospective tasks, but used external and internal cues equally for retrospective tasks. The students relied more on internal cues in both situations. In the other questionnaire study, Dobbs and Rule (1987) found that subjects in their 40s reported greater use of memory aids (presumably external) than those in their 30s, 60s, and 70s. The data from self-ratings are, therefore, rather inconclusive.

In Einstein and McDaniel's (1990) first experiment, 79% of subjects in the memory-aid condition used an external cue (such as taping a piece of paper to the computer screen) rather than an internal cue (such as rehearsal). No difference was detected between the two age groups in their choice of cue, but remember that subject numbers were rather small (12 in each group). The same criticism applies to Moscovitch and Minde's (see Moscovitch, 1982) first experiment which was discussed earlier (10 young and 10 old subjects). In fact, a similar study by West (1988, Experiment 1) found the opposite result, namely, greater reported use of external aids by younger subjects. However, strategy information was not available for all subjects (particularly for the older subjects), so again the study is inconclusive.

Cavanaugh, Grady, and Perlmutter (1983) asked young and old subjects to keep a detailed diary of their memory experiences for a month. As expected, all subjects reported using external aids much more frequently than internal aids. However, no difference was detected between the two age groups in their use of external and internal cues.

Finally, Maylor (1990) divided subjects into three groups, based on how they

TABLE 3
Summary of Effects of Age on the Use of External Rather Than Internal Cues in Prospective Memory Tasks from Self-Rated Questionnaires and Prospective Memory Experiments Conducted inside and outside the Laboratory

	Effect of age	
Positive	**None**	**Negative**
Self-rated questionnaires Jackson, Bogers, & Kerstholt (1988)		Dobbs & Rule (1987)
Prospective memory experiments In the laboratory	Einstein & McDaniel (1990; Expt. 1)	
Outside the laboratory Moscovitch & Minde (Expt. 1; see Moscovitch, 1982)	Cavanaugh, Grady, & Perlmutter (1983); Maylor (1990)	West (1988; Expt. 1)

attempted to remember the task of making telephone calls. Whereas most subjects adopted either external or internal cues ($N = 135$ and $N = 57$, respectively), a third group ($N = 30$) produced the best performance by telephoning "in conjunction with another (routine) event" or "planning/rearranging the day to fit in the telephone call" (conjunction cues). The three groups of subjects were not significantly different in age and had similar vocabulary and retrospective memory scores. However, subjects using external cues were more intelligent (higher AH4 scores; see Heim, 1968), reported more cognitive failures (higher CFQ scores), and were more depressed (higher Beck Depression Inventory scores) than subjects using either conjunction or internal cues. In other words, although no effect of age was detected, the choice of cue was at least sensitive to other subject variables. Further, the choice of cue also was shown to be influenced by the task, that is, whether subjects were required to telephone at an exact time (e.g., 09.18) or between two times (e.g., 08.00 and 12.00). Subjects in the exact condition were found to rely less on conjunction and external cues and more on internal cues than those in the between condition.

The absence of a significant age effect on the choice of cue in Maylor's (1990) study should be seen in the context of the presence of significant effects of other subject variables and a task variable. The studies summarized in Table 3 appear to show no convincing evidence that older people make either more or less use of external (as opposed to internal) cues in prospective memory tasks. Maylor concluded by suggesting that a promising area for further research would be to investigate whether or not the elderly can be trained to adopt more effective cues

than those they currently employ. Note that elderly subjects have been shown to benefit from training in the use of external cues for remembering appointments and conjunction cues for remembering routine tasks, at least as measured by self-reports (McEvoy & Moon, 1988).

IV. Correlates of Prospective Memory

If age has little effect on the choice of cue in prospective memory tasks, and age is related only weakly to prospective memory performance, then what factors do correlate with prospective memory? Two possibilities are summarized in Table 4. The first is simply how subjects themselves rate their own ability and the second is retrospective memory ability.

A. Self-Rated Memory Ability

With the exception of the results of Dobbs and Rule (1987), generally a positive relationship between self-ratings and performance is seen in prospective memory tasks. Harris and Wilkins (1982) used a laboratory task in which subjects were asked to respond at prearranged times while watching a film. Performance was related significantly to total CFQ score "suggesting that failure on the laboratory task may be related to similar failures in everyday life" (p. 134). The strength of the relationship seems to depend on whether or not the two types of measure are reasonably comparable. Thus, Martin (1986) observed that subjects

TABLE 4
Summary of the Relationships between Performance in Prospective Memory Tasks and Self-Rated Memory Ability or Performance in Retrospective Memory Tasks

Positive	Zero	Negative
Self-rated memory ability Harris & Wilkins (1982); Martin (1986); [Sunderland, Watts, Baddeley, & Harris (1986; marginally significant)]; Maylor (1990)	Dobbs & Rule (1987)	
Retrospective memory tasks Hitch & Ferguson (1991)	Meacham & Leiman (1975); Wilkins (1986); Kvavilashvili (1987; Expt. 1); Einstein & McDaniel (1990; Expts. 1 & 2); Maylor (1990)	Wilkins & Baddeley (1978)

who rated themselves as good at remembering appointments were indeed much less prone to missing appointments unexpectedly. Sunderland, Watts, Baddeley, and Harris (1986) included a prospective memory task in a set of laboratory memory tasks given to 60 elderly subjects. In contrast to Martin's result, only a weak correlation was detected between prospective memory performance and subjective ratings of the frequency of everyday (mainly retrospective) memory failures ($r = .21$).

Figure 3 illustrates another possible reason for correlations between performance in prospective memory tasks and self-rated memory ability to be sometimes rather low. In Maylor's (1990) study, a highly significant overall difference in CFQ score was found between subjects who performed well in the telephone task (zero memory failures) and those who did not (one or more memory failures). As noted earlier, CFQ score was also lower for subjects using internal (and conunction) cues than for those using external cues. This latter result obviously has the effect of reducing the overall correlation between memory failures in the telephone task and CFQ score. One interesting feature of Figure 3 is that subjects

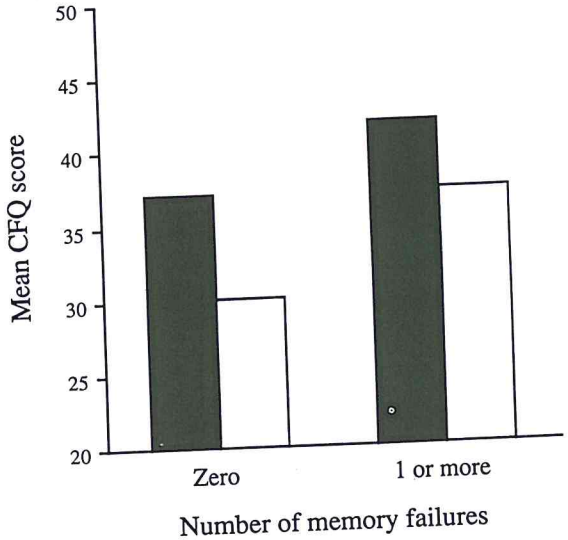

FIGURE 3
Mean scores on the CFQ (Cognitive Failure Questionnaire) for subjects with zero memory failures (those who successfully made five telephone calls) or one or more memory failures (those who forgot at least one of the calls) as a function of cue (external, filled; internal, open). (Data from Maylor, 1990.)

using internal cues who forgot at least once had the same mean CFQ score as those who remembered all five calls using external cues. In other words, subjects may be able to compensate for absent-mindedness by choosing an effective cue.

B. Retrospective Memory Ability

In contrast to the generally positive correlations between performance in prospective memory tasks and self-rated memory ability, the influence of retrospective memory ability would appear to be much smaller (see Table 4). This suggestion is, perhaps, not surprising—we have considered already evidence that prospective and retrospective memory are affected by old age differentially. Also note that retrospective memory tasks themselves do not always correlate very highly with each other (see, for example, Underwood, Boruch, & Malmi, 1978).

Wilkins and Baddeley (1978) tested 31 young subjects on a prospective memory task carried out at home and designed to be an analog of pill-taking. Subjects with high scores on a laboratory test of free recall were actually worse at the task than subjects with low free recall scores. However, unlike most of the other studies in Table 4, the investigators had no knowledge of or control over the use of cues.

The only study to report a significant positive correlation between prospective and retrospective memory is by Hitch and Ferguson (1991). These researchers asked 44 members of a university film society to retrieve the names of films they intended to see later on in a season and films they had seen earlier. The correlation between the two measures (memory for future intentions and memory for past activities) was small, but significant ($r = .27$). However, memory for future intentions is only one aspect of prospective memory (see earlier comment on Sinnott's study). When the prospective memory task involves not only remembering the intention but also translating it into action, the relationship with retrospective memory appears to break down. Thus, zero correlations were observed in a mailing experiment with students (Meacham & Leiman, 1975) and in a laboratory study with epileptic patients (Pajurkova & Wilkins; reported by Wilkins, 1986).

The studies by Kvavilashvili (1987) and Einstein and McDaniel (1990) are of particular importance since they tested both prospective and retrospective memory under the same laboratory conditions and within the same experimental task. Kvavilashvili went one step further by disguising the phenomenon under study in the following way. Subjects were asked to remind the experimenter at some later point in the session to look up someone's data (the name being an unfamiliar surname). The experimenter therefore was able to test prospective memory (remembering the intention, that is, reminding the experimenter) and retrospective memory (remembering the surname, that is, the content of the intention). No significant relationship existed between memory for intention and content in Kvavilashvili's study. In Einstein and McDaniel's experiments, prospective memory performance was unrelated to retrospective memory measures of short-term memory, free recall, and recognition. Similarly, laboratory measures of digit span, learning, and free recall had no influence on the choice of cue used in Maylor's (1990) telephone task, and no effect on performance in either the telephone or the mailing task.

To summarize this review of studies in Table 4, whereas retrospective memory performance would appear not to be correlated with prospective memory performance, self-rated memory ability is generally a positive correlate. The question of whether or not prospective memory itself represents a stable personality trait remains to be addressed. Some preliminary evidence, namely, significant positive correlations between various measures in Maylor's (1990) telephone and mailing tasks despite the fact that only the former was presented explicitly as the prospective memory task, suggests that it is. Additional research is required to discover the extent to which this effect results from the choice of similar cue types across different prospective memory tasks.

V. Conclusions

To return to the questions raised in the introduction, the studies discussed in this review suggest the following conclusions.

1. The generally optimistic view that old people have of their prospective memory ability appears to have some justification. Although both positive and negative effects of age on prospective memory have been demonstrated (sometimes within the same study, depending on the type of cue chosen), prospective memory is much less impaired by age than retrospective memory.
2. The evidence would seem to rule out increased reliance on external rather than internal memory aids as a complete explanation for minimized prospective memory loss in old age.
3. Self-rated memory ability is generally a better predictor than retrospective memory ability of performance in prospective memory tasks.

Obviously, these conclusions can be only tentative since prospective memory is a relatively new (but rapidly growing) area of research. Possible reasons for the apparently rather conflicting results (see Tables 1, 3, and 4) have been discussed. For example, the studies vary in their emphasis on the purely prospective component of the task. Also, if the type of memory aid adopted by the subject is not taken into account, effects of factors such as age (see Figure 2) and self-ratings (see Figure 3) may be obscured.

Finally, what are the important issues that should be considered in future investigations of aging and prospective memory? The following list of suggestions is by no means exhaustive.

1. Subjects' performance, choice of cues, and so on should be assessed across a range of prospective memory tasks (for example, time-based vs. event-based; explicit vs. disguised; inside vs. outside the laboratory). Wherever possible, the results should be compared directly with retrospective memory performance measured under the same conditions.
2. Why subjects forget in prospective memory tasks must be explored. [Note that Maylor (1990) presented some preliminary evidence to indicate that reasons for forgetting are, again, related to the type of cue used.]
3. The effect of old age on time monitoring in the context of prospective memory tasks has yet to be addressed.
4. Why self-rated memory ability should be a significant predictor of prospective memory performance must be determined. One possible explanation is in terms of the awareness of errors (see Rabbitt, 1990), in other words, people generally receive feedback when they fail everyday prospective memory tasks such as missing appointments.

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