

Prospective Memory and Aging: The Effect of Perceptual Salience

by


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### Abstract

The effect of perceptual salience on prospective memory (PM) performance was examined for three age groups. Young, young-old, and old-old adults completed a visual search task with embedded PM instructions. On each trial, participants indicated the position of a target letter in a letter string, unless either of two pre-specified letters (PM cues) were encountered. Each PM cue was associated with a specific response. Perceptual salience was manipulated by spatially displacing a single letter (i.e., PM cue, target, or distractor). This manipulation modulated performance of the prospective component (realizing that a PM response should be made) but not the retrospective component (recalling the correct response when a PM cue was encountered). Young adults successfully recalled a higher proportion of PM intentions than young-old and old-old adults. However, there were no significant differences between young-old and old-old PM performance.


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Prospective Memory and Aging:  
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Introduction

Prospective memory is defined as the realization of a delayed intention or as remembering to execute a previously encoded intention (Einstein, McDaniel, Richardson, & Guynn, 1995). For example, remembering to take medication, keep an appointment, or mail a letter are all examples of everyday prospective memory activities. In recent years, this aspect of human cognition has been the focus of an increasing number of prospective memory paradigms. However, the amount of research generated by these paradigms is minute when contrasted with the vast amount of retrospective memory research. The processes involved in prospective memory have relevance to issues beyond that of prospective memory research. For example, prospective memory paradigms contribute to the understanding of theories of cognitive aging because many of the processes thought to be critical for successful prospective memory performance (e.g., self-initiated retrieval, reality-monitoring, output monitoring) are known to be highly sensitive to the effects of aging (Maylor, 1996). Thus, newly created paradigms in prospective memory can provide opportunities to test theories of aging.

A potentially important paradigm for investigating prospective memory involves the manipulation of the distinctiveness of cues. Von Restorff (1933; as cited in Hunt, 1995) created the isolation paradigm in which one item in a list differs from the remaining items on one or more dimensions. The distinctive item is found to be more memorable

than the non-distinct items. Research on retrospective memory has demonstrated the importance of evaluating the effect of conceptual salience and perceptual distinctiveness on memory functioning (Rajaram, 1997). Although a number of prospective memory studies have examined the effect of conceptual salience on performance, no paradigms have explored the effect of perceptual distinctiveness.

In the present study, distinctiveness of cues will be manipulated to compare the perceptual salience of the primary task stimuli to that of the prospective memory task stimuli for young, young-old, and old-old adults. A trade-off may exist such that as the cover task becomes increasingly perceptually distinctive (intrudes on consciousness), participants become less likely to attend to prospective remembering. The nature of this relationship will be examined across three adult age groups. An additional objective is to examine whether the perceptual manipulation has the same effect on both the prospective and retrospective components of prospective memory.

#### Prospective and Retrospective Components of Prospective Memory

Successful prospective memory performance involves two components: We must remember at an appropriate moment that we must do something, and we have to recall what is to be done (Goschke & Kuhl, 1996). The former is called the prospective component, whereas the latter is referred to as the retrospective component (Einstein & McDaniel, 1990). Both are necessary for the successful execution of a previously encoded intention. For example, if an individual has to remember to give a friend a message, successful prospective memory requires that the appearance of the friend trigger the memory that a message has to be given (prospective component). Successful prospective memory also requires that the individual remember the content of the message

(retrospective component). Prospective memory can fail in several ways, two of which are addressed most commonly in the literature. A person may completely forget upon seeing the friend that there is a message to give (failure of the prospective component) or he/she may remember that there is a message to give but forget what the actual message is (failure of the retrospective component).

There is a third way that prospective memory can fail that has not been investigated as thoroughly in the literature. A person may retain the content of a message that is to be given, however, they may forget to respond to the cue. Einstein, Holland, McDaniel, and Guynn (1992) may have intended to include this type of failure under the rubric of prospective component failure as described above. However, they do not sufficiently distinguish between these two types of failures. Thus, the problem remains, how do we measure and evaluate these two types of prospective component failures. Does failure to recognize a cue mean the content of the intention (retrospective component) was necessarily also forgotten? Or is the content of the intention retained but access is denied because there is no sufficient cue to trigger retrieval? These types of failures have been neglected in past research and require further investigation if there is to be true understanding of the underlying mechanisms of prospective memory failures. A way of addressing this issue is by supplying the participants with the forgotten cues at the end of the experiment. Thus, the participant would be shown the cues that they had forgotten and they would be asked to try to remember the content of the corresponding intentions. This would allow the participant an opportunity to try to remember the content of the intention (retrospective component) even though they had forgotten the corresponding cues (prospective component).

Although the notion that prospective memory involves several components is frequently discussed in the literature, very little is known about the factors that influence these components. Thus, it is difficult to determine whether prospective memory failures result from failures of the prospective component or the retrospective component. Cohen, West, and Craik (1999) investigated the effect of variables on each of these components. They found that the effect of age was greater on the prospective component than on the retrospective component. That is, the efficiency of the prospective component was more disrupted in older than younger adults when there was a change in the format of the prospective cue from study to test. Furthermore, the results of Experiment 2 revealed that data driven and conceptually driven processes differentially influenced the prospective and retrospective components of prospective memory. The manipulation of study-test format (thought to influence the contribution of data driven processes) had the greatest impact on the efficiency of the prospective component. In contrast, the manipulation of semantic relatedness (thought to influence the contribution of conceptually driven processes) had the greatest effect on the efficiency of the retrospective component.

### Prospective Memory and Aging

Prospective memory has been studied with naturalistic methods, such as asking participants to remember to perform some action in an everyday setting. Moscovitch (1982) instructed both younger and older adults to call an experimenter at prearranged times throughout a period of several days. Results indicated that prospective memory was actually superior for the older adults than for the younger participants. Further investigation revealed the important and unexpected result that older adults were more motivated to perform the task and were more likely to employ reminders (i.e., written

notes) as a way of remembering the intention of phoning the experimenter. Thus, this study revealed that older adults could compensate for poorer prospective memory by employing external memory aids.

Laboratory experimental designs were developed to provide more control over the strategies that participants use (Einstein & McDaniel, 1990). Laboratory studies have yielded findings very different from those obtained by naturalistic methods. For example, Dobbs and Rule (1987) asked young and older adults at the beginning of an experiment to remind the experimenter to give them a red pen at a particular later point in the experiment. Thus, participants had to monitor this intention over a period of time while performing another primary task. No external cues were allowed. Results departed from the previous naturalistic studies, with older participants performing significantly worse than their younger counterparts. Other laboratory research has also found age-related differences in prospective memory in favour of younger adults (e.g., Einstein, McDaniel, Smith, & Shaw, 1998; Harris & Wilkins, 1982; Mäntylä, 1993; Maylor, 1993).

A model proposed by Craik (1986) claims that prospective memory performance becomes increasingly difficult as we age because it involves more self-initiated processing. He proposed that aging interferes with an individual's ability to execute self-initiated processes that are by their very nature voluntary, intentional, and effortful (Craik, 1986). These predictions are based in part on the idea that aging is associated with a reduction in processing resources (Salthouse, 1991). Specifically, a reduction in processing resources refers to limitations on processing speed, attention, and working memory capacity. Past research has provided substantial evidence revealing age-related declines in speed (Cerella, 1985), attention (Hartley, 1992), and working memory capacity (Light, 1996). Maylor

(1996) discusses the way these limitations may contribute to prospective memory failures in older adults. For example, she suggests that during the encoding phase of a study participants are given the requirements of the task as well as the prospective memory instructions. Under timed conditions, due to reductions in speed, older adults may have more difficulty in elaborative encoding. Furthermore, the ability to keep in mind a previously encoded intention, and then disengage from a primary activity in order to execute that intention, may depend on the management of attentional resources. Finally, holding a prospective memory intention in mind along with other mental contents may exceed the working memory capacity of older adults (Maylor, 1996). Despite Craik's (1986) prediction that prospective memory tasks are more effortful than other typical memory tasks, it is prudent to acknowledge that the amount of self-initiated processing required will presumably differ among prospective memory paradigms, depending on the specific requirements of the primary and prospective memory tasks. Indeed age-related effects in prospective memory have proven to be inconsistent, often depending on factors such as task complexity, duration between encoding and retrieval of the intention, and the number of intentions (Cockburn & Smith, 1994).

Einstein et al. (1995) proposed an explanation for variable age-related results based on a distinction between event-based and time-based prospective memory tasks. Event-based prospective memory represents a situation in which an external event acts as a trigger for some previously encoded intention. Thus, the event will prompt a memory search that will eventually result in the retrieval of the intention. For example, an event could be the sudden meeting of the friend that triggers the memory that one has a message to give. Time-based prospective memory reflects a situation in which the appropriateness

of an action or intention is determined by the passage of time (e.g., remembering to take a pill in two hours). Einstein et al. proposed that with time-based tasks, rather than with event-based tasks, there should be age-related differences in prospective memory because time-based tasks are especially dependent on self-initiated processing. This theoretical distinction was confirmed by results that revealed age differences on the time-based task (high in self-initiated retrieval) and no age differences on the event-based task (low in self-initiated retrieval) (Einstein et al., 1995). However, recent findings suggest that the distinction between event- and time-based prospective memory is only marginally useful and the better predictor of age-related differences is the specific requirements of the task. That is, the context of the task (i.e., difficulty of primary task, attentional requirements, working memory capacity) is more useful in predicting prospective memory performance than whether the task is event- or time-based. For example, Park, Hertzog, Kidder, and Morell (1997) found age differences on both event- and time-based tasks. Moreover, they found that deficits in time-based performance tended to be due to a fundamental deficit in time monitoring and deficits were not due to forgetting the cue or intention.

#### Theoretical Models of Prospective Memory Performance

In the familiarity plus search model, Einstein and McDaniel (1996) proposed that prospective memory is supported by two processes: an automatic familiarity-based noticing process and a consciously controlled recollection-based search process. It is suggested within this model that the presentation of a prospective cue automatically elicits a sense of familiarity (i.e., noticing) that causes the cue to be recognized. This recognition of the cue causes a directed search of memory to establish the significance of the cue and to determine whether a response is appropriate at that point in time. The findings from Cohen

et al. (1998) are partially consistent with this model if one assumes that the noticing element of this model reflects the prospective component and the directed search reflects the retrospective component. The prospective component was more sensitive to a change in the appearance of the prospective cue from study to test than to the degree of semantic relatedness of the prospective cue and intention. This finding is consistent with the idea that familiarity is more sensitive to changes in surface characteristics from study to test than conceptual influences. The retrospective component was more sensitive to conceptual level characteristics of the prospective cues and intentions than to changes in surface features. This finding is consistent with controlled search models within the area of retrospective memory.

There was an age-related decline in the efficiency of the prospective component of prospective remembering that was greater than that observed for the retrospective component of prospective remembering (Cohen et al., 1998). This finding runs counter to the model presented by Einstein and McDaniel (1996). That is, if the prospective component is relatively automatic and the retrospective component is relatively controlled, it would be expected that age-related differences should be greater in the latter component (Hay & Jacoby, 1999). The findings of Cohen et al. (1998) contradict the predictions of the noticing plus search model with respect to age-related differences in prospective memory.

The automatic associative model reflects an extension of Moscovitch's (1992) process model of retrospective memory to the area of prospective memory. According to Moscovitch's (1994) systems framework, associative episodic memory tasks are mediated in part by a memory module (subserved by hippocampal neuropsychological components)

that rapidly and reflexively deliver to consciousness the information associated with the presented cue. In this model, prospective memory is described as sufficient interaction between a prospective cue and an associated memory trace (i.e., ephory) resulting in the memory trace or intention being reflexively brought forth to consciousness (McDaniel, Robinson-Riegler, & Einstein, 1998). The finding that semantically related cues and intentions give rise to better prospective memory performance lends some support to this model. One would expect more success when consolidating related rather than unrelated information into memory. However, this model runs into trouble with one aspect of past prospective memory findings. This associative model is assumed to require few cognitive resources such that there should be little disruption of prospective memory due to concurrent tasks. However, McDaniel et al. (1998) found that there was a clear decline in prospective memory performance when participants performed a concurrent digit-monitoring task. It is obvious that further model and theory building is needed to extend understanding of prospective memory.

#### Relations and Distinctions between Retrospective and Prospective Memory

Most theorists agree that prospective memory must include some aspects of retrospective memory (Glisky, 1996; Huppert & Beardsall, 1993). However, the extent of overlap between the two types of memory remains unclear (Glisky, 1996). Certainly, comparing such comprehensive categories of memory leads to a nebulous distinction because there are different memory requirements depending on the particular task and type of memory that one is examining. Some theorists have reported results that appear similar across retrospective and prospective memory. For example, Einstein et al. (1992) found that when one increased the number of events to be remembered, performance was affected

similarly for both retrospective and prospective memory. Specifically, performance was negatively affected as the number of to-be-remembered events were increased. This implies that some components must be similar across the two types of tasks. Furthermore, research has shown that prospective memory behaves similarly to retrospective memory in respect to the role of environmental support. Specifically, when environmental support is reduced performance becomes poorer (Cohen, et al., 1998; Einstein & McDaniel, 1996).

In contrast, several studies have failed to find correlations between performance on retrospective memory and prospective memory tasks (Einstein & McDaniel, 1990; Maylor, 1990). These findings suggest that there are some different requirements for each type of memory. For example, some theorists suggested that there are fundamental differences in the way to-be-recalled (retrospective memory) and to-be-executed (prospective memory) tasks are encoded. Therefore, there is a need for laboratory tasks to investigate the basic underlying nature of the representation of an intention and how it differs from other forms of memory.

Some researchers suggest there is a difference between to-be-remembered content for prospective versus retrospective memory tasks. The idea is that memory representations of intentions in PM studies may have a particular persistence (i.e., increased or sustained level of activation). Several studies reported enhanced remembering for tasks that involve memory for intentions as opposed to memory for content (Goschke & Kuhl, 1993; Koriat, Ben-Zur, & Nussbaum, 1990). Thus, they proposed that in preparation for different retrieval requirements, intentions have a higher level of activation that makes them more accessible for future retrieval (Goschke & Kuhl, 1993). The relationship between prospective memory and retrospective memory is elucidated through the

examination of the requirements of both types of experimental paradigms.

An important difference between prospective memory and more typical experimental memory paradigms (i.e., free recall, recognition) is that for most prospective tasks there is no explicit reminder that prompts the person to initiate a memory search ( Craik, 1986; Einstein & McDaniel, 1990, Maylor, 1990). In free recall or recognition memory tasks, a participant is informed when the test phase begins and is explicitly instructed to retrieve information or to differentiate correct information from incorrect information. However, in prospective memory tasks, the test phase is more ambiguously defined, with the relevant cue buried in a large set of non-cues. Thus, the participant must engage in more spontaneous and self-initiated retrieval.

#### Automatic or Controlled Processing?

Ste-Marie and Jacoby (1993) examined the distinction between directed remembering and spontaneous remembering. They suggested that directed remembering involves consciously controlled processing and it is typically employed in laboratory tests of memory (i.e., free recall and recognition tests). It involves a memory search that is initiated in response to a prompt from an experimenter. Prospective remembering involves what Ste-Marie and Jacoby refer to as spontaneous remembering. They likened this process to a more automatic type of retrieval because the intention rises to consciousness involuntarily and without direct attempts to search memory. Ste-Marie and Jacoby's conception of prospective remembering differs from other accounts that perceive prospective remembering as an effortful process. For example, Maylor (1996) suggested that prospective memory is inherently effortful because an intention must be retrieved when one is in the midst of some other competing activity. That is, retrieval of the

intention must interrupt the ongoing flow of thought and activity in order to be properly executed. The person must disengage from an ongoing activity to carry out some action or intention at an appropriate time (Einstein & McDaniel, 1990). For example, in the morning a person may encode an intention to make a phone call at 4:00 p.m. in the afternoon. Then, in the afternoon while reading a book one may suddenly remember this intention to make a phone call. Thus, there is a need to disengage from the process of reading the book in order to successfully remember to perform a previously encoded intention (i.e., make a phone call). Arguably, the degree of effort will vary according to the level of support in terms of cueing conditions. For example, if an alarm is set in order to remind the person to make the phone call, presumably, prospective memory performance would be enhanced.

The most useful way of resolving this issue of automatic versus controlled processing is by understanding that under some conditions an intention can be realized by automatized routine skills if all of the parameters of the intended activity are sufficiently specified. Thus, a stimulus may trigger an intention without the conscious representation of the intention. In such cases, the encoding of an intention sets stored action schemas into a state of readiness and when the appropriate trigger conditions are satisfied, the intention can be executed without mediation of a conscious recollection of the intention (Goschke & Kuhl, 1996). Alternatively, if an intention needs to be postponed for a longer duration or if the intention cannot be realized by already known skills, then the intention cannot set action schemas in a state of readiness because further planning and controlled processing is needed (Goschke & Kuhl, 1996). Thus, one can conclude that depending on the duration

between the encoding and execution of an intention and the parameters of the intended activity, prospective remembering involves automatic or controlled processing.

### Importance of Cues in Prospective Memory

It is suggested that age-related decrements in prospective memory performance are highly related to and dependent on the particular task environment (Maylor, 1996). For example, much research (Einstein & McDaniel, 1990; Maylor, 1990; Meacham & Leiman; 1982) has highlighted the importance of cues in prospective memory performance. Mäntylä (1996) emphasized the importance of cues within his framework. He suggested that retrieval sensitivity relied on three different components: The activation level of the underlying intention (trace dependent component), the particular attributes of the cue (cue dependent component), and the participant's self-initiated operations and attentional resources (capacity dependent component). Cues are often separated into two categories: internal and external cues (Harris, 1984). Internal cues require manipulating information in such a way that the cue is internally generated. For example, encoding mnemonics would be a way of employing an internal cue. External cues require manipulating the external environment. Cues, such as writing a reminder note, can facilitate memory of a previously encoded intention. As discussed earlier, Moscovitch (1982) and other researchers (Maylor, 1990; Meacham & Leaman, 1982) have shown that older adults who use external cues will significantly improve their prospective memory performance.

Clearly, the effectiveness of external cues depends on several factors. Successful prospective memory depends on specific properties of the target or cue event. For example, external cue properties such as complexity, salience, and relatedness of cues to intentions have had an impact on prospective memory performance. Einstein et al. (1992)

manipulated complexity in terms of the number of prospective memory target words. The target words were embedded within a primary working memory task. Participants received either one or four target words and upon recognition of a target word they had to remember to perform a previously encoded intention. Einstein et al. (1992) reported an interaction of complexity with age in which older adults were significantly more disadvantaged than young adults when they had to identify four words whereas, performance was more similar across age groups in the one word condition.

The familiarity and distinctiveness of external cues was examined by McDaniel and Einstein (1993). Participants were instructed to press a response key whenever a specific target word appeared in a series of words. The target event occurred three times across 42 trials. The variables of interest were the familiarity and distinctiveness of these target words. Half of the participants were given a familiar target event (e.g., fuse or movie) and the other half was given an unfamiliar event (e.g., sone or yolif). In addition, half of the participants had the majority of non-target words being similar in familiarity; thus, if the prospective target cues were unfamiliar (e.g., sone), then the majority of the other non-target words would also be unfamiliar (e.g., bise, leefid). This was known as the non-distinctive condition. The other half of the participants received the majority of non-target words being dissimilar in familiarity. In this condition, if the target word was an unfamiliar word such as “sone,” then the majority of non-target words would be familiar words (e.g., table, dress). This was known as the distinctive condition. Results revealed that unfamiliar target events (e.g., yolif) benefited prospective memory as did target events that were distinctive relative to the local context.

An external cue's semantic relatedness to intentions was investigated in Cohen et al. (1998). This prospective memory task required that participants remember a series of written intentions that were paired with cues. The cues were the later reminders for the intentions. They appeared always in picture form in the test phase of the experiment. The amount of environmental support was varied through the use of these cues. The term environmental support refers to the degree to which external cues are available to an individual who is trying to reconstruct a prior mental state. Thus, the more environmental support, the more prospective remembering will be facilitated. That is, a task that requires a minimal amount of self-initiated processing and a lot of support from external cues should pose fewer problems for older adults. In this study, cues were presented at encoding in either pictorial or written form, and they were related or unrelated to the intention. Cues were manipulated so that half of the cues were related and half the cues were unrelated to the target intentions. Results showed that performance was best for both age groups in conditions of maximized environmental support and performance became poorer as the amount of environmental support decreased. These results correspond to findings in retrospective memory research in which with decreasing amounts of environmental support, younger and older adults' performance diverged with older adults experiencing larger deficits.

An external cue's impact on remembering is useless unless it can sufficiently capture attention. As discussed earlier, past prospective memory paradigms required the participant to engage in self-initiated memory retrieval without explicit reminding while in the midst of another ongoing activity (Maylor, 1996). Presumably, the more perceptually salient the target-cue, the more likely the successful recognition of that cue. This reasoning

is based on ideas regarding the isolation effect that were set forth by von Restorff (1933, as cited in Hunt, 1995). She found that if all but one item on a list are similar on some dimension, memory for the different item will be enhanced (Hunt, 1995). Thus, the isolation effect posits that the more perceptually salient a stimulus, the more likely it is to be attended. To date, no prospective memory paradigms have examined perceptual salience or the isolation effect as a variable. However, researchers have examined semantic salience or the importance of intentions as a variable in prospective memory paradigms (e.g., Kvavilashvili & Ellis, 1996). The more salient or important an intention the more likely prospective remembering will be enhanced (Kvavilashvili & Ellis, 1996). Whereas salience deals with the memorability of intentions on a conceptual level, perceptual salience deals with the memorability of cues on the perceptual level.

An important point must be made regarding the level of perceptual salience of a prospective memory cue. As perceptual salience of a cue increases, the task may begin to resemble a retrospective memory task in which subjects are given explicit reminders to execute some task. For example, if a cue needs to be so distinctive that it overshadows the primary task, the prospective memory task no longer requires self-initiated remembering. In this way it would become closer to being a retrospective memory task in which there is an explicit reminder.

It is useful to illustrate the idea of perceptual salience with a real life analogue. For example, if one had to remember to tell a friend an important message, seeing that friend would serve as the cue. One could imagine several possible scenarios in which the perceptual salience of that cue (seeing the friend) would differ. Conceivably, if one entered a room full of people and the target friend was sitting in the back row, it is

plausible that this cue (although within the perceptual space) would not be sufficiently perceptually salient to successfully trigger the prospective intention. However, if the friend were sitting in the front row, potentially their presence would be more perceptually salient and therefore would capture one's attention leading to successful prospective remembering of the message. If one could imagine a case in which the target friend jumped up and said, "I believe you have a message to tell me!" this would be an example of a case in which spontaneous remembering is eliminated because the cue becomes an explicit reminder. A similar situation exists in cued-recall paradigms. That is, some cues will be more useful and obvious in helping to cue retrieval than others. For example, the cue "table" will be a better cue for triggering the memory of a target word "chair" than the cue "blue."

#### Relationship between Primary Task and Prospective Memory Task

In prospective memory tasks, there is a trade off between attention devoted to the primary task and the level of attention devoted to maintaining an intention in mind. Prospective memory performance is better in conditions where the primary task is less demanding, because under these conditions it is more likely that a previously encoded intention will be successfully retrieved (Einstein & McDaniel, 1996). However, in conditions where the primary task is demanding, there exists a competition between the attention allocated to the primary task and to the prospective memory task. Kvavilashvili (1987) reported reliable positive correlations between the number of thoughts about the prospective memory intention during the retention interval and successful remembering to carry out the intention. Such a tradeoff can be realized in a real life experience. For instance, if one must remember to carry out an intention but a primary task is so engaging that no attention is available for the recognition of a prospective memory cue, it is likely

that prospective memory will fail. For example, giving a presentation to a roomful of people requires a high level of attention. If one also had to remember to give a friend, who was sitting in the room, a message, it is plausible that no matter how perceptually salient the cue (friend), there still may be a failure of prospective memory. The reason is that the primary task (giving a presentation) requires a very high level of attention, thus very little attention is left over to maintain prospective memory (remembering to give a message to a friend).

### Present Study

In the present study, the effect of perceptual salience of prospective memory cues will be manipulated in an effort to examine the effect of cue distinctiveness on the prospective and retrospective components of prospective memory. It is suggested that a tradeoff may exist such that as the cues for the prospective memory task become more perceptually distinct, prospective memory performance will become better. In contrast, as the primary task stimuli become more perceptually salient, the less attention available to allocate to maintain prospective remembering. A paradigm has been developed to address these expectations. Participants will be asked to perform a serial position search task in which they must identify a target letter amongst a string of other letters. A target letter (e.g., "E") will be presented on the computer screen. Participants will be instructed to push the number key that corresponds to the position of the target letter within a subsequent letter string. Along with the instructions for the serial position task, participants will also be given a set of prospective memory (PM) instructions. They will be told that whenever they encounter a "B" or "D" letter within a string of letters, they must stop what they are doing (serial position task) and press the "9" key for the "B"

stimulus and the “7” key for the “D” stimulus. If a PM target is present within a letter string, participants are instructed to respond to this target and this response overrides responding to the serial position task (locating the position of target letters).

Perceptual salience will be manipulated by spatially displacing one letter below the rest of the letters in the letter string. According to results from the isolation effect (von Restorff, 1933; as cited in Hunt, 1995), it is predicted that the letter that differs from the rest of the letters in the letter string will be more quickly and correctly identified. Presumably, the displaced letter will intrude on perceptual awareness more than the other letters in the letter string, and therefore, will be more easily identified. These manipulations will allow us to examine the relationship between distinctiveness of the primary task stimuli and distinctiveness of the prospective memory task stimuli.

A more specific question is whether the young, young-old (YO) and old-old (OO) adults will respond similarly to these perceptual manipulations. In the present study, a more detailed analysis of older adults’ performance can be made through the examination of two older adult age groups. Past prospective memory studies have made age comparisons using only two age groups (university students and one group of older adults). By examining the performance of university students as well as two older adult age groups, this study may help elucidate when age-related deficits in performance occur relative to young adults’ performance.

Furthermore, this design allows us to explore the factors that influence the efficiency of the prospective component (realization that a response should be made) and the retrospective components (recalling the correct response when a PM cue is recognized) of prospective memory. The prospective component can be measured as the

proportion of prospective cues that are recognized and elicit a prospective response regardless of whether or not that response is correct. The retrospective component can be obtained by dividing the number of instances an individual both recognizes a prospective cue and correctly recalls the associated intention at the time the cue is detected, by the number of instances when the prospective cue is recognized regardless of whether or not the correct intention is recalled. Therefore, we can examine whether the perceptual manipulation differentially affects both components of prospective memory. Furthermore, this research design will offer an opportunity to test a recent theoretical model of prospective memory, namely the familiarity plus search model (Einstein & McDaniel, 1996).

The issue of vigilance and its role in prospective memory paradigms is relevant in terms of the present task. I argue that this task can not be likened to a simple vigilance task based on several criteria. In vigilance tasks, individuals are asked to monitor a source for the infrequent occurrence of some event. Although there may be an element of vigilance within a prospective memory study, this does not mean that prospective memory is synonymous with vigilance tasks. Vigilance involves only one task that does not include the interruption of other activities when a target event occurs. A key component of prospective memory paradigms is that some ongoing activity must be interrupted when the PM cue is encountered. The participant must disengage from the ongoing task to carry out the PM intention. Second, vigilance tends to be unaffected by aging (Maylor, 1996). Third, failures in vigilance tend to be attributed solely to perceptual deficits (unable to see the target) whereas, failures in prospective memory are

more often attributed to memory lapses in terms of forgetting that a cue requires a certain response (Maylor, 1996).

As discussed earlier, it is unclear how the processes underlying tests of prospective memory overlap with processes underlying retrospective memory. There is a need to better understand the relation between these two types of memory (Glisky, 1996). To address these issues, several ancillary measures will be collected in the hopes of clarifying the relationship of prospective memory to other forms of memory. Performance on the prospective memory task will be compared with performance on a retrospective memory task. Specifically, the retrospective task will be a word recall test requiring participants to remember words from a 30-item list. It is thought that prospective memory performance will correlate positively with this free recall test. This prediction is based on the hypothesis that, depending on the extent to which a retrospective memory task is dependent on processes associated with the frontal lobes (e.g., planning, organization, and selection), it will correlate with prospective memory tasks (Glisky, 1996). Finally, a memory compensation questionnaire will be given to participants requiring that they answer questions about memory strategies that they use in their everyday life. It is predicted that those participants who use more external reminders will show worse prospective memory performance. This expectation is based on findings by Mäntylä (1998) who showed that those who report higher use of memory aids show corresponding decline in prospective memory performance. This prediction is in opposition to d'Ydewalle (1996) who found that older subjects who used external reminders more frequently showed better prospective memory performance on tasks that include conditions of low experimental control.

#### Method

## Participants

Twenty-four young adults ( $M = 19.96$  years of age,  $SD = 3.33$ ), 24 young-old adults ( $M = 66.58$  years of age,  $SD = 3.92$ ), and 24 old-old adults ( $M = 81.25$  years of age,  $SD = 2.98$ ) participated in the experiment. Although the sample was well-educated, a one-way analysis of variance (ANOVA) revealed that young-old adults ( $M = 15.04$ ,  $SD = 3.03$ ) had significantly more years of education compared to young adults ( $M = 13.08$  years,  $SD = 1.18$ ),  $F(69) = 4.15$ ,  $p < .05$ . Old-old adults ( $M = 14.00$  years,  $SD = 2.47$ ) did not differ significantly in their years of education from young or young-old adults. Self-reported health was measured using a 5-point Likert style scale. Participants were asked to reflect on their health in the last month and then rate themselves on a five-point scale (1=very good, 2=good, 3=fair, 4=poor, 5=very poor). A one-way ANOVA showed a significant difference between age groups,  $F(69) = 4.05$ ,  $p < .05$ . A post-hoc Tukey HSD test revealed that young adults ( $M = 1.41$ ,  $SD = .59$ ) reported significantly better health than old-old adults ( $M = 2.00$ ,  $SD = .83$ ). Young-old adults' ratings ( $M = 1.50$ ,  $SD = .83$ ) were intermediate, and not significantly different from young nor old-old adults.

Young adults were recruited from an undergraduate psychology course and they received course credit for their participation in the experiment. The young-old and old-old participants were recruited from a volunteer pool maintained by the Laboratory of Roger Dixon at the University of Victoria. These community-dwelling participants were reimbursed for their travel expenses (e.g., bus fare, parking).

## Design and Apparatus

The design was a 3 (Age: young, young-old, old-old)  $\times$  3 (Perceptual Displacement: PM cue displaced, neutral, target-displaced) mixed factorial design with age as the

between-subject variable and perceptual isolation as the within-subject variable. The dependent variable was the proportion of correct prospective memory responses. This task was administered on a PC compatible computer. The character size of the stimuli were no smaller than approximately  $10 \times 14$  mm. This size was suitable for all levels of visual acuity. Letters were presented in upper case in the centre of the screen.

### Procedure

Upon arrival to the laboratory, the experimenter obtained informed consent from participants. A brief biographical questionnaire was administered recording basic demographic information. The study was described to participants by the experimenter and participants were asked to read instructions on the computer screen outlining the requirements of the study. Finally, participants were given a short training phase that consisted of 10 practice trials to ensure that the instructions for the primary task and the embedded prospective memory task were clearly understood.

### Measures

Serial position task. The primary task consisted of participants performing a serial visual search task. Participants were told that they would see a single target letter from the alphabet appear on the computer screen. They were instructed to remember this letter because it would appear in a subsequent string of six letters. The purpose to saying the letter aloud was to ensure that the participant visually and orally processed each letter, thus controlling for possible lapses in attention. After the letter was read aloud, the experimenter pushed the space bar and a six-letter string appeared on the screen. When the letter string appeared, participants were instructed to press the number key that corresponded to the position of the target letter. The number of the positions was counted

from left to right in the string. The numbers were located on the numeric keypad on the right side of the computer keyboard. As there were six letters in each string, the possible range of responses was from 1 through 6 inclusive. For example, if the target letter was "E" and it appeared in the fourth position (from the left), then the participant was to press the number "4" on the numeric keypad. It is important to note that participants were told that there would be a target present in the letter string in every trial. There were no trials in which there was no target present. Participants were told to perform their serial position identification as quickly and accurately as possible.

An additional perceptual manipulation was employed such that on approximately 25% of the trials, one letter in a letter string was spatially displaced one line below the letter string. The displaced letter maintained its serial position while being placed significantly below the rest of the letters. Previous literature has demonstrated that such a manipulation causes displaced letters to be perceptually salient (Von Restorff, 1933; as cited in Hunt, 1995). Thus, a displaced target letter would lead to quicker identification. Correspondingly, a displaced distractor letter would slow identification of the target (non-displaced letter). Displacement of stimuli was varied systematically in terms of position in the string and in terms of the position of the displaced trials within the total number of trials.

There were 112 trials in total (excluding the 10 practice trials). On 84 trials there were no letters displaced, on 14 trials the target letter was displaced, on 10 trials the distractor was displaced, and on 4 trials the PM cue was displaced. (Twelve trials out of the 112 were prospective memory trials.) On the majority of trials (71%) there was no letter displaced. These proportions were selected purposefully so that when a letter was

displaced it was an uncommon event that increased the effectiveness of the perceptual manipulation. (If most of the trials incorporated some form of letter displacement, participants would begin to expect it and the manipulation would become less potent.)

Prospective memory task. The prospective memory task was embedded within the serial position task. During the instruction phase, participants were told that if at any point during the experiment they saw the letter "B" or the letter "D" in one of the letter strings, they must make a specific response. Participants were told that they should press the number "9" if they see a letter "B" at any point in the study, and they were told to press number "7" if they see the letter "D" at any point during the study. These specific numbers were chosen with certain criteria in mind: (a) the numbers do not conflict with the primary task responses (1-6), and (b) the earlier number "7" is paired with the later letter "D" and the later number "9" is paired with the earlier letter "B". This last criterion was used to add an extra challenge to remembering the correct response with the correct cue.

Participants were told that these cues may or may not occur throughout the duration of the study. (This last statement was included to discourage the participants from excessive monitoring on every trial.) Participants were told to press these responses (7 or 9) with these cues (D or B) regardless of the position of the letter in the letter string. Thus, much like real life, when participants recognized a PM cue, they had to disengage from the primary task of serial visual search, in order to perform the intention of pressing the "7" or "9" key. The prospective memory cues occurred 12 times out of the 112 trials. That is, they occurred in 11% of the trials. The 12 PM cues were divided into three conditions. These conditions are represented in Figure 1.

The first condition was the “PM cue displaced” condition and it consisted of 4 trials. In this condition, the prospective memory cues were the most perceptually distinctive relative to the other two conditions. That is, the prospective memory cues (B or D) were spatially displaced relative to the other letters in the letter string. Therefore, the target cue from the primary task (serial position task) would always appear within the letter string whereas the prospective memory cues always appeared in the displaced position.

In the “neutral” cue condition, there were 4 trials in which target cues from the serial position task and the prospective memory task appeared within the letter string. No letters in this condition were displaced. Therefore, the relationship between the target cue and the PM cue was neutral because they both appeared within the letter string and no letter was displaced.

Finally, in the “target-displaced” condition, there were 4 trials in which the target cues from the serial position task were in the displaced position and the prospective memory cues appeared within the letter string. Thus, it was more difficult to respond successfully to the PM cues (B or D) because they were less perceptually distinctive.

These perceptual manipulations allowed us to examine the effect of spatial displacement on visual search and prospective memory performance for all three age groups. It gave us the opportunity to examine the competition between the primary task and prospective memory task performance at various levels of perceptual salience. For example, we were able to observe how attention devoted to the primary task competes with the attention devoted to the prospective memory task.

Responses were scored using two criteria designed to reflect memory for the prospective and retrospective components of prospective remembering. The prospective

component was scored as the proportion of times that an individual correctly identified a letter as a prospective memory cue, regardless of whether he or she recalled the associated intention. The retrospective component was scored as the proportion of recognized prospective cues to which the participant also correctly recalled the intention. For example, if a participant correctly identified 3 out of the 4 prospective cues in a given condition, and also recalled the associated intention to 2 out of the 3 identified cues, the participant received a score of (.75 or 3/4) for the prospective component, and a score of (.67 or 2/3) for the retrospective component.

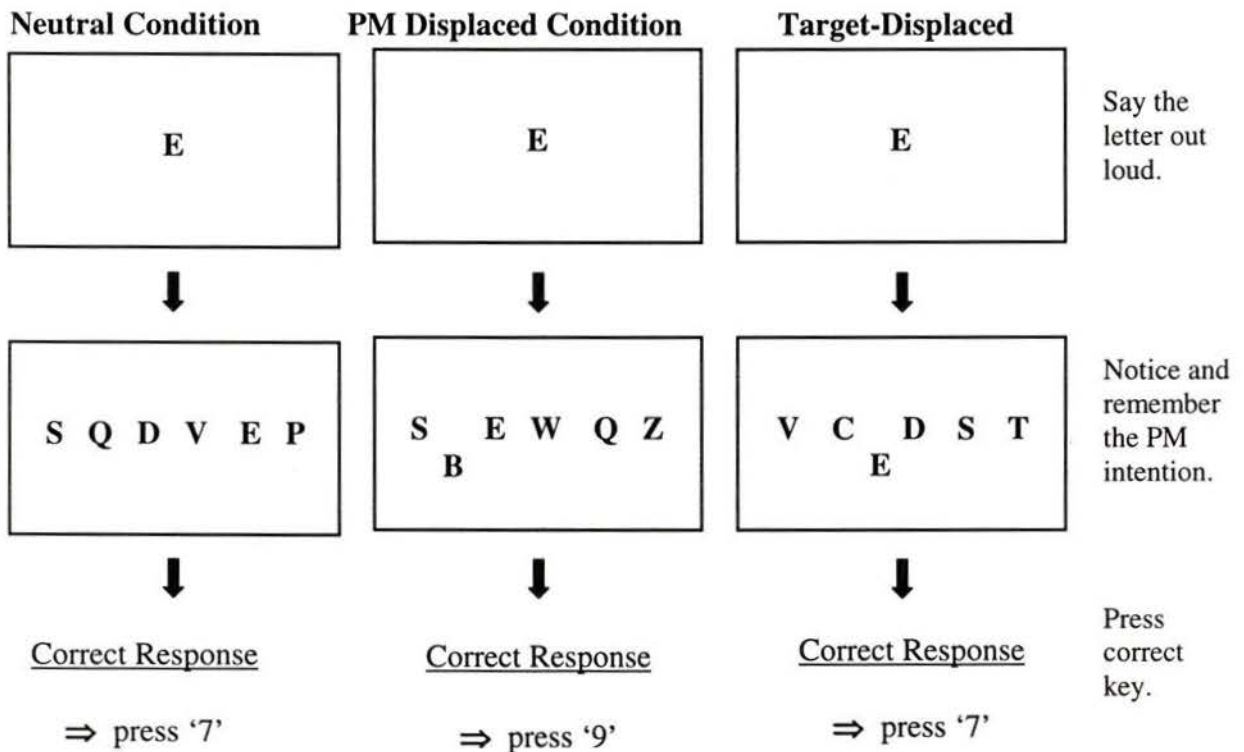


Figure 1. Schemata of stimuli from the three cue conditions: (a) neutral condition (b) PM cue displaced condition (c) target-displaced condition (This figure is for illustrative purposes and please note that the actual stimuli are much larger.)

Word recall. A word recall test was included for the purpose of comparing performance on a prospective memory test with performance on a retrospective memory test. (See Appendix A.) This measure was included from part of the Victoria Longitudinal Study test battery. Participants were given two minutes to study a list of 30 common English nouns. The list of words comprised five categories with six words in each. The five categories were fruits, tools, animals, landforms, and musical instruments. Immediately after the two-minute study phase, participants were told that they had five minutes to write down as many words as possible in any order they wish. The dependent variable was the proportion of words correctly recalled.

In addition to performance on the proportion of words correctly recalled, two other measures were included to examine specific aspects of word recall performance more closely. First, performance was converted into the number of categories recalled. This measure was used as a way of measuring indirectly the retrieval of superordinate organizational units (Tulving & Pearlstone, 1966; as cited in Small, Dixon, Hultsch, & Hertzog, 1999). Second, the average number of words recalled per category was calculated as an indirect measure of the retrieval of subordinate units, given retrieval of the superordinate category.

Memory Compensation Questionnaire (MCQ). A memory compensation questionnaire was administered to participants assessing the degree to which participants perform compensatory activities to improve their memory functioning. (See Appendix B.) The original MCQ (Dixon and Bäckman, 1992) includes 7 scales, five of which reflect forms of memory compensation (e.g., external memory aid use, internal memory aid use, investment of time, investment of effort in memory, reliance on others for memory aid).

Three of these scales were used in the present study. The external scale (8 items), internal scale (10 items), and reliance scale (5 items) were used as they reflect strategies pertinent to everyday retrospective and prospective memory performance. Thus, 24 questions in total were administered to participants. Questions were worded and presented such as this: (a) external scale: "Do you use shopping lists when you go shopping?" (b) internal scale: "Do you use letters from the alphabet as cues when you want to remember the name of a person, city, or something else?" (c) reliance scale: "When you want to remember an important event, do you ask somebody else (e.g., spouse or friend) to remind you?". Answers to each question were presented in a 5-point Likert-style format (e.g., Never, Seldom, Sometimes, Often, Always) and participants circled the response that applied best to them. Scale scores represented the total mean response.

In addition, 13 items were selected from the MCQ as they focused on compensatory efforts directed at everyday prospective memory. This prospective memory compensation scale included 5 items from the external scale, 5 items from the reliance scale, 2 items from the internal scale, and 1 item from the effort scale.

The three principal MCQ scales have been found to have substantial reliability and validity characteristics (deFrias, 1998), with Cronbach's  $\alpha$  consistently in the .70 to .80 range across age and gender. The selected prospective memory items showed similar reliability and validity characteristics ( $\alpha = .72$ ).

## Results

Results are presented in five sections. First, correlational analyses were performed to examine the degree of relationship between tasks. Second, reaction time and accuracy performance on the serial position task was examined using analysis of variance

(ANOVA). Third, performance on the prospective memory task was analyzed in terms of reaction time and accuracy. Analysis of the prospective component of prospective memory performance is reported first followed by analysis of the retrospective component. Fourth, performance on the word recall task was examined in terms of proportion correct, proportion of categories recalled, and the proportion of words per category recalled. Finally, the role of participants' everyday use of memory strategies was examined in terms of the frequency of use of external memory aids, internal memory aids, and reliance on others. In addition, the MCQ prospective memory scale is examined.

### Task Correlations

Pearson Product Moment correlations were calculated to examine the degree of relationship between tasks. It was expected that the word recall task would correlate significantly with the prospective memory task based on the hypothesis that free recall tasks depend on processes associated with prospective memory tasks (prospective and retrospective components). In line with this prediction, there were significant positive correlations between performance on the word recall and prospective memory tasks (collapsing across condition and age) at  $p < .01$ . The correlations ranged from  $r = .42$  to  $r = .44$ . To examine this relationship by age group, correlations were computed separately for young, YO, and OO adults. As shown in Table 1, performance on the PM and RM components were substantially correlated for all age groups. The correlations between PM and RM components, on the one hand, and word recall, on the other, were positively correlated only for the YO and OO groups.

Table 1

Correlation between prospective component, retrospective component, and word recall for young, young-old, and old-old adults

	RM Component	Word
<b>YOUNG</b>		
PM Component	.50*	-.20
RM Component		-.12
<b>YOUNG-OLD</b>		
PM Component	.65**	.67**
RM Component		.36
<b>OLD-OLD</b>		
PM Component	.67**	.35
RM Component		.53*

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

It was expected that participants' performance on word recall would correlate with specific scales within the memory compensation questionnaire. When performance was collapsed across age groups, results showed a significant ( $p < .05$ ) correlation between word recall and the internal memory aid use scale ( $r = .25$ ). The other correlations ranged from  $r = -.07$  to  $r = .05$ . The correlations computed by age are reported in Table 2.

Table 2

Correlation between word recall and the MCQ scales for young, young-old, and old-old adults

	Category Recall	Per Category	E(MCQ)	I(MCQ)	R(MCQ)	PM(MCQ)
<b>YOUNG</b>						
Word Recall	.19	.99**	.12	.33	-.13	.01
Category Recall		.18	.18	.16	.41*	.21
Per Category			.13	.35	-.13	.03
E(MCQ)				.15	.16	.69**
I(MCQ)					.12	.37
R(MCQ)						.70**
PM(MCQ)						
<b>YOUNG-OLD</b>						
Word Recall	.51*	.99**	.03	.08	.14	.05
Category Recall		.52*	-.26	-.04	-.46*	-.42*
Per Category			.05	.10	.06	.04
E(MCQ)				.44*	.21	.66**
I(MCQ)					.07	.60**
R(MCQ)						.64**
PM(MCQ)						
<b>OLD-OLD</b>						
Word Recall	.56**	.99**	.40	.26	-.01	.27
Category Recall		.57**	-.08	-.02	-.27	-.27
Per Category			.39	.27	.01	.27
E(MCQ)				.13	.29	.68**
I(MCQ)					.20	.41*
R(MCQ)						.80**
PM(MCQ)						

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

Note. E(MCQ) = external scale, I(MCQ)=internal scale, R(MCQ)= reliance scale, PM(MCQ)=prospective memory scale.

Finally, it was predicted that selected scales of the MCQ would correlate with prospective memory performance. As shown in Table 3, when performance was collapsed across the three age groups and analyzed by condition, there was a significant negative correlation between retrospective component performance and the external memory aid use scale ( $r = -.26$ ) in the neutral and PM displaced conditions at  $p < .05$ . Furthermore, the PM scale correlated significantly at  $p < .05$  with retrospective component performance in the neutral condition ( $r = -.25$ ). When correlations were examined by age group, there were no significant correlations between prospective memory performance and the MCQ.

Table 3

Correlation between prospective and retrospective component performance and MCQ scales

	RMNeut	RMPM	RMTarg	E(MCQ)	I(MCQ)	R(MCQ)	PM(MCQ)
PMNeut	.50**	.43**	.54**	-.11	-.12	-.05	-.17
PMPM	.67**	.61**	.61**	-.13	.05	-.04	-.14
PMTarg	.60**	.46**	.62**	-.22	-.05	.06	-.16
RMNeut				-.26*	-.04	-.02	-.25*
RMPM				-.26*	.05	.00	-.14
RMTarg				-.22	-.10	.06	-.15

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

Note.

PMNeut = Prospective component (neutral condition)

PMPM = Prospective component (PM cue displaced condition)

PMTarg = Prospective component (Target-displaced condition)

RMNeut = Retrospective component (neutral condition)

RMPM = Retrospective component (PM cue displaced condition)

RMTarg = Retrospective component (Target-displaced condition)

#### Serial position task

Accuracy was evaluated using a 3 (Age: young, young-old, old-old) × 3 (Trial Type: non- displaced, target-displaced, distractor-displaced) analysis of variance (ANOVA) with repeated measures on the second factor. The dependent variable was the proportion of letters that were evaluated correctly in terms of their serial position.

Analyses yielded a main effect of Trial Type,  $F(2, 69) = 186.37, p < .01, \eta^2 = .85$ .

Inspection of the means revealed that performance was most accurate in the distractor-displaced ( $M = .96, SD = .08$ ) and the non-displaced conditions ( $M = .95, SD = .05$ ) and least accurate in the target-displaced condition ( $M = .78, SD = .10$ ). T-tests revealed significant performance differences between target-displaced trials and both the non-displaced and distractor-displaced conditions. Although, no main effect of Age was observed, there was a significant interaction between Age and Trial Type,  $F(2, 69) = 2.46, p < .05, \eta^2 = .07$ . The means from this interaction are represented in Table 4. They indicate that all age groups performed similarly in the non-displaced and distractor-displaced trials, however, in the target-displaced trials young-old and old-old adults did significantly poorer relative to young adults' performance.

Table 4

Mean Proportion of Correct Identifications of Targets in Serial Position Task for young, young-old, and old-old adults

	Young		Young-Old		Old-Old	
	M	SD	M	SD	M	SD
Non-Displaced	.95	(.04)	.97	(.04)	.94	(.06)
Target-Displaced	.81	(.10)	.76	(.11)	.77	(.08)
Distractor-Displaced	.96	(.07)	.96	(.08)	.96	(.09)

*Numbers in parentheses represent standard deviations.*

To examine reaction time performance, a 3 (Age)  $\times$  3 (Trial Type) ANOVA was conducted with repeated measures on the second factor. The dependent variable was speed

of performance measured in milliseconds. There was a main effect of Trial Type,  $F(2, 69) = 29.75, p < .01, \eta^2 = .47$ . Follow-up t-tests indicated that performance was significantly faster on non-displaced trials ( $M = 2151.25$  ms,  $SD = 747.81$ ) compared to target-displaced ( $M = 2468.16$  ms,  $SD = 955.74$ ) and distractor-displaced ( $M = 2425.02$  ms,  $SD = 884.62$ ) trials. There was no significant difference between target-displaced and distractor-displaced trials. There was a main effect of Age,  $F(2, 69) = 29.23, p < .01, \eta^2 = .46$  and Tukey HSD tests revealed that young adults ( $M = 1584.15$  ms,  $SD = 276.82$ ) performed significantly faster than both young-old ( $M = 2568.87$  ms,  $SD = 618.62$ ) and old-old adults ( $M = 2891.40$  ms,  $SD = 826.50$ ). There was no significant difference between young-old and old-old adults. There was a significant Age  $\times$  Trial Type interaction,  $F(2, 69) = 3.86, p < .05, \eta^2 = .10$ . As revealed in Figure 2, young adults did not vary as much in their reaction time across the three trial types, however, YO and OO adults did vary considerably across trial types. YO and OO adults slowed their responding to a greater extent than young adults on the target- and distractor-displaced trials compared to their performance on non-displaced trials.

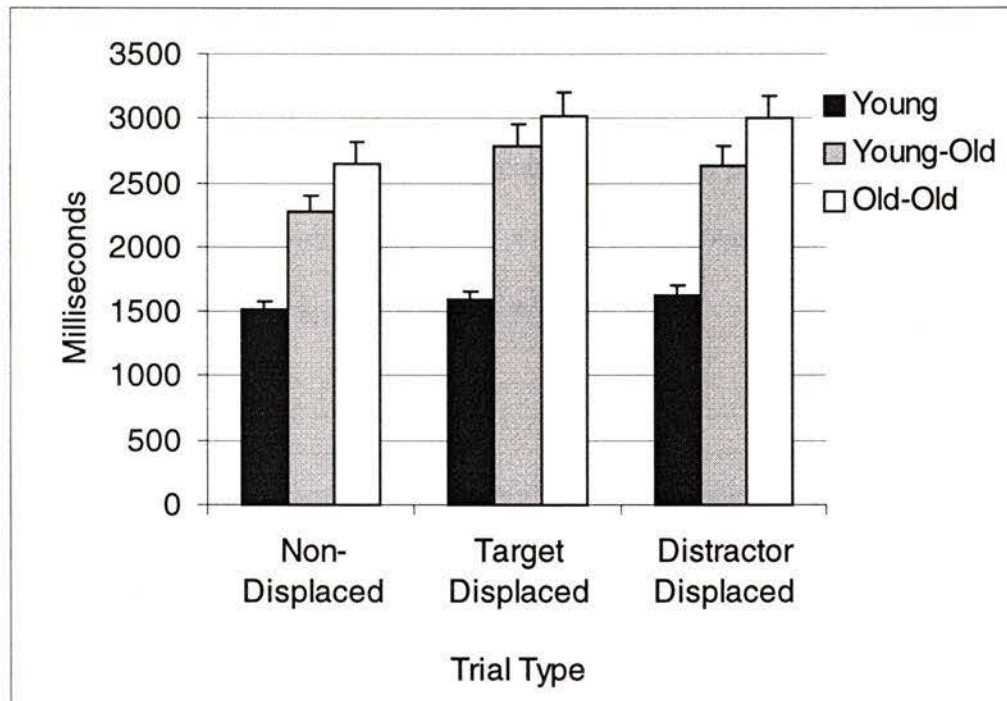


Figure 2. Mean reaction time on the serial position task as a function of trial type for young, young-old, and old-old adults. Bars represent standard error.

### Prospective Memory Task

The effects of perceptual displacement and age on the prospective component of prospective remembering were evaluated in a 3 (Age: young, young-old, old-old)  $\times$  3 (Perceptual Displacement: PM cue displaced, neutral, target-displaced) ANOVA with repeated measures on the second factor. The prospective component was scored as the proportion of times that an individual correctly identified a letter as a prospective cue during the test phase, regardless of whether he or she recalled the associated intention. Results revealed a main effect of Perceptual Displacement,  $F(2, 69) = 13.81, p < .01, \eta^2 = .29$ , showing that performance was significantly better in the PM cue displaced condition ( $M = .63, SD = .38$ ) compared to the neutral ( $M = .47, SD = .35$ ) and target-displaced ( $M =$

.50,  $SD = .36$ ) conditions, which were not significantly different from one another. There was a main effect of Age,  $F(2, 69) = 3.38, p < .05, \eta^2 = .09$ , which the Tukey HSD test revealed was due to a significant difference between the performance of young adults ( $M = .65, SD = .23$ ) and old-old adults ( $M = .41, SD = .35$ ). Although no significant interaction was observed, the data are presented in Figure 3.

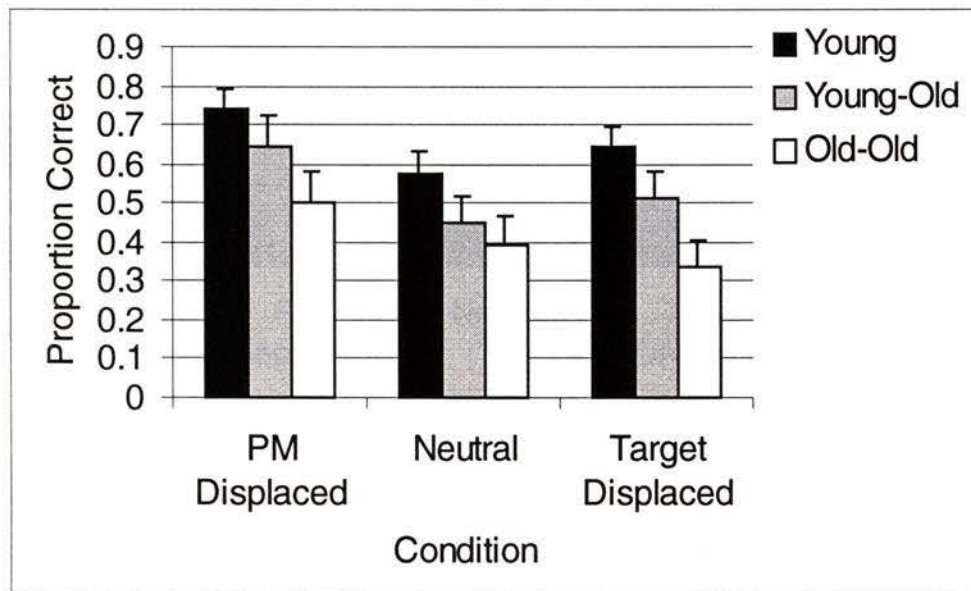


Figure 3. Performance on the prospective component of prospective memory as a function of condition for young, young-old, and old-old adults. Bars represent standard error.

The influence of perceptual displacement and age on the retrospective component of prospective remembering was considered in a similar analysis. The retrospective component was scored as the proportion of correctly recalled intentions. There was a main effect of Age,  $F(2, 69) = 6.97, p < .05, \eta^2 = .17$ , indicating that young adults ( $M = .80, SD = .27$ ) recalled significantly more correct intentions compared to both young-old adults ( $M = .50, SD = .41$ ) and old-old adults ( $M = .42, SD = .42$ ). Young-old and old-old adults'

performance were not significantly different. There was no main effect of Trial Type and no interaction was found. (See Figure 4.)

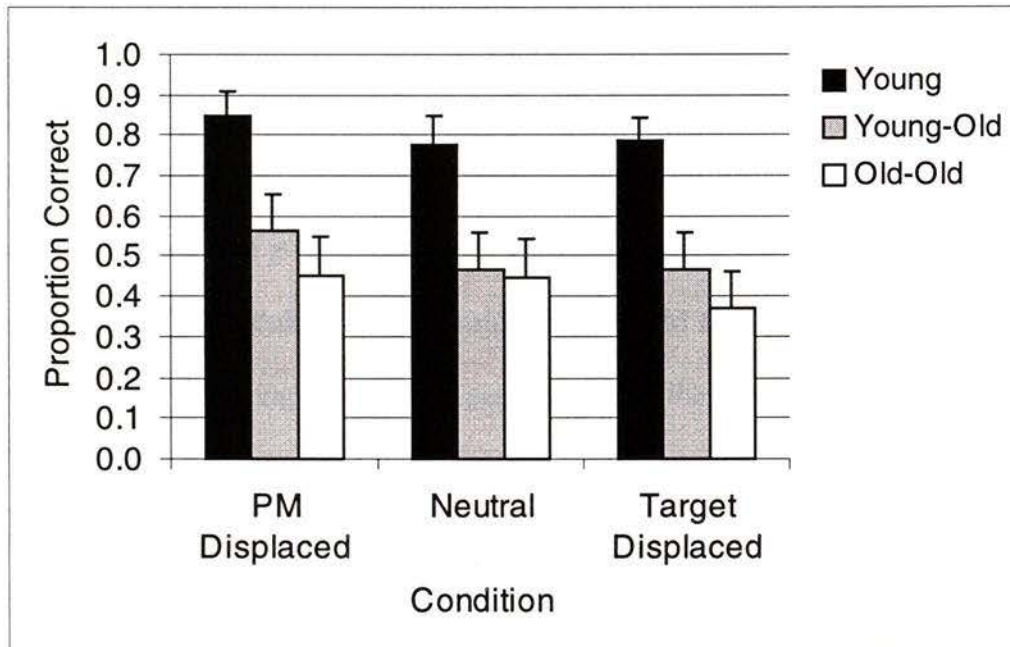
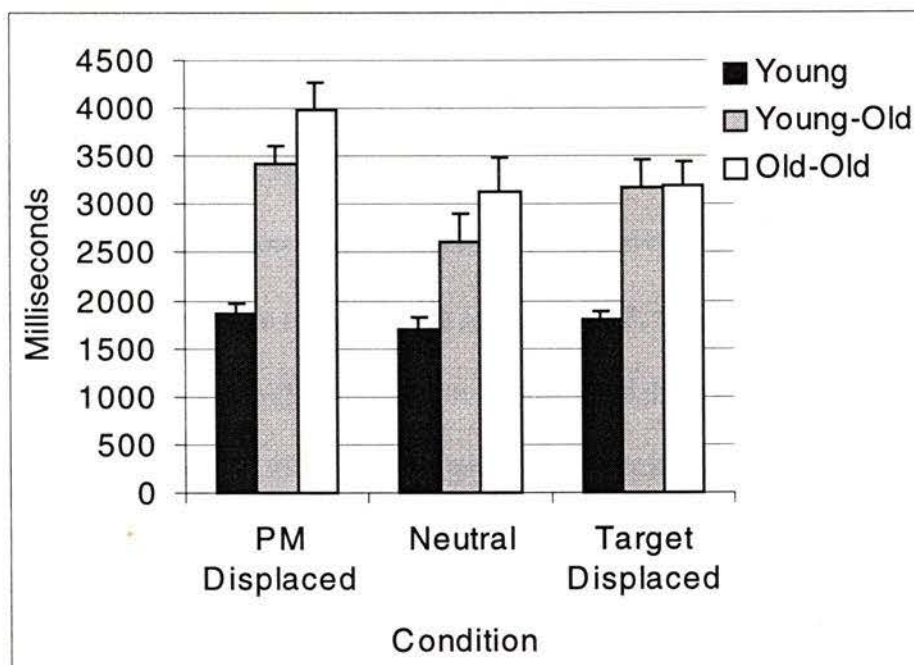


Figure 4. Performance on the retrospective component of prospective memory as a function of condition for young, young-old, and old-old adults. Bars represent standard error.

Participants' reaction time performance was analyzed by conducting a 3 (Age: young, young-old, old-old)  $\times$  3 (Perceptual Displacement: PM cue displaced, neutral, target-displaced) ANOVA with repeated measures on the second factor. There was a main effect of Perceptual Displacement,  $F(2, 69) = 9.38, p < .01, \eta^2 = .22$ , revealing that reaction time was significantly fastest for the neutral condition ( $M = 2484.45$  ms,  $SD = 1141.36$ ) than for the target-displaced condition ( $M = 2716.05$  ms,  $SD = 1318.36$ ), which was significantly faster than performance on the PM-displaced condition ( $M = 3093.66$  ms,  $SD = 1579.49$ ). There was a main effect of Age,  $F(2, 69) = 19.94, p < .01, \eta^2 = .37$ .

Examination of the means revealed that young adults ( $M = 1790.68$  ms,  $SD = 388.05$ ) were significantly faster than both young-old ( $M = 3065.95$  ms,  $SD = 1113.22$ ) and old-old adults ( $M = 3437.53$  ms,  $SD = 1141.88$ ). There was no significant difference between the latter two groups' reaction time performance. There was a marginal interaction between Age and Perceptual Displacement,  $F(2, 69) = 2.36$ ,  $p = .06$ ,  $\eta^2 = .06$ , revealing that in the PM displaced condition there was a greater difference between reaction time performance between the three age groups than in the neutral and target-displaced conditions. As shown in Figure 5, old-old adults were much slower in the PM displaced condition ( $M = 3989.65$  ms,  $SD = 1688.27$ ) compared to their performance in the neutral ( $M = 3135.43$  ms,  $SD = 1381.25$ ) and target-displaced conditions ( $M = 3187.52$  ms,  $SD = 1280.02$ ). The pattern was less pronounced for young-old and young adults.



**Figure 5.** Mean reaction time on the prospective memory trials as a function of condition for young, young-old, and old-old adults. Bars represent standard error.

Because the age groups differed in years of education, we covaried education in re-analysis of the prospective remembering data. First, performance on the prospective component was analyzed in a 3 (Age: young, young-old, old-old)  $\times$  3 (Perceptual Displacement: PM cue displaced, neutral, target-displaced) analysis of covariance (ANCOVA) with repeated measures on the second factor. Although education level did not significantly correlate with prospective memory performance, including it as a covariate in the ANCOVA eliminated the main effect of Perceptual Displacement. A partial correlation was conducted between education level and performance on the PM component controlling for Age. The correlation between education and PM component performance was significant ( $r = .26$ ) when Age was controlled for. Thus, it appears that education shares common variance with the factor of Age and therefore may be behaving as a suppresser variable. The main effect of Age remained,  $F(2, 69) = 4.33, p < .05, \eta^2 = .11$ . The young adults ( $M = .68, SD = .23$ ) recognized significantly more cues than old-old adults ( $M = .41, SD = .35$ ). No interactions were found. The effect of covarying education and its effect on the retrospective component of prospective remembering was examined in a similar analysis. The main effect of Age remained,  $F(2, 69) = 7.40, p < .05, \eta^2 = .18$ , indicating that young adults ( $M = .82, SD = .27$ ) recalled the correct intention significantly more than young-old ( $M = .48, SD = .41$ ) and old-old adults ( $M = .42, SD = .42$ ).

Self-reported health differed between age groups with young adults reporting significantly better health than old-old adults. Furthermore, there was a marginally significant difference between young-old and old-old adults. These results led to the analysis of the factor of health as a covariate to determine whether it accounted for a significant amount of variance. A reanalysis of the prospective component of prospective

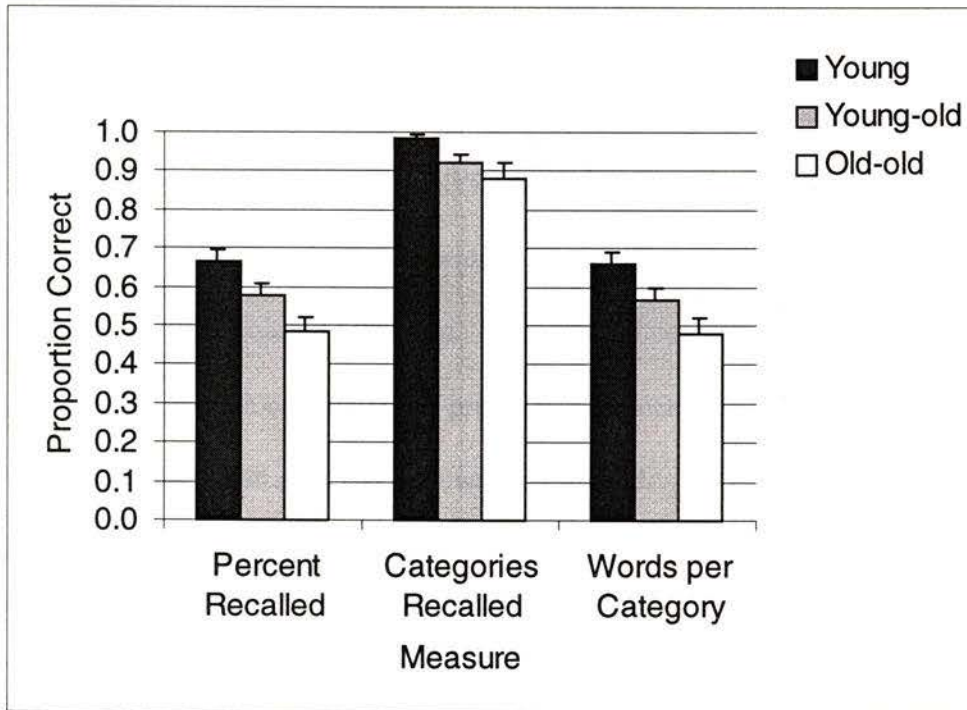
memory was conducted with the factor of health as a covariate. A 3 (Age)  $\times$  3 (Perceptual Displacement) ANCOVA was conducted with repeated measures on the second factor. Covarying health eliminated the main effect of Perceptual Displacement, however the main effect of Age remained,  $F(2, 69) = 5.00$ ,  $p < .05$ ,  $\eta^2 = .13$ , with young adults ( $M = .70$ ,  $SD = .23$ ) recognizing significantly more cues than old-old adults ( $M = .39$ ,  $SD = .35$ ). A similar analysis was conducted examining the effect of covarying health on the retrospective component of prospective remembering. As before, there was a main effect of Age,  $F(2, 69) = 6.93$ ,  $p < .05$ ,  $\eta^2 = .17$ , indicating that young adults ( $M = .82$ ,  $SD = .27$ ) remembered significantly more intentions than young-old adults ( $M = .51$ ,  $SD = .41$ ) and old-old adults ( $M = .41$ ,  $SD = .42$ ).

### Word Recall

Word recall performance for young, young-old, and old-old adults was evaluated using a one-way analysis of variance (ANOVA) with the dependent variable being the percent of words correctly recalled. There was a significant difference between age groups,  $F(69) = 9.02$ ,  $p < .001$ ,  $\eta^2 = .21$ . The Tukey HSD test revealed that young adults ( $M = .66$ ,  $SD = .13$ ) recalled significantly more words than both young-old adults ( $M = .58$ ,  $SD = .19$ ) and old-old adults ( $M = .48$ ,  $SD = .18$ ). Young-old adults' performance differed significantly from old-old adults' performance.

The next analyses attempted to determine whether the differences observed in the overall proportion of words recalled could be attributed to performance on the proportion of categories recalled and/or the proportion of words per category recalled. The proportion of categories recalled was computed by dividing the number of categories recalled for each participant by the total number of categories possible (5 categories). These proportions

were submitted to a one-way ANOVA, results indicated a significant difference between age groups,  $F(69) = 3.57, p < .05, \eta^2 = .09$  with the Tukey HSD test confirming that young adults ( $M = .98, SD = .06$ ) recalled a significantly larger proportion of categories than old-old adults ( $M = .88, SD = .19$ ). Young-old adults ( $M = .93, SD = .12$ ) represented an intermediate group in which performance did not differ significantly from young or old-old adults. Finally, the proportion of words recalled per category was examined by calculating the mean number of words per category recalled for each participant and then dividing this number by the total number possible per category (6 words). A one-way ANOVA revealed a significant difference between age groups,  $F(69) = 8.94, p < .01, \eta^2 = .21$ . The Tukey HSD test showed that the age difference was due to young adults ( $M = .66, SD = .13$ ) recalling a greater proportion of words per category than both young-old ( $M = .57, SD = .13$ ) and old-old adults ( $M = .48, SD = .18$ ). Consistent with results on the percent of words recalled young-old adults did differ significantly from old-old adults. These data are presented in Figure 6.



**Figure 6.** Proportion correct as a function of word recall measure for young, young-old, and old-old adults. Bars represent standard error.

As Glisky (1996) suggested, there is a need to better understand the relation between prospective and retrospective memory performance. Because the age groups differed in word recall performance, we covaried word recall in a re-analysis of the prospective memory data. Performance on the prospective component was analyzed in a 3 (Age)  $\times$  3 (Perceptual Displacement) ANCOVA with repeated measures on the second factor. Covarying word recall resulted in an elimination of the main effects of Age and Perceptual Displacement. There was a significant interaction between Perceptual Displacement and the covariate (word),  $F(69) = 3.48$ ,  $p < .05$ ,  $\eta^2 = .09$ , indicating that

covarying word recall affects performance differentially depending on the condition. To explore further the effects of word recall, three separate regressions were calculated to compare how much variance could be explained by word recall performance on each of the PM conditions. Word recall was regressed on performance in the neutral ( $R^2 = .10$ ), PM displaced ( $R^2 = .23$ ), and target-displaced ( $R^2 = .13$ ), conditions. Inspection of the  $R^2$ 's indicate that word recall appears to account for more variance in prospective component performance in the PM isolated condition. The effect of covarying word recall and its effect on the retrospective component of prospective remembering was examined in a similar analysis. The main effect of Age was eliminated.

#### Memory Compensation Questionnaire

Answers from the MCQ were presented as a 5-point Likert-style scale and responses were coded for frequency from 0 to 4. Responses were averaged and submitted to a 3 (Age)  $\times$  3 (Scale: external, internal, reliance) ANOVA with repeated measures on the second factor. The dependent variable was participants' mean score out of 4. A main effect of Scale,  $F(2, 69) = 193.58$ ,  $p < .01$ ,  $\eta^2 = .74$ , revealed that participants used external reminders ( $M = 2.93$ ,  $SD = .65$ ) significantly more than internal reminders ( $M = 2.19$ ,  $SD = .63$ ) and internal reminders were used significantly more than reliance ( $M = 1.08$ ,  $SD = .70$ ). There was no main effect of Age, although there was an Age  $\times$  Scale interaction,  $F(2, 69) = 6.82$ ,  $p < .05$ ,  $\eta^2 = .17$ . As Figure 7 shows, young adults ( $M = 2.45$ ,  $SD = .61$ ) used external memory strategies significantly less compared to both young-old ( $M = 3.11$ ,  $SD = .59$ ) and old-old adults ( $M = 3.22$ ,  $SD = .46$ ), whereas, the use of internal memory strategies and reliance on others was more similar across age groups.

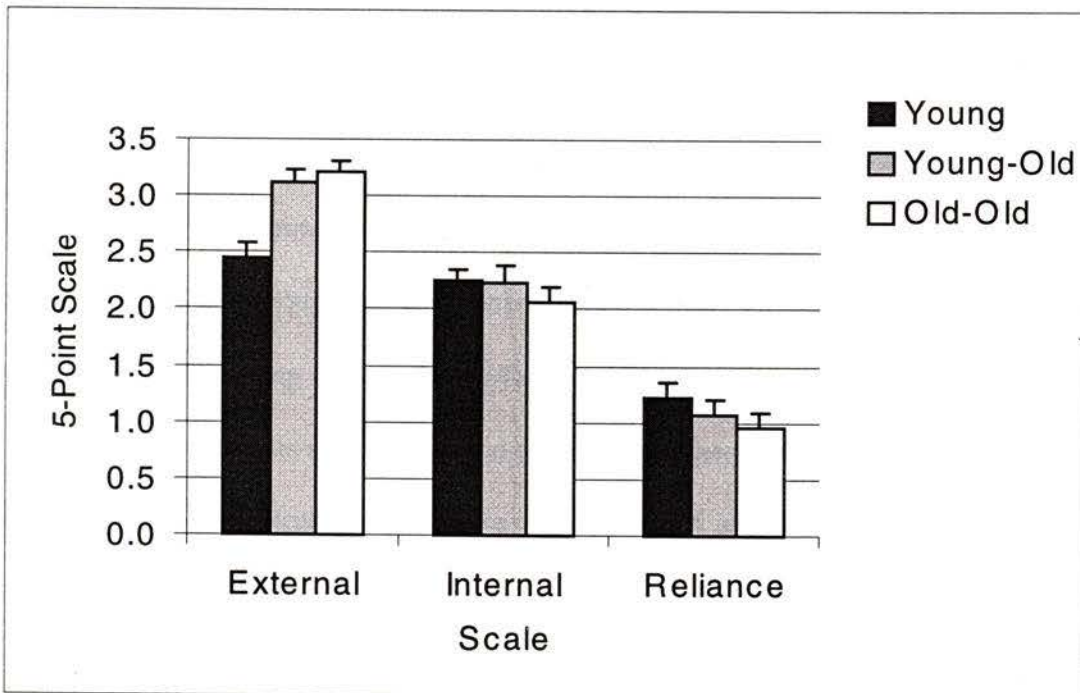


Figure 7. Questionnaire responses as a function of scale for young, young-old, and old-old adults. Bars represent standard error.

#### Discussion

The significance of the prospective memory findings will be discussed first, followed by the serial position task, followed by the word recall task, and finally the results from the memory compensation questionnaire will be discussed last.

#### Prospective Memory Study

This experiment demonstrated that manipulating perceptual salience of prospective memory cues influenced the efficiency of the prospective and retrospective components of prospective remembering differentially. Consistent with my hypothesis, the manipulation of salience of PM cues, thought to influence the contribution of data driven processes, had the greatest impact on the efficiency of the prospective component of prospective remembering. This finding is consistent with Cohen et al. (1998), who found that the

efficiency of the prospective component is modulated by data driven processes. In comparison, and in line with our predictions, this manipulation had no effect on the efficiency of the retrospective component. It is theoretically useful to identify variables that differentially influence the prospective and retrospective components of prospective remembering. By studying both components and the factors that modulate them, we extend our understanding of success and failures of prospective memory.

Generally, results showed that the efficiency of the prospective and retrospective components of prospective memory were more disrupted in older adults than in younger adults. In addition, the present study afforded the opportunity to make a more detailed analysis of older adults' performance through the examination of two older adult age groups. Previous experimental studies of prospective memory tended to include extreme comparisons of young adults (university students) with only one group of older adults. It is plausible that these past studies included samples of older adults that varied differentially by age. As other researchers have noted (Dixon, Cohen, Hazlitt, Maitland, & Hultsch, 1999), older adult samples may be at different points in the progressive decline in the speed of performing motor and cognitive operations. Indeed, in a recent review, Bäckman, Small, and Wahlin (1999) showed that there are notable differences in cognitive performance among young-old (i.e., 55-70 years), old-old (i.e., 71-85 years), and especially very old adults (i.e., 85+ years). By including two groups of older adults, we attempted to investigate whether age-related differences exist between young-old and old-old adults, thereby extending what is currently known about older adults' prospective memory performance.

Results revealed a significant age difference solely between young and old-old adult age groups for the prospective component (correct identification of cue regardless of whether they recalled the associated intention) of prospective memory. But there was no significant difference between young and young-old adults nor was there a significant difference between young-old and old-old adults. These results indicated that the young-old age group appears to represent an intermediate age group whose performance falls between young and old-old age groups. What is to be gained from this finding is the fact that age effects, in terms of performance on the prospective component, appear to reveal themselves when comparing young to very old adults. That is, the old-old adults with a mean age of 81 years showed a deficit in performance relative to young adults but the young-old adults with a mean age of 67 years did not. The implication is that age-related decline seems to be gradual and occurs linearly from young to late adulthood and it reveals itself (relative to young) only well into the later years. Thus, researchers should be concerned that a given sample of older adults may not be homogeneous with respect to the factors (e.g., health, neurological changes, activity-level) responsible for age-related declines in performance.

For performance on the retrospective component (proportion of cues to which the participant also correctly recalled the correct intention), the findings were quite different. Young adults remembered a significantly higher proportion of intentions compared to both young-old and old-old adults. There was no significant age difference between young-old and old-old adults. For this analysis, unlike performance on the prospective component, young adults did differ significantly from young-old adults. Young adults had relatively little difficulty remembering the correct response when they encountered a PM cue,

whereas both groups of older adults experienced significantly more difficulty remembering the correct response. Thus, for performance on the retrospective component, unlike what was found for performance on the prospective component, a decline in performance relative to young adults was evident for adults with a mean age of 67 years. These findings serve to clarify what is known about older adults' performance on prospective memory tasks. By distinguishing between performance on the prospective and retrospective component, a clearer but more complex picture of young-old adults' performance emerges, with performance deficits being more apparent for performance on the retrospective component. It appears that young-old adults represent an intermediate age group who have retained cognitive capacities that enable adequate performance on the prospective component of prospective memory. However they do show more substantial deficits when it comes to retrospective component performance. Thus, one could conclude that performance on the retrospective component of prospective memory may be more sensitive to age-related decline.

In the familiarity plus search model, Einstein and McDaniel (1996) proposed that prospective remembering is supported by an automatic familiarity-based noticing process and a consciously controlled recollection-based search process. By this account, the presentation of a PM cue automatically elicits a sense of familiarity causing the cue to be recognized. This recognition of the PM cue leads to a directed search of memory in the hopes of establishing the significance of the cue and to determine whether a prospective response is appropriate at that time. Findings from the present study were not entirely consistent with this model. For example, if one assumes that the prospective component reflects automatic familiarity and the retrospective component reflects consciously

controlled recollection then one would predict age-related differences in the retrospective component but not for the prospective component. For it has been shown by a substantial amount of research (Hasher & Zacks, 1979; Schneider & Shriffrin, 1977; Shiffrin & Schneider, 1977) that controlled but not automatic operations are viewed as being resource demanding therefore sensitive to age-related decline. In accordance with this distinction, there is considerable evidence showing age-related deficits in tasks requiring controlled processing (Hay & Jacoby, 1999). Thus, if the prospective component is relatively automatic and the retrospective component is relatively controlled, it would be expected that age-related differences should be greater in the latter component. But this prediction did not hold for the present study. Therefore, the current results cast doubt on the noticing plus search model, and on its predictions with respect to age-related changes in prospective remembering. Consistent with results from the present study, other studies have also found significant age-related differences in performance for performance on both the prospective and retrospective component of prospective memory (Cohen et al., 1998; Maylor, 1993; West & Craik, 1999). Based upon our findings, it appears that increasing age does have some effect on the efficiency of the prospective component making it incompatible with the familiarity plus search model.

It is plausible that advocates of the familiarity plus search model may conclude that older adults showed age-related deficits on the prospective component of prospective memory merely because they had trouble with the perceptual aspect of this task. They may also suggest that older adults were at a disadvantage in terms of their ability to simply see the cue due to their declining vision (e.g., reduced functional field of view). As well, it has been well documented that sensory decrements are linked to deficits in cognitive

performance and this correlation increases with age (Baltes & Lindenberger, 1997).

However, if this were the case, one would expect a significant interaction between Age and Perceptual Displacement such that older adults benefited significantly more than young adults in the PM displaced condition. The logic is that if older adults were at a perceptual disadvantage, they should especially benefit from the perceptual salience of the cues in the PM displaced condition, thus resulting in an interaction between Age and Perceptual Displacement. However, this interaction was not significant. Although this is indirect evidence, it does support the tentative conclusion that older adults did not perform more poorly than young adults solely due to a perceptual disadvantage. Instead an alternative explanation incorporating a cognitive aspect may be more useful. Hartley (1992) discussed age-related deficits in the attention literature, specifically in visual search tasks. He tackles the issue of visual acuity and its role in performance. Hartley concluded, "...age differences cannot be compensated for by simply correcting refractive error or even by selecting the sizes of the letters to compensate for reduced acuity. The phenomenon must be more complex and at a higher level." (Hartley, 1992, p. 9). Thus, Hartley also considers the usefulness of an explanation that incorporates a higher cognitive influence to better explain age-related deficits in visual search performance.

According to the automatic associative module model (McDaniel et al., 1998; see also Moscovitch, 1994), successful prospective remembering occurs when there is sufficient interaction between a prospective cue and an associated memory trace. A module (subserved by the hippocampus) is thought to respond reflexively to cues. This results in the memory trace for the intended action being delivered automatically to consciousness (McDaniel, Robinson-Riegler, & Einstein, 1998). Thus, successful

prospective remembering is determined by the amount of association between the cue and associated memory trace. If the cue does not automatically interact with a memory trace, then that memory trace is not retrieved unless another memory module (prefrontal component) initiates a strategic memory search. Unfortunately, the present study is not appropriate for testing this model. Perhaps, an evoked response potential (ERP) study would be needed to pinpoint the underlying neural substrates that subserve the prospective and retrospective components of prospective memory. This would appear to be one direct way of testing the automatic associative model.

### Serial Position Task

The prediction that performance in the serial position task would be most accurate in the target-displaced condition and least accurate in the distractor-displaced condition was not supported by the present findings. Rather, results were exactly opposite to what was predicted. Performance was most accurate in the distractor-displaced condition and least accurate in the target-displaced condition. These results run counter to findings in the retrospective memory literature in which the processing of salient or distinctive attributes of stimuli leads to the experience of remembering or improved performance (Rajaram, 1997). A simple explanation exists for these results. If participants were required to solely identify the target's presence (not its serial position), performance would surely have been enhanced in the target-displaced condition. However, in the present paradigm participants were not asked to respond merely to the presence of the target but they had to identify the position of the target. It was understood that there was a target present on every trial and that the goal was to identify its position as quickly as possible. Thus, when the target was spatially displaced (target-displaced condition), it made the possibility of errors greater

because the target was not in line with the rest of the letters. This could have made errors in judgements of serial position (decreased accuracy) more likely.

These results lead to an idea for a potential future paradigm that could clarify the influence of the perceptual manipulation on performance. A study that included a two-step response from participants could provide an opportunity to measure two aspects of participant's performance. The task would be similar on many levels to the present task. However, participants would be told that the target letter may or may not be present on every trial. The participants would first identify the presence or absence of the target letter in each trial. Subsequently, if it were present, the participant would record the letter's serial position within the letter string. In this modified task, the target-displaced trials would undoubtedly enhance performance on the first step of the response (recording the presence or absence of target). Neutral or distractor-displaced trials would benefit performance on the second part of the response (locating the letter's serial position). This modification would allow for a more focused analysis of the effect of the perceptual manipulation.

### Word Recall

Word recall performance was measured three different ways in an effort to capture aspects of relational processing of a categorical word list (Small et al. 1999). Participants were measured on the proportion of words recalled, the proportion of word categories recalled as well as on the number of words per category recalled.

There was a significant positive correlation between word recall performance and prospective memory performance for both young-old and old-old adults. However, this relationship did not exist for younger adults. This pattern of results suggests that older

adults' performance on word recall shares some variance with their performance on the prospective memory task. The question that follows is what aspect of performance is common within these two tasks for older adults. Some researchers (e.g., Glisky, 1996) suggest that prospective memory performance (depending on the specific demands of the task) will correlate positively with retrospective memory performance. Specifically, the degree of correlation is thought to depend on the extent to which the retrospective memory task is dependent on processes associated with the frontal lobes (e.g., planning, organization, and selection). The present word recall task did incorporate an organizational component because the 30 words belonged to five word categories however, the words were not listed in these categories. Therefore, it was up to the participant to employ an organizational strategy that enabled them to categorize the words.

Along with strategies of planning and organization, most likely other factors such as working memory capacity and speed of processing were also relevant to successful performance on this task (for a review see, Hultsch, Hertzog, Dixon, & Small, 1998). Although it is impossible to conclude based on these results which processes were most crucial for successful performance, it does appear that some common age-related process was shared by the word recall and PM task leading to a positive correlation for both young-old and old-old groups. The lack of correlation between these two tasks for younger adults may indicate that this shared process is age-related and therefore not relevant for younger adults.

It was expected that participants' performance on word recall would correlate with specific scales within the memory compensation questionnaire. When performance was collapsed across age groups, results showed a significant positive correlation between word

recall and the internal memory aid use scale. This result is logical because as noted above, performance on the word recall task required internal encoding strategies for organizing the word list during the study phase. Questions about such strategies are targeted within the MCQ internal memory scale items. Thus, one would expect a positive correlation.

Young-old adults had significantly better performance than old-old adults on overall word recall and the proportion of words per category recalled. However, for the proportion of categories recalled there was no significant difference between young-old and old-old adults. These findings are partially consistent with recent findings by Small et al. (1999). They found that young-old adults recalled significantly more words per category than old-old adults (as in the present study). However, they found that young-old adults recalled significantly more categories than old-old adults (unlike the present study). However, it is likely that the reason for the lack of significance between young-old and old-old adults' performance in the proportion of categories recalled in the present study, is due to the smaller sample size. The Small et al. (1999) study involved a young-old sample consisting of 158 adults and an old-old age group consisting of 84 adults. If the lack of significance in the present study is due to small sample size, one would expect a power analysis to reveal this. The observed power in the present study for the analysis of categories recalled was moderate (.64). Potentially, this lack of power was responsible for the lack of significance between young-old and old-old adults' performance on the proportion of categories recalled.

#### Memory Compensation Questionnaire

As shown by the large effect size for the main effect of Scale (e.g.,  $\eta^2 = .74$ ), all age groups varied significantly in the type of memory strategies used. When performance was

collapsed across all three age groups, results showed that external aids were used most frequently, then internal memory aids, and finally reliance on others was used least frequently. This result confirms the findings by de Frias (1998) who used a much larger sample of participants. External memory strategies were found to be most frequently used because they are most easily accessible in terms of the abundance of calendars, post-it notes and other organizational aids designed to improve memory. It may be of interest to note, anecdotally, that participants appeared to find it more difficult to reflect upon the frequency with which they used internal memory aids. That is, several individuals mentioned that it was more difficult to accurately quantify their frequency of use of internal memory aids. This observation suggests that reflecting upon internal memory processes is more abstract and therefore more difficult to report, whereas, the use of external memory aids may be slightly easier to accurately report because it requires reflecting on more concrete processes.

Reliance on others was found to be the least used memory aid. An explanation for the low self-report of reliance strategies can be obtained through noting the participants' comments while they completed the questionnaire. Many participants, regardless of age, reported that they either live alone or did not live with a person who was suitable to rely on. For example, a number of college-age adults reported that they lived in residence or in apartments with roommates who didn't share similar schedules to themselves. Therefore, they chose not to depend on their roommates as reminders for important events because they were unreliable and it would have been impractical. As well, a number of older adults mentioned that they lived alone or that they doubted the ability of their spouse to successfully remind them of an event. Thus, they choose to rely on the use of other

memory aids instead such as writing reminder notes. Presumably, a person who reported a high degree of reliance on others as memory aids, most likely lived with a spouse or someone who shared their own daily schedule and activities on a regular basis. Although, this explanation is based solely on anecdotal findings, it is a logical explanation for the very low report of reliance strategies. It would be useful to include questions about family configuration and living arrangements in future research to corroborate the present explanation.

There was no main effect of Age, although the factor of Age did interact with Scale revealing that young-old and old-old adults used external memory aids significantly more than younger adults. This leads to the question: How does more or less external strategy use relate to performance on cognitive tasks? External strategy use did not correlate with performance on word recall or prospective memory performance when correlations were conducted by age. However, when performance was collapsed across the three age groups and analyzed by prospective memory condition, there was a significant negative correlation between retrospective component performance (neutral, PM displaced conditions) and the external memory scale. This implies that the higher the use of external strategies (as in young-old and old-old adults), the poorer the performance on prospective memory performance. This correlation is in line with the present study's prospective memory results, in which young-old and old-old adults recalled significantly less PM intentions relative to young adults. Thus, increased use of external memory aids may be an indication of an awareness of declining memory capacity and increased use may reflect an effort to compensate for these deficits. The findings of the present study are in line with findings by Mäntylä (1998). In Mäntylä's study, middle-aged adults performed several prospective

memory tasks and participants completed several questionnaires including scales from the MCQ. Participants were divided into two groups, complainers and non-complainers, based on their responses on a memory complaint questionnaire. Mäntylä found that those who reported higher use of external memory aids (complainers), showed poorer prospective memory performance. Thus, similar to the findings of the present study, Mäntylä also found a negative relationship between external memory strategy use and prospective memory performance.

### Summary

This research demonstrates that different factors modulate the efficiency of the prospective and retrospective components of prospective remembering. These findings fit well with a view that data-driven processes influence the prospective component but not the retrospective component of prospective remembering. Results from this newly created prospective memory paradigm offer more insight into the nature of age-related decline in prospective memory. Specifically, different patterns of age differences resulted from analysis of the prospective and retrospective components of prospective memory. Performance on the retrospective component appeared to be more sensitive to age-related decline. Finally, the findings of these experiments were only partially consistent with recent theoretical models, leading to the suggestion that it will be important to consider factors influencing both prospective and retrospective components when pursuing further theory building efforts in the area of prospective memory.

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Appendix A

Items used in Word Recall Test

HORSE	BANANA
VALLEY	HAMMER
PEACH	TRUMPET
CHISEL	COW
VIOLIN	GRAPE
LION	RIVER
WRENCH	CLARINET
CHERRY	BEAR
CANYON	PLIERS
FLUTE	PLUM
ELEPHANT	CLIFF
DRILL	GUITAR
LEMON	PIG
CAVE	FILE
SAXOPHONE	LAKE

## Appendix B

### Selected Items from the Memory Compensation Questionnaire

#### Directions

In this questionnaire, we would like you to tell us about how you use your memory. There are no right or wrong answers to these questions because people are different. Please take your time and answer each of these questions to the best of your ability.

Each question is followed by five choices. Read the choices carefully for each question. Choose one of the choices and draw a circle around the number corresponding to that choice. Mark only one number for each question.

Some of the questions ask how often you do certain things that may be related to your memory. For example:

Do you make a list of things to be accomplished during the day?

1. Never
2. Seldom
3. Sometimes
4. Often
5. Always

In this example you could choose any one of the answers. Choose the one that comes closest to what you usually do.

#### Keep these points in mind

- (1) Please answer every question, even if it doesn't seem to apply to you very well.
- (2) Answer as honestly as you can what is true for you. Please do not mark something because it seems like the "right thing to say".

1. Do you use shopping lists when you go shopping?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
2. When you want to remember an important appointment do you ask somebody else (for example, spouse or friend) to remind you?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
3. When you are reading a book, do you use a bookmark to indicate where you stopped reading last time?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
  
4. When an interesting T.V. program is going to be on in the next few days do you ask somebody else to help you remember (for example, spouse or friend)?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
  
5. When you want to remember an event such as a birthday, do you ask somebody else (for example, spouse or friend) to help you remember?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
6. Do you post notes on a board or other prominent place to help you remember things for the future (for example, meetings or dates)?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
7. When you want to remember the name of a particular person, do you ask somebody else (for example, spouse or friend) to help you remember?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never

8. Do you sometimes ask someone (for example, spouse or friend) to help you remember when you are going to start a trip?
1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
9. Do you put things (for example, glasses or keys) in particular places to remember where they are for future purposes?
1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
10. Do you put things in obvious places (for example, briefcase in front of the door) in order to remember them when you're going out?
1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
11. When you want to remember something from a T.V. program do you use "memory tricks" like grouping or repeating to yourself?
1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
12. Do you take your time to go through and reconstruct an event you want to remember?
1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
13. Do you write down appointments (for example, with the hairdresser or the dentist) in a notebook or calendar?
1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
14. Before an important day do you think about or plan the things you have to do?
1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always

15. Do you note birthdays in a notebook or calendar in order to remember them?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
16. Do you repeat telephone numbers to yourself in order to remember them well?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
  
17. Do you write down telephone numbers in a calendar or notebook in order to remember them?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
  
18. When you want to remember the name of a person do you try to associate the name with the person's face?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
19. When you want to remember something that happened in a particular day do you review and reconstruct the events of that day in order to help you remember?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
  
20. Do you use letters as cues (in other words, go through the alphabet) when you want to remember the name of a person, a city, or something else?
  1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
  
21. Do you put in effort when you want to remember the time of an important meeting?
  1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never

22. When you want to remember something do you try to relate it to something else you know well in order to remember it better?
1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never
23. Do you use mental images or pictures to remember some types of information?
1. Never
  2. Seldom
  3. Sometimes
  4. Often
  5. Always
24. Do you repeat important appointments to yourself in order to remember them as well as possible?
1. Always
  2. Often
  3. Sometimes
  4. Seldom
  5. Never

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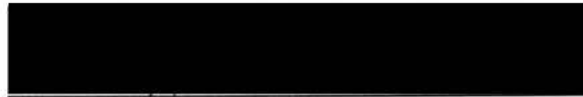
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