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The Effect of Perceptual Distinctiveness on the Prospective and Retrospective Components of Prospective Memory in Young and Old Adults

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Abstract

In two experiments, the effect of perceptual distinctiveness of cues on prospective memory performance was examined. Young and older adults completed a visual search task with embedded prospective memory instructions. On each trial, participants were asked to indicate the position of a target letter in a letter string, unless either of two letters previously identified as prospective memory (PM) cues was presented. Each PM cue was associated with a specific response. Perceptual distinctiveness was manipulated by spatially displacing a single letter. The PM component (successful detection of the cue) and the retrospective memory (RM) component (recalling the correct response when a cue is detected) were measured separately. Perceptual displacement of cues modulated performance of the PM component but not the RM component. Young successfully detected a larger proportion of cues (PM component) than older adults. However there were no effects of age or cue displacement on participants' ability to recall the intention once they detected a cue (RM component performance). Results are discussed within the context of current theoretical models of prospective memory.

The Effect of Perceptual Distinctiveness on the Prospective and Retrospective Components of Prospective Memory in Young and Old Adults

Remembering to carry out a previously formed intention is termed "prospective memory." This type of memory underlies important everyday activities such as remembering to take medication, make a phone call, keep an appointment, or mail a letter (Einstein, McDaniel, Richardson, & Guynn, 1995; Hertzog, Park, Morrell, & Martin, 2000; Park, Morrell, & Shifren, 1999). Successful prospective memory performance is thought to involve two components: remembering at an appropriate moment that one must do something, and recalling what is to be done (Einstein, Holland, McDaniel, & Guynn 1992). The former is called the prospective component, whereas the latter is referred to as the retrospective component. For example, if a person 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 person remember the content of the message (retrospective component).

Results pertaining to adult age differences in prospective memory performance are conflicting, with some studies reporting no deficits for older adults (e.g., Einstein & McDaniel, 1990; Einstein et al., 1992) and others observing significant age-related differences (e.g., Einstein, McDaniel, Smith, & Shaw, 1998; Maylor, 1993, 1996a, 1998; West & Craik, 1999). These discrepant results must be qualified by at least two observations. First, older adults tend to show superior prospective remembering relative to younger adults in naturalistic contexts with little experimental control (Moscovitch, 1982). This may be due to older adults' tendency to use everyday external memory aids such as notes (Dixon, de Frias, & Bäckman, 2001). In contrast, older adults typically exhibit prospective memory deficits within laboratory contexts in which memory supports such as reminder notes are not permitted (e.g., Rendell & Thomson, 1999). Second, specific task characteristics also modulate age differences (Craik & Kerr, 1996). For example, tasks that require an individual to remember to perform an action in future circumstances that contain no prompts or cues and that involve an unrelated (and attention demanding) ongoing activity are associated with age-related deficits (D'Ydewalle, Luwel, & Brunfaut, 1999). It is well known that disengaging from demanding concurrent activities presents special challenges to older adults (Maylor, 1996b).

Several cue properties known to affect level of recall in retrospective memory also have an impact on prospective memory performance. These properties include complexity, salience, and relatedness (Mäntylä, 1996). In a study by Maylor (1998), young, middle-aged, and older adults were tested on their sensitivity to a prospective memory cue. Participants completed an event-based prospective memory task embedded in a task in which they were instructed to identify the names of famous faces. The prospective memory task required them to mark the trial number of any of the faces wearing glasses. Results showed that performance declined across age groups (Ms = .77, .62, .26), with the older adults correctly identifying only 26% of the prospective memory cues. Based on self-reports from participants, Maylor claimed that older adults appeared to think less frequently of the prospective memory instructions relative to other age groups.

Because prospective memory tasks are usually embedded in some attention-demanding ongoing cognitive activity, it is likely that the perceptual salience of a prospective memory cue would influence prospective memory performance. The more perceptually salient the target-cue relative to the array of other stimuli, the more likely the successful recognition of that cue. In line with this idea, several researchers have investigated the distinctiveness of prospective memory cues and their effect on performance. For example, Uttl and Graf (2000) showed that increasing the size of target pictures resulted in better detection of the cue. Several researchers have shown that presenting a cue word in upper case letters relative to the majority of lower case words results in superior prospective memory performance (Einstein, McDaniel, Manzi, Vochran, & Baker, 2000; West, Herndon, & Crewdson, 2000). An explanation for this phenomenon offered by McDaniel and Einstein (2000) is that cues that are distinctive, relative to existing knowledge or to the current context, result in the involuntary capture of attention. Thus, distinctiveness can operate both to switch attention from an ongoing task and to provide a frame of reference for retrieving the associated intention (McDaniel & Einstein, 2000).

A general conclusion from these studies is that perceptually distinctive prospective memory cues facilitate prospective memory performance. However, two remaining questions should be addressed. First, do such cues affect performance on the prospective component and retrospective components equivalently? Second, do such cues affect performance similarly for young and older adults? Given that older adults may think about prospective memory instructions less than younger adults (Maylor, 1998), older adults' prospective memory performance may be less likely to be affected by a perceptual salience manipulation.

Relatively little evidence exists as to the influence of variables on the prospective and retrospective components of prospective memory. Recently, however, Cohen, West, and Craik (2001) studied two issues: (a) whether adult age differences were greater for the prospective or the retrospective component of prospective memory and (b) whether data-driven and conceptually driven processes differentially influenced these two components. Data-driven processes are those that depend on information that is perceptual in nature (e.g., the colour of a word) and conceptually driven processes are those that recruit the semantic meaning of a stimulus to aid in responding (e.g., the definition of a word). In the Cohen et al. study, the influence of data-driven processes was varied by maintaining or changing the format of the prospective cue from study to test. Thus, young and older adults were given a cue for an intention in either a picture or a word form. The influence of conceptually driven processes was manipulated by varying the degree of semantic relatedness between the prospective cue and intention. That is, the cue was either related or unrelated to the intention. For example, given the intention “I must go to the doctor” a related cue might be an ambulance and an unrelated cue might be a hot air balloon. Results showed that there was a greater effect of age (young more accurate than older adults) for the prospective component than for the retrospective component even when the retrospective demands of the task were high. Furthermore, the results of Experiment 2 revealed that data-driven and conceptually driven processes differentially influenced the prospective and retrospective components of prospective memory. Specifically, the manipulation of study-test format (thought to influence 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.

Based on these findings, in the present study we predicted that the perceptual salience of prospective memory cues would differentially influence the prospective and retrospective components of event-based prospective memory. Specifically, we expected that the manipulation of perceptual salience would modulate performance on the PM component but not the RM component. In the current task, participants performed a visual search task in which they identified a target letter among a string of other letters. Along with the instructions for the visual search task, participants were given a set of prospective memory instructions. They were told to press a specific key every time they encountered either of two pre-specified prospective memory cues. Perceptual salience was manipulated by spatially displacing one letter below the rest of the letters in the letter string. According to results from studies of the isolation effect (von Restorrf, 1933; as cited in Dunlosky, Hunt, & Clark, 2000), we predicted that the letter displaced from the rest of the letters in the letter string would be more salient. This manipulation allowed examination of the relationship between distinctiveness of the primary task stimuli and distinctiveness of the prospective memory task stimuli.

Experiment 1

The purpose of Experiment 1 was to examine adult age differences in sensitivity to a perceptual salience manipulation in a prospective memory paradigm. Participants were asked to complete a visual search task in which two pre-specified cues served as reminders to carry out a prospective memory intention. These cues varied systematically in their perceptual salience relative to the primary task in which it was embedded. Both the prospective component (realization that a response should be made) and the retrospective components (recalling the correct response when a PM cue is recognized) were measured separately. Therefore, Experiment 1 was designed to examine whether the perceptual manipulation differentially affected both PM and RM components of prospective memory equivalently for young and older adults.

Method

Participants

Thirty young adults (M = 19.87 years, SD = 3.42) and 30 older adults (M = 71.67 years, SD = 3.48) were tested. Although the sample was well-educated, a one-way analysis of variance (ANOVA) revealed that older adults (M = 14.08 years, SD = 2.34) had significantly more years of education compared to young adults (M = 13.10 years, SD = 1.42), $F(1, 58) = 3.86$, $p < .05$. Self-reported health was measured using a Likert scale. Participants were asked to reflect on their health in the last month and then rate themselves on a 5-point scale (1 = very good, 2 = good, 3 = fair, 4 = poor, 5 = very poor). There was no significant difference between young (M = 1.63) and older (M = 1.80) adults' self-reported health ($p = .43$).

Young adults were recruited from an undergraduate psychology course and they received optional extra credit for their participation in the experiment. The older participants were recruited from a volunteer pool maintained by 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 2 (Age: young, old) × 3 (Perceptual Displacement: PM-displaced, none-displaced, target-displaced) mixed factorial design with age as the between-subject variable and perceptual displacement as the within-subject variable. For the primary visual search task, the dependent variable was the proportion of correct responses. For the prospective memory task, the dependent variables were the proportions of correct responses on the prospective component and on the retrospective component. The task was administered on a PC. Letters from the alphabet served as the stimuli in this task. All of the letters from the alphabet were used and the character size of the stimuli was approximately 10 × 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

The experimenter first obtained informed consent from participants who were tested individually. A brief biographical questionnaire was administered to obtain 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. After reading the instructions, participants explained to the experimenter what they had read. The experimenter clarified any ambiguities until the participant showed full understanding. 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

Visual Search Task. The primary task was a visual search task in which participants were asked to identify the serial position of a target letter. Participants were told that on each trial they would see a single target letter appear on the computer screen. They were instructed to say aloud and remember this letter because it would appear in a subsequent string of six letters. The purpose of 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 the target was replaced by a six-letter string. Letter strings were presented serially from left to right with each letter's presentation separated by 300 ms. As each letter appeared it stayed on the screen until the letter string was complete; at this point, participants could make their response. They were instructed to press the number key on the numeric keypad that corresponded to the position of the target letter. 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. Participants were told that there would be a target present in the letter string in every trial. Instructions emphasized that the visual search identification task should be performed as quickly and accurately as possible.

On a portion of the trials, one letter in the letter string was spatially displaced one line below the remainder of the string. Displacement of letters was varied systematically in both position in the string and position of the displaced trials within the total number of trials. There were 112 trials in total (excluding the 10 practice trials). There were three types of trials in the visual search task: (a) none-displaced trial: on 80 trials there were no letters displaced, (b) target-displaced trial: on 10 trials the target letter was displaced, and (c) distractor-displaced trial: on 10 trials one of the distractors was displaced. (The 12 remaining trials were prospective memory trials which are described in the following section.) Therefore, on the majority of trials there was no letter displaced. These proportions were selected purposefully so that a displaced letter was an uncommon event.

Prospective memory task. The prospective memory task was embedded within the visual search task described above. The prospective memory cues occurred in 12 trials out of the total 112 trials. During the instruction phase, participants were told that if at any point during the experiment they saw the letter “B” they should press the number "9" and if they saw the letter “D” they should press the number “7.” These specific numbers were chosen with two 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 increase the difficulty of remembering the correct response after viewing a "B" or "D." Participants were told that these cues might or might not occur throughout the duration of the study, to discourage them from excessive monitoring on every trial. Participants were told to press the appropriate responses (7 or 9) for the prospective memory cues regardless of the serial position of the PM-cue letter. Thus, much like real life, when participants recognized a PM cue they had to disengage from the primary task of identifying the target letter to perform the intention of pressing the “7” or “9” key. The PM cues never occurred in the first or sixth positions of the letter string. On half of the PM trials, the PM cue was before the target cue, whereas on the remaining half of the trials the PM cue was after the target cue. Three cue conditions were used.

The PM-displaced condition consisted of 4 trials. In this condition, the prospective memory cue (B or D) was spatially displaced relative to the other letters in the letter string. Therefore, the target cue from the primary task (visual search task) appeared within the letter string whereas the prospective memory cues appeared in the displaced position. In the none-displaced condition, there were 4 trials in which target cues from the visual search task and the prospective memory task appeared within the letter string, with none of the letters in the string displaced. Therefore, the relationship between the target cue and the PM cue was neutral. Finally, in the target-displaced condition, there were 4 trials in which the target cues from the visual search task were in the displaced position and the prospective memory cues appeared within the letter string. Thus, the PM cues (B or D) were less perceptually distinctive than the target cues. These cue conditions are represented in Figure 1.

Scoring. 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. For example, if the participant incorrectly pressed "7" for the "B" they received credit for detecting the letter as a PM cue (PM component) but they did not receive credit for remembering the correct response (RM component). The retrospective component was scored as the proportion of detected prospective cues to which the participant also correctly recalled the intention. Thus, if the participant correctly detected the cue as a PM cue and executed the correct response they received credit for the PM and RM components of prospective memory. 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.

The means for the RM component were conditionalized upon participant's performance on the PM component. That is, when a participant failed to detect a PM cue, we were unable to probe the person's memory for the associated intention because this would result in reminding them that they had forgotten the prospective memory cue, which would contaminate performance on subsequent prospective memory trials. Therefore, RM component performance was measured only for trials in which participants successfully detected a PM cue.

Results

Visual Search Task

Performance was evaluated using a 2 (Age: young, old) × 3 (Perceptual displacement: none-displaced, target-displaced, distractor-displaced) analysis of variance (ANOVA) with repeated measures on the second factor. The dependent variable was the proportion of target letters that were evaluated correctly with respect to serial position on trials on which there was no PM cue. Accuracy was extremely high on this task (e.g., young adults overall mean = .97, older adults overall mean = .96). No main effects or interactions were observed (all F's < 1).

Prospective Memory Task

The effects of perceptual displacement and age on the prospective component of prospective remembering were evaluated in a 2 (Age: young, old) × 3 (Perceptual Displacement:

none-displaced, target-displaced, PM-displaced) ANOVA with repeated measures on the second factor. Analyses revealed a main effect of age, $F(1, 58) = 7.99$, $p < .05$, $\eta^2 = .12$, indicating that young adults (M = .78, SD = .26) detected significantly more prospective memory cues than older adults (M = .55, SD = .39). Although there was no main effect of perceptual displacement, this factor was involved in a marginally significant interaction with age, $F(2, 57) = 2.72$, $p = .07$, $\eta^2 = .09$. Multiple comparisons analysis showed that there was a significant difference ($p = .043$) between none-displaced (M = .83) and target-displaced (M = .71) conditions for young adults and no significant difference between these cue conditions for older adults (see Figure 2).

The influence of perceptual displacement and age on the retrospective component of prospective remembering was considered in a similar analysis. Because a cue must be detected before the RM component can be evaluated, older adults who missed every prospective memory cue (n = 4) were dropped from the analysis of the RM component. There was virtually no difference between means for young (M = .78) and older adults (M = .79). That is, when participants successfully detected the cue, there was little difference between age groups in their ability to recall the associated intention. No main effects or interactions involving the perceptual manipulation were observed.

Discussion

Performance was at ceiling on the primary task in which the prospective memory task was embedded, so there were no significant differences between young and old performance. Nevertheless, a significant main effect of age on PM component performance was found for the prospective memory task. That is, young adults detected significantly more prospective memory cues than older adults. The age effect on PM component performance may be understood by examining participants’ performance on the primary task. It is plausible that older adults may have devoted more resources to performing the visual search task accurately, reducing the probability of disengaging from the primary task and successfully identifying the prospective memory cues. It is well known that an inherent challenge of prospective memory tasks is the need to disengage attention from the ongoing task to execute successfully the planned intention (Maylor, 1996b). It is important to note that although there was a significant effect of age on PM component performance, there was no effect of age on the ability to retrieve the associated intentions (RM component performance). These results showed that there was a greater effect of age (young more accurate than older adults) for the prospective component than for the retrospective component which is in line with previous research (Cohen et al., 2001).

Although the interaction between Age and Perceptual Displacement was only marginally significant, it suggests that there was a relatively larger difference between young and older adults performance in the none-displaced condition. This age difference was reduced in the PM displaced condition because older adults seemed to have benefited from the increased perceptual salience of the displaced PM cue.

Experiment 2

Two modifications of the procedure of Experiment 1 were implemented. First, in addition to a young adult group, we included two older adult age groups. Although evidence regarding late-life changes in retrospective memory is accumulating (Bäckman et al., 2000) there is little available information regarding age-related patterns of prospective memory performance among very old adults. Second, in Experiment 2, to strengthen the perceptual displacement manipulation, the letters in the letter strings appeared simultaneously instead of one letter at a time. The reasoning was that if all letters appeared at the same time, one letter that differed from the rest would ‘pop out’ and appear distinctive compared to the rest of the letters. Therefore, we predicted that this would increase the effect of displacement of PM cues. Furthermore, in Experiment 1 when letters were presented serially from left to right, there was 300 ms gap between each letter's presentation, thus allowing time for participants to prepare a response. In contrast, in Experiment 2, all letters in a given string were presented simultaneously, thus considerably speeding up the presentation of letter strings.

Method

Participants

Thirty-one young adults (M = 19.94 years, SD = 3.04), 32 young-old adults (M = 66.91 years, SD = 4.47), and 34 old-old adults (M = 79.86 years, SD = 3.57) participated in this experiment. A one-way analysis of variance (ANOVA) revealed a significant difference between age groups with respect to years of education, $F(2, 95) = 6.12$, $p < .05$. Tukey HSD tests showed that young-old adults (M = 15.13, SD = 3.24) had significantly more years of education compared to young adults (M = 13.13 years, SD = 1.23) and old-old adults (M = 13.57 years, SD = 2.25). Self-reported health was measured as in Experiment 1, using a 5-point Likert scale (1 = very good to 5 = very poor). A one-way ANOVA showed a significant difference between age groups, $F(2, 93) = 4.30$, $p < .05$. A post-hoc Tukey HSD test revealed that young adults (M = 1.48, SD = .63) reported significantly better health than old-old adults (M = 2.03, SD = .75). Young-old adults' ratings (M = 1.69, SD = .86) were intermediate, and not significantly different from either young or old-old adults.

As in Experiment 1, young adults were recruited from an undergraduate psychology course and received optional extra credit for their participation in the experiment. Older participants were recruited from the same older adult volunteer pool. Older adults were reimbursed for their travel expenses.

Materials and Procedure

The method for Experiment 2 was identical to that of Experiment 1 except that the six letters in each letter string were presented simultaneously rather than sequentially as in the previous experiment.

Results

Visual Search Task

Performance on the visual search task (excluding the 12 PM trials) was evaluated using a 3 (Age: young, young-old, old-old) × 3 (Perceptual Displacement: none-displaced, target-displaced, distractor-displaced) analysis of variance (ANOVA) with repeated measures on the second factor. Once again the dependent variable was the proportion of letters that were evaluated correctly with respect to serial position. Analyses yielded a main effect of perceptual displacement, $F(2, 94) = 351.09$, $p < .01$, $\eta^2 = .88$ showing that performance was most accurate in the distractor-displaced ($M = .96$, $SD = .08$) and the none-displaced ($M = .95$, $SD = .05$) conditions and least accurate in the target-displaced condition ($M = .78$, $SD = .10$). Post-hoc Tukey HSD tests revealed significant performance differences between target-displaced trials and both the none-displaced and distractor-displaced conditions. Although no main effect of age was observed, there was a significant interaction between age and perceptual displacement, $F(4, 188) = 6.93$, $p < .05$, $\eta^2 = .13$. This interaction is represented in Figure 3. They indicate that all age groups performed similarly in none-displaced and distractor-displaced trials, but in the target-displaced trials young-old adults ($M = .76$, $SD = .09$) and old-old adults ($M = .77$, $SD = .06$) performed significantly more poorly than young adults ($M = .81$, $SD = .09$).

Prospective Memory Task

The effects of perceptual displacement and age on the prospective component of prospective remembering were evaluated in a 3 (Age) × 3 (Perceptual Displacement) ANOVA with repeated measures on the second factor. There was a main effect of perceptual displacement, $F(2, 94) = 18.81$, $p < .01$, $\eta^2 = .28$, showing that performance was better in the PM cue-displaced condition ($M = .65$, $SD = .38$) compared to the none-displaced ($M = .49$, $SD = .35$) and target-displaced ($M = .50$, $SD = .36$) conditions, which were not significantly different from one another (see Figure 4). Although the main effect of age was not significant, simple effects analysis showed that young adults ($M = .63$, $SD = .23$) were significantly more successful ($p = .046$) at detecting prospective memory cues compared to old-old adults ($M = .46$, $SD = .35$). No interaction was observed ($F < 1.47$).

The influence of perceptual distinctiveness and age on the retrospective component of prospective remembering was considered in a similar analysis. As in Experiment 1, several older adults who failed to detect any prospective cues (young-old adults: n = 4; old-old adults: n = 6) were dropped from the analysis. As noted above there was an effect of perceptual distinctiveness for PM component performance, however for RM component performance means did not differ reliably from each other ($p > .05$; none-displaced: $M = .71$, PM-displaced: $M = .75$, target-displaced: $M = .67$). Nor was there a significant main effect of age or interaction (all Fs < 1).

Discussion

This experiment demonstrated that manipulating perceptual salience of prospective memory cues, thought to reflect the contribution of data-driven processes, enhanced the efficiency of the prospective component of prospective remembering. That is, when a prospective memory cue was displaced relative to other letters, successful detection of this cue was enhanced (PM component performance). In contrast, this manipulation had no reliable effect on the efficiency of remembering the intention once the cue was detected (RM component performance).

Performance in the visual search task yielded a significant effect of perceptual distinctiveness and there was a significant interaction in which the two older age groups performed more poorly on the visual search task when the target was displaced than when no letters were displaced or a distractor was displaced. We speculate that this unexpected effect occurred because the older adults found it more difficult to identify the serial position (1 through 6) of the target when it was displaced than when it was on the same line as the distractors. Recall that participants in both age groups tested in Experiment 1 performed at or near ceiling on the visual search task. Presumably, the sequential presentation procedure used in Experiment 1 made it easy for participants of all ages to identify the target's serial position (even when displaced).

General Discussion

The purpose of this study was to examine the effect of perceptual distinctiveness of cues on prospective memory performance for young and older adults. Both the prospective component (realization that a response should be made) and the retrospective components (recalling the correct response when a PM cue is recognized) were measured separately. Therefore, we were able to examine whether the perceptual manipulation differentially affected both components of prospective memory for young and older adults.

Consistent with our hypothesis and previous research (Cohen et al., 2001), the manipulation of salience of prospective memory cues, thought to influence the contribution of data-driven processes, had the greatest impact on the efficiency of the PM component of prospective remembering. Our results showed that this manipulation had no reliable effect on the efficiency of the retrospective component. Recently, neuropsychological evidence has supported the idea that there are different event-related potentials (ERP) modulations associated with detecting the cue (PM component) and retrieval of the intention (RM component). In a study by West, Herndon, and Crewdson (2000) a difference between prospective and retrospective component performance was dissociated at the neural level. The PM component was associated with a negativity over the occipital-parietal region that was greatest in amplitude at approximately 320 milliseconds following stimulus onset. The RM component was associated with a positivity over the parietal region between 400 and 1000 ms post-stimulus onset. Our behavioural results are consistent with findings from this neuropsychological study.

It is useful to consider the current findings within the context of an account of prospective memory that was developed by Burgess and Shallice (1997). They suggested that prospective memory performance is mediated by the Supervisory Attentional System (SAS) and that this form of memory is a voluntary and strategic process. The authors suggested that individuals use the SAS to monitor the environment for target cues that signal whether an intention should be executed. A key assumption is that executive resources are set aside to be available to monitor the environment for cues. McDaniel and Einstein (2000) noted that the exact nature of these monitoring processes are not well understood. They proposed two possible accounts: (a) monitoring can be described as executive resources that are committed to continuously monitoring the environment for cues or (b) monitoring can be described as a system that periodically brings the intention into mind and thereby sets the individual in a state of readiness for when the cue actually occurs. Our results from Experiment 2 indicate that regardless of the amount of resources that participants devoted to monitoring the environment for cues, perceptual salience of cues relative to the ongoing cognitive activity in which they are embedded also play a part in determining success of cue detection. For example, in cases in which the prospective memory cue was perceptually salient, prospective memory performance improved (M = .63) relative to none-displaced (M = .49) and target-displaced (M = .50) conditions. Thus, it appears that the success of monitoring processes is influenced by these variations in cue salience.

The inclusion of two older adult age groups in Experiment 2 allowed us to make a more detailed analysis of older adults' performance. No significant difference was observed between young (M = 19.94 years) and young-old adults (M = 66.91 years) nor was there a significant difference between young-old and old-old adults (M = 79.86 years). These results indicate that the young-old age group is an intermediate age group whose performance falls between young adult and old-old adult age groups. The only age effects, with respect to performance on the PM component, are revealed when comparing young to older adults who are over 70 years of age. The only reliable age differences for PM component responding were between young (M = 19.87 years) and old (M = 71.67 years) adults in Experiment 1 and the young (M = 19.94 years) and old-old (M = 79.86 years) age groups in Experiment 2. This is consistent with other evidence indicating that age-related decline is gradual and occurs monotonically from young to late adulthood and reveals itself (relative to young) only well into the later years after age 70 (e.g., Dixon et al., in press; Nilsson et al., 1997).

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 successes and failures of prospective memory. The present 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 not necessarily simple depiction of older adults' performance emerges, showing the impact of perceptual distinctiveness of cues on prospective memory performance. That is, a data-driven manipulation of displacement of cues modulated performance on the PM component and not the RM component of prospective memory.

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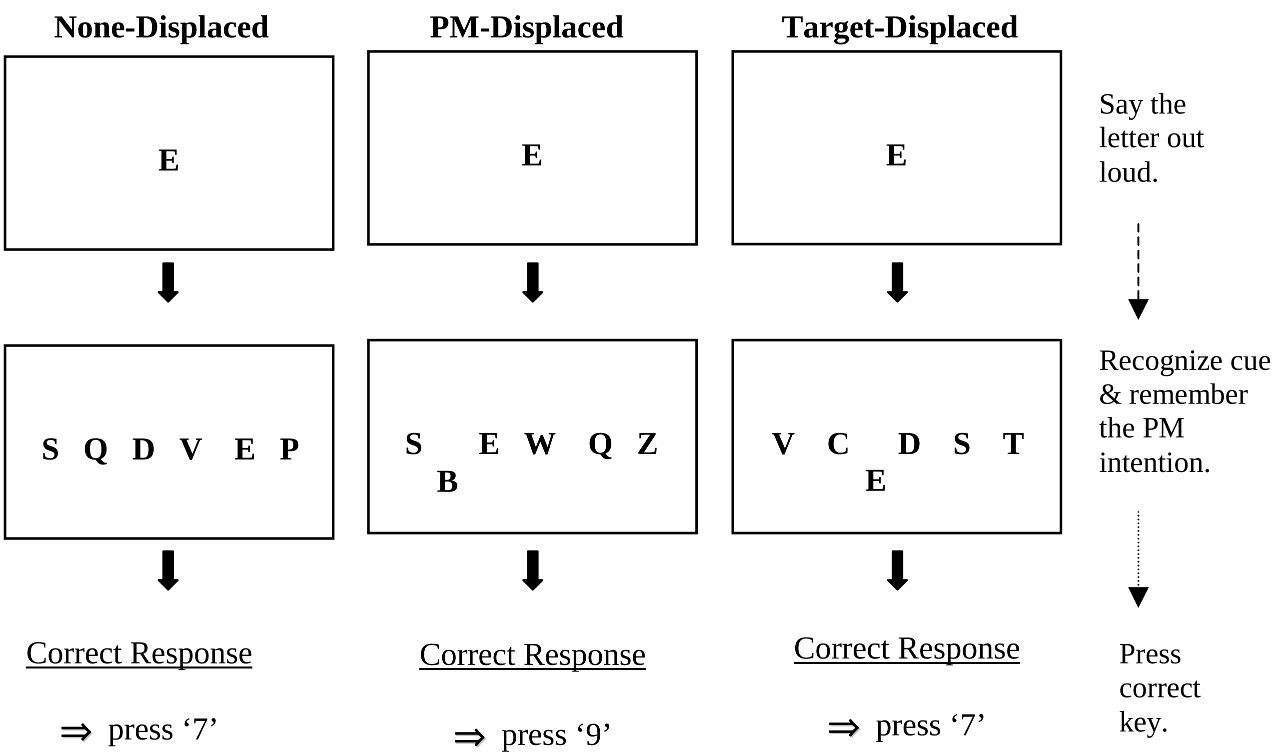
Figure Captions

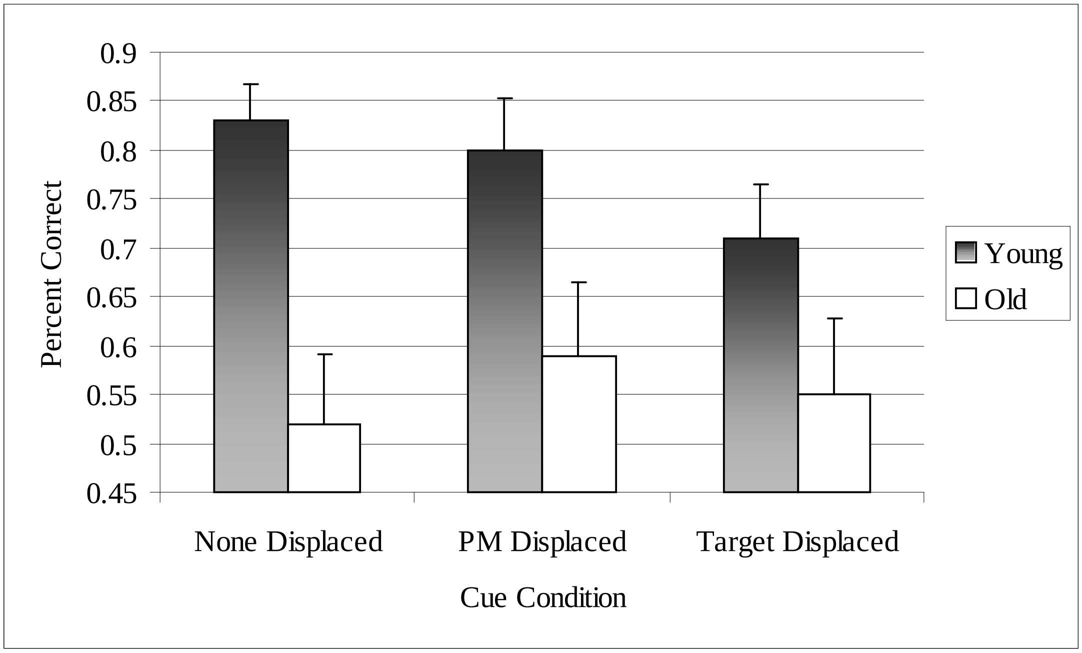
Figure 1. Schemata of stimuli from the three cue conditions: (a) none-displaced condition (b) PM-displaced condition (c) target-displaced condition. (This figure is for illustrative purposes - actual stimuli were much larger.)

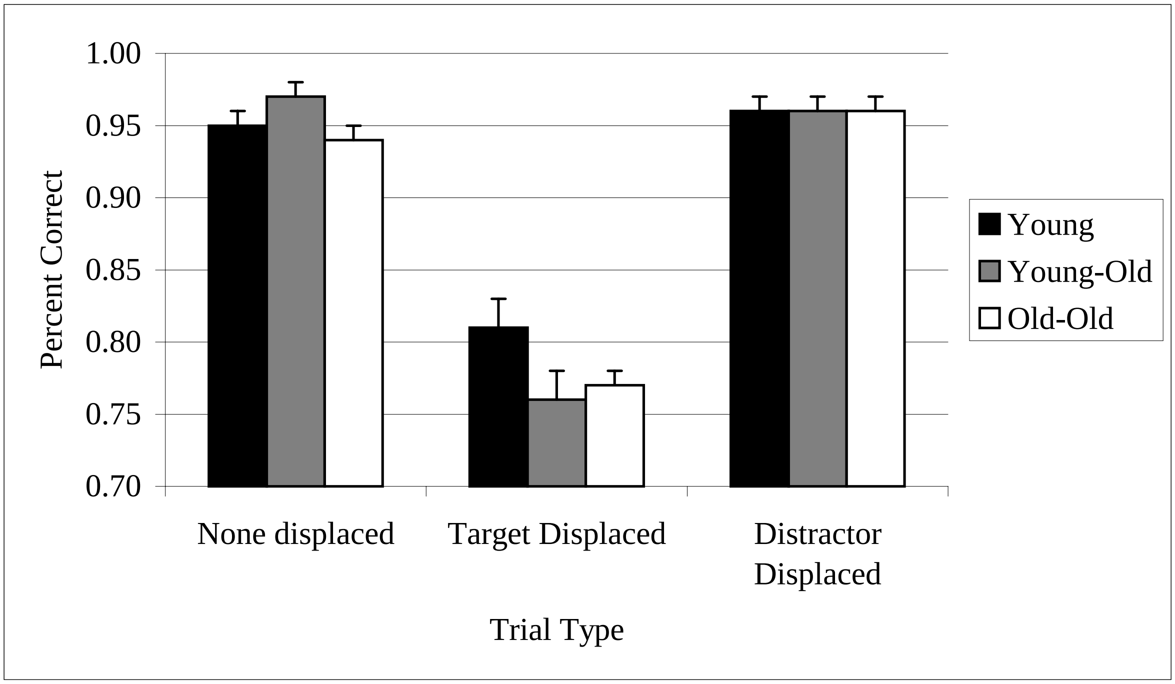
Figure 2. Mean accuracy for responding on the PM component of prospective memory in Experiment 1 as a function of cue type for young and old adults. Bars represent standard error.

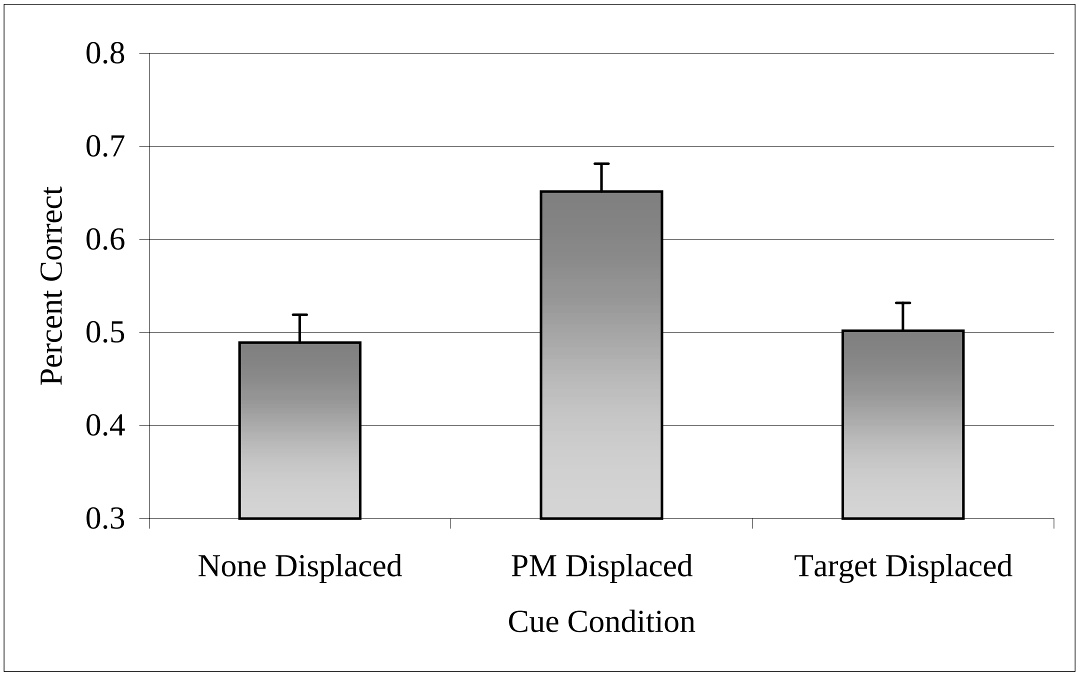
Figure 3. Mean accuracy for responding on the Visual Search Task in Experiment 2 as a function of trial type for young and old adults. Bars represent standard error.

Figure 4. Mean accuracy for responding on the PM component of prospective memory in Experiment 2 as a function of cue type collapsed across age groups. Bars represent standard error.


None-Displaced
PM-Displaced
Target-Displaced
E
E
E
Say the letter out loud.
S Q D V E P
S E W Q Z B
V C D S T E
Recognize cue & remember the PM intention.
Correct Response
⇒ press '7'
Correct Response
⇒ press '9'
Correct Response
⇒ press '7'
Press correct key.


0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
Percent Correct
None Displaced
PM Displaced
Target Displaced
Cue Condition
Young
Old


1.00
0.95
0.90
0.85
0.80
0.75
0.70
Percent Correct
None displaced
Target Displaced
Distractor Displaced
Trial Type
Young
Young-Old
Old-Old


0.8
0.7
0.6
0.5
0.4
0.3
Percent Correct
None Displaced
PM Displaced
Target Displaced
Cue Condition