Published in final edited form as:
*Neuropsychol Dev Cogn B Aging Neuropsychol Cogn*. 2013 January ; 20(1): 101–124. doi: 10.1080/13825585.2012.691152.

# The Effects of Age and Focality on Delay-Execute Prospective Memory

**Andrew J. Kelly**, **Christopher Hertzog**, **Melissa G. Hayes**, and **Anderson D. Smith**
School of Psychology, Georgia Institute of Technology

## Abstract

In everyday prospective remembering, individuals must often delay the execution of a retrieved intention until they are in the appropriate setting. These so-called “delay-execute” tasks are particularly troublesome for older adults, who consistently demonstrate impaired performance in this kind of laboratory task. To better understand this effect, we investigated delay-execute prospective memory performance in younger and older adults. Specifically, we examined the strategies individuals used to maintain intentions over a delay period by analyzing RTs to the ongoing task, both before and after the cue event. The results suggest that younger and older individuals perform the task similarly by rehearsing or reformulating the intention. Despite performing the task in a similar manner, older adults showed greater impairments in delay-execute prospective remembering.

### Keywords

Prospective memory; aging; delay-execute

Prospective memory (PM) is the ability to perform an action at some point in the future. For instance, an individual may need to remember to call their mother for her birthday. In a typical laboratory event-based PM task, participants are instructed to notice and respond to certain cue words (e.g., dog) in the context of an ongoing task (e.g., short-term memory task; Einstein & McDaniel, 1990). However, intentions often come to mind when a person is unable to immediately perform the task. For example, someone might retrieve the intention to call their mother for her birthday but is in a meeting and unable to make the call until after the meeting ends. In fact, recent research suggests that the majority of PM tasks in everyday life involve some kind of delayed enactment (Kvavilashvili & Fisher, 2007). The delay-execute PM task has been used to investigate this kind of situation (Einstein, McDaniel, Manzi, Cochran, & Baker, 2000). In this task, participants read a short paragraph followed by a series of other tasks, such as comprehension and trivia questions. Participants are also given PM cues to search for and respond to by pressing a designated key. PM cues typically appear in the paragraph and are made salient (e.g., uppercase lettering) to ensure they are easily noticed. Participants are instructed not to respond until the trivia question appears on the screen, meaning they have to maintain the intention to respond across a delay period (e.g., during a series of comprehension questions).

Research has demonstrated that young adults fare well in this paradigm, often displaying commensurate or slightly reduced PM performance relative to event-based tasks (Einstein et al., 2000; 2003; McDaniel, Einstein, Stout, & Morgan, 2003). In contrast, older adults are

Correspondence concerning this article should be addressed to Andrew Kelly, School of Psychology, Georgia Institute of Technology, 654 Cherry Street, Atlanta, GA 30332-0170. Contact: gth814s@mail.gatech.edu.

impaired at maintaining intentions over delays (Einstein et al., 2000; McDaniel et al., 2003). McDaniel and colleagues (2003) found that when intentions had to be delayed across a 5-second unfilled interval, older adults exhibited substantial forgetting (.45) relative to younger adults (.90). Such poor remembering by older adults is especially noteworthy given that they sometimes display high event-based PM performance similar to younger adults (e.g., Cherry & LeCompte, 1999; Einstein & McDaniel, 1990).

Why are older adults more impaired in delay-execute PM tasks? Research suggests there are two primary strategies people employ to maintain intentions over a delay. First, individuals can maintain the intention in focal awareness by rehearsing it until it can be completed. Alternatively, individuals can reformulate the intention (e.g., "press the key when I reach the trivia question") and retrieve it again at the appropriate time (Einstein et al., 2000; McDaniel et al., 2003). Given age-related declines in working memory capacity (e.g., Hertzog, Dixon, Hultsch, & MacDonald, 2003; Park et al., 1996; 2002), older adults may be constrained in their ability to effectively rehearse intentions across a delay or to reformulate a plan. Younger adults may not have to rely on reformulation, and instead may rely on rehearsal because of their intact working memory capacity.

Indirect evidence for rehearsal of intentions can be examined by instructing participants to rehearse. If individuals were not rehearsing, such instructions should improve PM performance. If individuals were already rehearsing then instructions would have no effect. Einstein et al. (2003 - Experiment 2) demonstrated that younger adults instructed to rehearse performed similarly to younger adults given no instructions, which suggests that younger adults were already rehearsing and successfully completing delayed intentions. McDaniel et al. (2003 - Experiment 1) revealed that older adults instructed to rehearse did slightly better than uninstructed older adults, but neither older group performed equivalently to younger adults. This pattern of results suggests that older adults have a problem with actively maintaining an intention and that older adults may not be inclined to spontaneously rehearse the intention (McDaniel et al., 2003), both of which cause declines in delay-execute PM performance.

Evidence for differential strategy use and rehearsal can also be assessed by using divided attention. If individuals are actively rehearsing, dividing attention should be most detrimental during the delay period and should have little effect during initial retrieval or delayed retrieval. Conversely, if individuals are reformulating the intention, dividing attention should be most harmful during initial retrieval and the delayed retrieval period, and should have little effect during the delay period. Einstein et al. (2000) reported that dividing attention at initial retrieval and during the delay hurt both younger and older adults, but that this effect was greater for older adults. McDaniel and colleagues (2003) demonstrated that older adults showed high prospective remembering (comparable to that of younger adults) when full attention was available at initial retrieval and the intention was to be retrieved during a break in the task. When older adults had their attention divided during initial retrieval and there was a task occurring during the retrieval opportunity, older adults showed significant declines in PM performance. This suggests that older adults appear to reformulate and retrieve, as they are more affected by divided attention at initial encoding and filled task intervals at delayed retrieval.

Other explanations of age differences in delay-execute performance exist. For instance, older and younger adults may both rely on reformulation and retrieval, but older adults may be more adversely affected by dividing attention (e.g., Park, Smith, Dudley, & Lafronza, 1989). There are also problems with the use of instructional techniques. Individuals may not actually engage rehearsal processes even when instructed to do so.

Additional leverage on whether younger and older adults perform delayed-execute tasks in qualitatively different ways can be obtained by examining response times (RTs) in the ongoing task. Researchers often compare event-based PM RTs in the ongoing task between control (ongoing task only; no PM Task) and experimental (ongoing task with a PM task) conditions to gauge whether participants are monitoring (e.g., Einstein et al., 2005; Smith, 2003). An increase in RT from control to experimental trials suggests that individuals are monitoring for PM cues in the environment (Smith, 2003). Equivalent RTs suggest that individuals are not monitoring, perhaps relying instead on spontaneous retrieval (Einstein et al., 2005). Einstein et al. (2003) measured RTs in a delay-execute task and reported that younger adults answered fewer questions in the ongoing task while holding a PM intention in mind. Further, with a 5-second delay, answering questions took longer with a PM intention in mind, relative to when there was no intention in mind. This pattern of results implies that rehearsal of the intention slowed participants' responses during the ongoing task.

The current study used a lexical decision task for the ongoing task in a PM experiment. We compared RTs before the PM cue to RTs for trials occurring after the cue, when the intention to respond at the end of the block has been activated. Increased RTs after initial PM cue recognition (relative to baseline) may indicate that individuals are rehearsing the intention until the appropriate time for its execution. On the other hand, if RTs quickly returned to baseline, individuals may have reformulated the intention in the hopes of being able to retrieve it again later without additional rehearsal.

## Theories of Prospective Memory

Unlike previous studies, we asked participants both to (1) respond to the initial presentation of the PM cue and (2) press the same key again at the end of the block to fulfill the delayed intention. This design provided an opportunity to contrast predictions about delay-execute PM generated by two theories of event-based PM: The preparatory attention and memory processes (PAM) model (Smith, 2003; 2008; 2010; Smith, Hunt, McVay, & McConnell, 2007) and the multiprocess model (Einstein & McDaniel, 2010; Einstein et al., 2005; McDaniel & Einstein, 2000). According to the PAM model, after formation of a prospective intention, preparatory attentional processes are directed towards considering items or events in the environment as signals to retrieve and execute the intention (Smith, 2008). Preparatory attentional processes include fully conscious, intentional monitoring and monitoring outside of focal awareness (Smith et al., 2007). The multiprocess theory contends that in some situations PM intentions can be realized without engaging preparatory attentional processes (Einstein et al., 2005). Specifically, the multiprocess theory has postulated several mechanisms (e.g., reflexive-associative process, discrepancy plus search processes) through which intentions can be retrieved spontaneously, without resources explicitly devoted to noticing and retrieving the intention (Breneiser & McDaniel, 2006; Einstein & McDaniel, 2008).

We manipulated focality of the event-based cue to produce evidence relevant to the two theories (McDaniel & Einstein, 2000; 2007). With focal cues, the discrimination process required for the ongoing task is closely related to the basis for determining whether an event is a PM cue and is likely to prompt automatic retrieval of the intention (Kliegel, Jäger, & Phillips, 2008; McDaniel, Einstein, & Rendell, 2008). Nonfocal cues require processing features of the stimuli that do not overlap with the discrimination required by the ongoing task and noticing of PM cues should require the allocation of strategic attentional resources (Einstein & McDaniel, 2005).

Both the PAM theory and the multiprocess theory contend that nonfocal cues demand preparatory attentional processes to evaluate stimulus characteristics and successfully complete PM intentions. Specifically, these attentional demands will have processing consequences in the form of RT increases from control to experimental trials, indicative of monitoring. The theories diverge in predictions for focal cues. According to the multiprocess theory, focal cues will trigger spontaneous retrieval of the intention, avoiding a need to devote preparatory attentional resources to noticing and responding to focal PM cues (McDaniel et al., 2008; Scullin, Bugg, McDaniel, & Einstein, 2011). Consequently, successful PM performance could occur without RT costs on PM trials. According to the PAM theory, preparatory attentional processes are always needed to support successful PM. Thus, successful PM performance should be associated with increases in RT from control to experimental trials for focal cues.

PM cue focality influences age differences in event-based PM as well. With focal cues, older and younger adults tend to show equal PM performance (e.g., Cherry & Lecompte, 1999). With nonfocal cues, age differences are more likely to be observed (e.g., Park et al., 1997). A meta-analysis by Kliegel et al. (2008) suggested that age differences are not completely eliminated with focal cues, but they are significantly reduced relative to nonfocal cues (although see Uttl [2011] for a different conclusion). Thus in terms of event-based PM performance, we expected high PM performance for younger and older adults with focal cues. With nonfocal cues, however, the literature suggests we would observe age differences, such that older adults perform worse than younger adults.

## Ease - of - Retrieval

Another goal of this study was to generate some evidence about whether strategy choice is a dynamic process that varies according to characteristics of the remembering situation. The nature of the initial PM retrieval is relevant for this purpose. Previous metacognitive research suggests that retrieval fluency is a potent factor that people use to make predictions about their future episodic remembering (e.g., Benjamin, Bjork, & Schwartz, 1998; Hines, Touron, & Hertzog, 2009). Benjamin and colleagues reported that individuals predicted their future memory recall performance based on the item's retrieval fluency, even when it was not a valid predictor of future memory success. By analogy, we hypothesized that if initial intention retrieval occurs easily or spontaneously, individuals may feel assured that they will also remember the intention after the delay. Hence, individuals may rely on retrieving the intention at the end of the delay instead of rehearsing the intention to respond after the delay (McDaniel et al., 2003), or they may generally put less effort into rehearsing or reformulating. Accordingly, focal cues are retrieved quickly and automatically and as such, should be associated with a high level of retrieval fluency. Nonfocal cues should be associated with lower retrieval fluency, as noticing the PM cue in these situations should be more effortful.

In the current study, we examined age differences in event-based and delay-execute PM through use of a slightly modified event-based paradigm in which individuals must press a particular key when they saw a PM cue and then press the same key again at the end of the block. This is critical because it allowed for a direct, within-subjects comparison of age differences in these two varieties of PM tasks. Consistent with previous research, we expected to show significant age differences in delay-execute PM performance. Further, the ongoing task was a lexical decision judgment which allowed for an examination of RTs before and after PM retrieval. Thus, these data can provide more direct information about how individuals are performing this task, and can critically evaluate the idea that older and younger adults perform this kind of task differently. Finally, we manipulated the focality of the target to see if this influenced age differences in event-based PM and to determine whether it had any bearing on how individuals completed the delay-execute PM task. According to the multiprocess framework, age differences should be evident in event-based PM performance for nonfocal cues, but not for focal cues.

## Method

Forty-eight young adults (18 – 24 years old) and 48 older adults (60–79 years old) were included in this study. Young adults were recruited from the undergraduate population at Georgia Tech and received course credit for their participation. Older adults (all of whom live independently in metropolitan Atlanta and are capable of making their own way into the laboratory) were recruited from the laboratory database and were compensated for their time. All participants were native English speakers, and reported themselves to be in good health. Information about the final sample can be seen in Table 1. Six younger adults and 25 older adults were removed from the analysis because of failures to follow instructions (i.e., failing to recall PM task instructions and/or PM cues).

Younger participants ($M$ = .35; $SD$ = .13) recalled a greater proportion words than older adults ($M$ = .20; $SD$ = .09) on the free recall task. They also answer more problems on all three comparison tasks. However, older participants ($M$ = 33.5; $SD$ = 4.5) performed better than younger adults ($M$ = 30.9; $SD$ = 3.4) on the vocabulary measure. Thus, this sample is typical of those seen in other cognitive aging studies. Also important, there were no differences between focal and nonfocal groups for either of these measures.

### Design

The design of this experiment was a 2 × 2 × 2 × 2 mixed factorial with age (young, old), and focality (focal, nonfocal) serving as between-subjects variables. The within-subject variables were the presence of a PM task (i.e., without PM task, with PM task) and length of delay (short, long).

### Materials

The ongoing task was a lexical decision task in which participants were asked to decide whether a given item was a word or nonword. Words (including PM cues) and nonwords were chosen from the English Lexicon Project database (Balota, et al., 2007). PM cues consisted of the following animal names: *raccoon, giraffe, baboon, elephant*. We created two versions of the focal task to ensure there were no differential effects of the PM cues. In the focal-A condition, the cues were *baboon* and *elephant*. In the focal-B condition the cues were *raccoon* and *giraffe*. In both focal conditions, each cue was presented four times. Additionally, all filler items (300 nonwords and 298 words) also appeared four times throughout the experimental portion of the task, for a total of 2400 trials (8 PM trials, 1200 nonword, 1192 word trials) across 24 experimental blocks. In the nonfocal condition, participants were asked to respond whenever they saw the name of an animal. The nonfocal condition employed all four PM cues with each word appearing twice. Thus, in this condition there were 596 words and 600 nonwords that appeared twice for a total of 2400 trials. For the control trials (i.e., lexical decision task only) a different set of 240 words and 240 nonwords were used for a total of 480 trials spread across 5 blocks (96 trials per block).

### Procedure

All participants were tested individually in a single laboratory session lasting approximately 1.5 hours. Upon arrival, participants gave informed consent, completed a short demographic questionnaire, and then were randomly assigned to one of three conditions: focal-A, focal-B, or nonfocal. Participants were given instructions for the lexical decision task in which they decided whether a given item is a word or nonword. Participants were instructed to press the 'p' key (marked with a green sticker) if the item was a word and to press the 'q' key (marked with a red sticker) if the item was not a word. Participants completed five practice trials and were given an opportunity to ask questions before continuing. Participants then completed 5 blocks of lexical decision task. Within each block, each response triggered the appearance of the next trial. Participants were given an opportunity to rest between each block.

After completing the control blocks, participants were given PM task instructions. Participants were informed that we had a secondary interest in their ability to perform an action sometime in the future. In the focal condition, participants were asked to respond by pressing the 'b' key as soon as they saw one of the following cue words: either *baboon* and *elephant* (focal-A) or *raccoon* and *giraffe* (focal-B). In the nonfocal condition, participants were asked to respond by pressing the 'b' key as soon as they saw the name of an animal. This is consistent with the multiprocess classification (i.e., McDaniel & Einstein, 2007) and is considered nonfocal because the initial discrimination does not involve processing that would lead one two directly noticing the PM cue. Furthermore, in all conditions participants were asked to press 'b' again at the end of blocks containing a target word, thereby modifying the delay-execute task to incorporate the immediate response element of a typical event-based PM task (see Einstein & McDaniel, 1990). In addition to the PM task instructions, participants were informed that they would still be making word or nonword decisions using the red and green keys, comparable to previous trials.

Participants were given as much time as needed to review the PM task instructions and were then asked to repeat back the instructions in order to ensure proper understanding of the PM task. All participants reached 100% accuracy on instruction recall before continuing with the experiment. Participants then completed letter, pattern, and number comparison worksheets (Salthouse & Babcock, 1991), all of which served as a delay between the setting of a PM task intention and its realization. Next, participants resumed with the experiment and completed the remaining 24 blocks of PM task trials. At the end of blocks containing a target word, participants who responded with a 'b' at any point during that block were prompted to type the name of the target word. Over 24 blocks, PM cues occurred once within eight blocks (i.e., blocks 5, 7, 10, 12, 16, 19, 20, 22), and their distance from the end of each block was manipulated to investigate the effect of length of delay on PM task performance. For blocks containing a short delay, the PM cue appeared five trials before the end of the block. For blocks containing a long delay, the PM cue appeared during the 25th trial (i.e., halfway through the block).

Upon completion of the experimental blocks, participants were again asked to recall the PM cues and task instructions. As previously noted, participants who were unable to correctly recall PM task instructions were removed from the analyses. Participants then completed a short post-task questionnaire in which they were asked how many times they responded to a PM cue as well as how many times they remembered to press 'b' at the end of blocks. Participants were also asked about their strategies for keeping these items in mind and whether or not their strategies would have changed if the task were more or less difficult. Finally, participants completed the Automated Operation Span (AOSPAN) task (Unsworth et al., 2005), the Shipley vocabulary test (Zachary, 1986), and a free recall task. In the free recall task, participants saw 24 words and after a 20 second delay were asked to recall (in any order) as many words they could remember.

## Results

There were no differences between Focal-A and Focal-B conditions for all analyses, so these data were collapsed into a single condition. Also, because there were no differences across short and long delays, results were collapsed across this variable. The alpha level was set at .05 for all analyses. We report Cohen's (1988) d statistic as an index of effect size. Cohen suggested benchmarks of 0.2, 0.5, and 0.8 for small, medium, and large effects, respectively (see Fritz, Morris, and Richler, in press, for further discussion). For interactions, the *d* statistic was calculated as the difference between effect sizes. For example, in a Focality × Trial interaction, *d* represents the difference between the associated effect size for the focality (focal vs. nonfocal) difference on control trials condition, and the associated effect size for focality differences on trials before the PM cue.

For PM performance analyses we conducted standard univariate analyses with between-subject variables of age and focality. We conducted mixed linear models on the dependent variables of RT and accuracy, with age, focality, and trial serving as fixed factors. The mixed model approach has advantages for incomplete data sets, which can be problematic when analyzing response by event outcome. In this approach, degrees of freedom (*df*) are calculated using the Satterthwaite approximation, which results in partial denominator *df* for *F*-tests of fixed effects. We were not interested in age-related differences in lexical decision RTs. These tests are therefore not reported, although as expected older adults were slower in responding than younger adults.

## PM Performance

Immediate PM performance was recorded as the number of times (out of 8) the participant correctly pressed the 'b' key upon seeing a PM cue. These data can be seen in the top portion of Table 2. There were no differences between younger ($M = .76$; $SE = .04$) and older adults ($M = .70$; $SE = .05$), $F(1,92) = 1.36$, $p = .247$, $d = 0.24$. However, there was a main effect of focality, $F(1,92) = 15.72$, $p < .001$, $d = 0.82$, which arose from lower remembering with nonfocal targets ($M = .62$; $SE = .06$) relative to focal targets ($M = .84$; $SE = .06$). The Age × Focality interaction did not reach significance, $F(1, 92) = .63$, $p = .43$, $d = 0.14$. Delay-execute PM performance was recorded as the proportion of correct 'b' presses at the end of a block of trials. Older adults ($M = .46$; $SE = .09$) were impaired relative to younger adults ($M = .67$; $SE = .08$), $F(1,92) = 6.78$, $p = .011$, $d = 0.53$. However, there was no effect of focality, $F(1,92) = 1.95$, $p = .166$, $d = 0.28$, nor was there an Age × Focality interaction ($F < 1$).

Next, we grouped immediate and delayed PM performance into a two-level within-subject variable (i.e., PM task) and examined the influence of focality separately for younger and older adults. For younger adults, there was no difference across PM tasks, $F(1,46) = 2.07$, $p = .157$, $d = .26$. There was a robust difference in focality, $F(1,46) = 6.05$, $p = .018$, $d = 0.71$. The interaction was not significant ($F < 1$). Older adults' performance was lower with delay-execute PM than with immediate PM, $F(1,46) = 15.18$, $p < .001$, $d = 0.62$. There was also a difference in focality, $F(1,46) = 4.17$, $p = .047$, $d = 0.59$. PM task did not interact with focality, $F(1,46) = 1.84$, $p = .18$, $d = 0.03$.

## Immediate PM -RTs

To better understand immediate PM performance, we examined RTs to the ongoing task. Specifically, we examined RTs on the last block of control trials (i.e., lexical decision task only) and on the 5 trials preceding PM cues. We log transformed the RTs to address skew in the RT distribution. In accordance with recommendations from Smith (2010), we analyzed RTs for words and nonwords separately. We also conducted separate analyses for trials in which the PM cue was noticed and for those trials in which it went unnoticed.

The untransformed means for word trials in which the participant correctly responded to the PM cue are shown in the upper panel of Figure 1. Individuals in the nonfocal condition ($M =$

3.10; *SE* = .018) had slower RTs than individuals in the focal condition (*M* = 3.03; *SE* = .02), $F(1, 86) = 8.48$, $p = .005$, $d = 0.49$. This was qualified by a Focality × Trial interaction, $F(1,86) = 6.5$, $p = .013$, $d = .65$. In the focal condition RTs were faster on trials preceding the PM cue relative to control trials. In the nonfocal condition, RTs were slower on trials before the PM cue relative to control. This effect seems to be mostly carried by older adults, however, the Age × Focality × Trial interaction, $F(1, 86) = 1.76$, $p = .19$ failed to reach conventional levels of significance[1]. In all, this suggests that individuals were monitoring more for nonfocal targets relative to focal targets.

For nonword trials (bottom panel of Figure 1), there was no effect of focality, $F(1,86) = 1.65$, $p = .22$. There was a main effect of trial, $F(1, 86) = 22.32$, $p < .001$, $d = 0.46$, which is explained by control RTs (*M* = 3.15; *SE* = 0.02) being slower than trials before the PM cue (*M* = 3.08; *SE* = 0.02). The Focality × Trial interaction, $F(1, 86) = 2.63$, $p = .11$, $d = .31$ was not reliable. The Age × Focality × Trial interaction, $F(1,86) = 1.46$, $p = .23$, was also not reliable[2].

We next analyzed trials in which participants failed to correctly respond to the PM cue. First, we examined word trials, which can be seen in the upper panel of Figure 2. There were no significant main effects or interactions (all *F*s < 1.04). Examination of nonword trials (bottom panel of Figure 2) revealed an effect of trial, with control trials (*M* = 3.16; *SE* = 0.03) having slower RTs relative to trials preceding a PM cue (*M* = 3.08; *SE* = 0.03), $F(1, 54) = 6.23$, $p = .016$, $d = 0.39$. No other main effects or interactions were significant (*F*s < 1). Thus, when individuals failed to respond to the PM cue there was no evidence of monitoring, and no evidence of increased monitoring for nonfocal cues relative to focal cues.

## Immediate PM – Accuracy

We also examined accuracy on the ongoing task. For this analysis, we only focused on word trials, as they are most relevant. However, the results for the nonwords are displayed in Table 3. Generally speaking accuracy on the lexical decision task was high. When the intention was successfully retrieved, the critical result was the Focality × Trial interaction, $F(1,86) = 5.44$, $p = .022$, $d = 0.47$. As can be seen in Table 3, accuracy slightly declined from control to PM trials in the focal condition. In the nonfocal condition, this decrease was more pronounced. The focality effects on accuracy imply a differential attentional cost on nonfocal trials, one that apparently did not differ as a function of age. This mirrors the findings of the RT analysis.

When the PM cue did not elicit a response there was no effect of age or focality (*F*s < 1), but there was an effect of trial, $F(1, 54) = 19.72$, $p < .001$, $d = .61$, such that performance during the control trials (*M* = .93, *SE* = .01) was more accurate than during the PM trials (*M* = .89; *SE* = .01). However, this effect did not interact with age or focality (all *F*s < 1).

## Delay-Execute PM - RTs

We were also interested in how individuals performed the ongoing task after an intention had been successfully or unsuccessfully retrieved. Specifically, we examined RTs on the five trials preceding the PM cue (Trial 1), RT to the PM cue itself (Trial 2), and RTs on the three trials immediately following the PM cue (Trials 3, 4, and 5 respectively). This fine-grained analysis, as others have done with event-based PM tasks (Loft & Yeo, 2005), should yield the most detailed information. Finally, we examined these data separately for each type

[1]For older adults, the Focality × Trial interaction, $d = .63$. For younger adults, $d = .31$.

[2]For older adults, the Focality × Trial interaction, $d = .20$. For younger adults, $d = .08$

of outcome (Yes-Yes, Yes-No, No-No, No-Yes) in order to identify interesting differences that may point to reasons why an intention was or was not successfully retrieved.

The results for Yes-Yes instances are displayed in Figure 3. There were differences across trials, $F(4, 251.764) = 60.46$, $p < .001$. To follow-up on this result, we conducted Bonferroni-corrected pairwise comparisons which revealed that all comparisons were significant at the $p < .001$ level except for: Trial 1 vs. Trial 5 and Trial 2 vs. Trial 3. This effect was overshadowed by two significant interactions. First, there was an Age × Trial interaction, $F(4, 251.764) = 3.79$, $p = .005$. There was also a Focality × Trial interaction, $F(4, 251.764) = 9.85$, $p < .001$. To follow up on this finding, we analyzed the difference in focality (collapsed across age group) at every trial. There were no significant differences between the focal and nonfocal conditions at Trials 1, 3, and 5. There was a difference at Trial 2, $F(1, 72) = 10.45$, $p = .002$, $d = 0.96$ with slower RTs on Trial 2 in the focal condition ($M = 3.51$, $SE = 0.04$) relative to the nonfocal condition ($M = 3.32$, $SE = 0.04$). There was also a significant difference at Trial 4, $F(1, 72) = 12.0$, $p < .001$, $d = 1.07$, with slower RTs in the nonfocal condition ($M = 3.33$; $SE = 0.04$) relative to the focal condition ($M = 3.15$; $SE = 0.04$).

Next, we examined Yes-No instances. There were focality effects, $F(1, 85.583) = 4.06$, $p = .047$, $d = 0.28$, explained by slower RTs in the nonfocal condition ($M = 3.3$, $SE = 0.02$) relative to the focal condition ($M = 3.23$; $SE = 0.02$). There were also differences across trials, $F(4, 157.596) = 35.24$, $p < .001$. The results of the follow-up tests were the same as the Yes-Yes analysis. However, unlike the Yes-Yes analysis there were no significant two-way interactions, nor was the Age × Focality × Trial interaction ($F < 1$).

For No-Yes instances, RTs in the nonfocal condition ($M = 3.28$; $SE = 0.04$), were slower relative to the focal condition ($M = 3.1$, $SE = 0.05$), $F(1, 32.01) = 8.53$, $p = .006$, $d = 0.73$. There were also differences between trials, $F(4, 74.935) = 9.31$, $p < .001$. Post hoc pairwise comparisons revealed that RTs on Trial 3 were statistically different than all other trials (all comparisons at $p < .001$). No other comparisons were significant. All interactions were not reliable.

Finally, for No-No instances, there was no effect of focality ($F < 1$), however there were differences across trials, $F(4, 146.321) = 14.29$, $p < .001$. Follow-up tests revealed that RTs on Trial 3 were significantly slower than all other trials (all comparisons at $p < .001$). No other effects nor interactions were reliable.

In summary, older and younger adults showed very similar RT patterns following the detection of a PM cue. Furthermore, the RT patterns imply that for the nonfocal condition, slower RTs after retrieval of the intention (e.g., Trial 4 in the Yes-Yes analysis) were associated with successful delayed remembering. Notably, this pattern was not evident in Yes-No trials. This change in RT after intention retrieval may reflect reformulation of a plan immediately after detecting the prospective cue, which is important for successfully retrieving the delayed intention.

### Delay- Execute PM – Accuracy

We examined accuracy to the ongoing task as additional evidence for monitoring for PM cues. Control accuracy was calculated as the average proportion of correct lexical decisions on the last control block. PM task accuracy was similarly calculated as the accuracy on all trials following the PM cue. These data can be seen in Table 4. For word trials in Yes-Yes instances, there was a main effect of age, $F(1,68) = 4.04$, $p = .048$, $d = 0.42$. There was also higher accuracy in focal conditions ($M = .94$; $SE = .01$) relative to the nonfocal condition ($M = .90$; $SE = .01$), $F(1, 68) = 8.32$, $p = .005$, $d = .60$. No two-way interactions were reliable, nor was the Age × Focality × Trial interaction, $F(1,68) = 1.06$, $p = .31$[5]. For nonword trials, there was a Focality × Trial interaction, $F(1,68) = 8.51$, $p = .005$, $d = 0.07$. In the focal condition, accuracy numerically increased from before to after the PM cue. However, in the nonfocal condition, accuracy decreased from trials before to after the cue.

For Yes-No word trials, the most critical result was a Focality × Trial interaction, $F(1,47) = 6.26$, $p = .016$, $d = .68$. In focal condition, accuracy increased from trials before the cue to after the cue. In nonfocal condition, response accuracy decreased from before to after the cue. The Age × Focality × Trial interaction, $F < 1$, was not reliable[6]. Examination of nonwords also revealed a Focality × Trial interaction, $F(1,47) = 6.98$, $p = .011$, $d = .46$, which is identical to the pattern just described. In addition, there was also an Age × Trial interaction, $F(1,47) = 5.26$, $p = .026$, $d = .22$. Younger adults' accuracy remained stable, whereas older adults' accuracy noticeably decreased after the cue appeared.

For No-No and No-Yes instances, there were no differences in accuracy across all variables. This was true for words and nonwords.

In summary, in both the Yes-Yes and Yes-No conditions, there was evidence of lower lexical decision accuracy after retrieval of the intention in the nonfocal condition only. Consistent with elements of the RT data, this suggests that in the nonfocal condition, participants were perhaps reformulating or rehearsing the intention during the delay in hopes of remembering at the end of the block, which in turn reduced accuracy on the ongoing task.

## Comparisons Across Task Performance

Next, we examined differences between Yes-No and Yes-Yes trials as well as No-No and No-Yes to potentially identify important differences that predicted success and failure in the delayed component of the task. We conducted linear, mixed model analysis separately for each trial, including variables, of age, focality, and PM outcome (Success, Failure). Across trials, there were no significant differences between instances in which individuals remembered to execute the delayed intention and those in which they did not (most $F$s < 1: for Trial 2 RT, $F(1, 67.8) = 1.42$, $p = .23$). There were no statistically reliable interactions with successful PM outcomes.

We also looked at differences across No-Yes and No-No instances. There were no statistically reliable effects for RTs on Trials 1 and 2. For Trial 3 there was a Focality × PM outcome interaction, $F(1, 15.85) = 5.53$, $p = .032$. In the nonfocal condition, RTs were slower when the intention was successfully retrieved at the end of the delay. There was no such difference for the focal condition. On Trial 4, there was a main effect of focality, $F(1, 59.398) = 6.49$, $p = .013$, and the Focality × PM outcome interaction was significant, $F(1, 28.003) = 9.35$, $p = .003$. Again, in the nonfocal condition, RTs were slower when the intention was successfully retrieved at the end of the delay, relative to when it was not. In the focal condition, there was no difference in RTs.

## RTs at the 2nd ‘b’ Press

Finally, we looked at RTs when participants retrieved the delayed intention (i.e., the 2nd ‘b’ press) as a potential index of whether people were keeping the intention in focal awareness. That is, faster retrievals might be associated with an intention being kept in focal awareness. This was calculated as the amount of time elapsed before a response (either ‘b’ or ‘enter’) was made. The data were log transformed to address the skewed RT distribution. We

[5]For older adults, the Focality × Trial interaction, $d = .09$. For younger adults, $d = .56$

[6]For older adults, the Focality × Trial interaction, $d = .49$. For younger adults, $d = .87$

compared averaged RTs for when the intention was correctly retrieved (i.e., Yes-Yes and No-Yes) versus when the participants forgot to retrieve the intention at the end of the delay (i.e., Yes-No and No-No). We submitted these data to a 2 (age) × 2 (focality) × 2 (DEPM outcome: Success, Failure) linear mixed model analysis. There was an Age × PM outcome interaction, $F(1, 84.24) = 18.19$, $p < .001$, $d = 0.48$. As can be seen in Figure 4, there seems to be a crossover interaction such that when younger adults were successful at remembering to execute the delayed intention, they were slower at making the 'b' press relative to those who failed to remember. For older adults, however, individuals who remembered to execute the delayed intention were faster than those who forgot the intention.

## Discussion

The goal of the current study was to investigate the effect of age and focality on delay-execute PM. Unlike previous studies, individuals were instructed to make responses to the initial cue, allowing us to make within-subject comparisons across immediate and delayed PM retrieval. Additionally, we examined RTs to a lexical decision task in order to determine how individuals were performing the task.

### Age Differences in PM?

We found a noticeable deficit for older adults consistent with the majority of past research (Einstein et al., 2000; 2003; McDaniel et al., 2003). Specifically, older adults only remembered to respond at the end of the trial block about half of the time. Thus, our modified approach did not alter the paradigm in a drastic manner.

### Age Differences in Task Approach?

Our analysis suggested that older and younger adults perform in qualitatively similar ways. In particular, both age groups showed increases in RT on the two to three trials following the PM cue. We interpret these transient RT elevations as reflecting rehearsal or reformulation of the intention during a brief period following detection of the PM cue. This finding is consistent with Einstein et al. (2003) who found that participants required to hold an intention in mind for 5 seconds were slower answering questions than individuals who were not holding an intention in mind. Importantly, RT increases were not apparent throughout the entirety of the delay, suggesting individuals do not actively rehearse the intention over the entire delay period.

As another measure of participant strategy, we also looked at how quickly individuals responded at the end of the block. We reasoned if individuals maintained the intention in immediate awareness, responses at the end of the block should be faster relative to individuals planning on retrieving the intention from long-term memory. Our examination yielded a cross-over interaction such that older adults who successfully completed the delayed intention were faster to respond relative to younger adults who also successfully remembered.

This result suggests several possibilities. First, older adults were keeping the intention in focal awareness more so than younger adults. This runs counter to suggestions that older adults' lower cognitive capacity would leave them unable to maintain intentions in focal awareness. However, it is possible that our sample of older adults were "high-functioning" and have the cognitive capacity to maintain intentions in focal awareness, much like younger adults typically do. Previous work by Kliegel and Jäger (2006) suggested that high-functioning older adults were able to perform comparably to younger adults in delay-execute tasks. A second possibility is that older adults placed more emphasis on the delayed intention task at the expense of performance on the ongoing task. In Yes-Yes and Yes-No trials in the nonfocal condition, there was a decrease in accuracy and an increase in RT after initial retrieval of the intention, indicating an increase in attention directed toward the PM task. However, this pattern was not exclusive to older adults, and additional analyses of the data provided little direct support for this possibility.[7] A final possibility is that when the PM cue is successfully recognized, it is based on greater memory strength, and thus is retrieved more quickly at the end of the delay (e.g., Dosher, 1984). Future research should try to disentangle these possibilities.

To evaluate the importance of these RT changes, we examined them across various trial types. We observed slower RTs after responding to a nonfocal cue on Trial 4 of Yes-Yes trials, which was not evident in the Yes-No analysis. Also, comparing No-Yes vs. No-No trials with nonfocal cues, RTs were slower when the delayed-intention was realized. There were no differences with focal cues. Curiously however, this effect was not observed with Yes-Yes vs. Yes-No comparisons. Finally, there were also effects on accuracy. In the nonfocal condition, accuracy declined after intention retrieval but did not change in the focal condition. Thus, it appears that in some situations, the amount of rehearsal or reformulation taking place immediately after retrieving the PM intention is critical for the success of retrieving the intention again at the end of the delay.

Interestingly, the aforementioned findings were restricted to the nonfocal condition and were not evident in the focal condition. However, while the focality of the PM cue affected performance to the ongoing task, it did not affect delay-execute remembering. Thus, these data tentatively suggest that fluency of the PM cue affects behavior, however not enough to ultimately affect remembering. Einstein et al. (2000) found no age differences in delayed remembering when the PM cue was easily noticed. The present study failed to show attenuated or eliminated age differences with a more fluent retrieval. There could be many reasons for this discrepancy, including differences in paradigms, participants, and the PM cue manipulation. Nevertheless, future research should continue to investigate the impact of PM cue fluency on PM performance and monitoring behavior.

## Immediate PM and Theories of PM

We also examined predictions of two models of PM in a delay-execute paradigm. Our results revealed high PM performance and no evidence of monitoring for older or younger adults with focal cues. With nonfocal cues, PM performance was lower relative to focal cues and monitoring was evident when the intention was realized, but absent when it was not. Additionally, when monitoring was evident there were noticeable accuracy declines in the nonfocal condition. These data are broadly consistent with the multiprocess theory. It stipulates that focal PM cues can be realized through automatic retrieval processes. When this happens, PM performance can remain high even though RTs show no evidence of monitoring. The PAM model predicts that monitoring is necessary for successful remembering with all cues, which is inconsistent with the current data. However, this is not fully consistent with the multiprocess account because that model predicts age differences with nonfocal cues, which was not found in the current study.

As it pertains to aging, we found no PM performance differences between younger and older adults with focal and nonfocal cues. This pattern is partially consistent with the multiprocess theory. Specifically, this theory predicts no age differences with focal cues because automatic intention-cueing processes are spared with normal aging. With nonfocal cues, age differences are expected as older adults are presumed to have declines in finite cognitive

[7]Comparing older adults' RTs throughout the delay, and on the 5 trials before the end of the block across No-Yes vs. No-No and Yes-Yes vs. Yes-No yielded no significant differences.

resources necessary for successful monitoring. The only seemingly inconsistent finding is that of no age differences in immediate PM performance with nonfocal cues. However, the lack of age differences may be explained by looking at the RT data. Older adults appear to be monitoring more for the PM cue, relative to younger adults, suggesting that they have placed a greater focus on the PM task (e.g., Kidder et al., 1997). In other words, older adults have maintained similar performance to younger adults by directing more of their processing resources towards the PM task. This interpretation is also consistent with the PAM model as well.

In summary, we used a slightly modified delay-execute PM paradigm to obtain detailed information on older and younger adults' strategies for realizing delayed intentions. Our data suggest that older and younger adults perform delay-execute PM tasks in a similar manner, namely by briefly rehearsing or reformulating the intention after the initial retrieval. Despite using similar strategies, older adults were still quite impaired at acting upon the delayed intention. This suggests that the drastic age-related declines in delay-execute PM are due to some other factor than strategy use, such as forgetting due to the interference created by ongoing task performance. Future research should continue to investigate the causes of older adults' impairment in delay-execute PM performance.

## Acknowledgments

This research was supported in part from an NIH training grant from the National Institute on Aging (T32000175).

## References

Balota DA, Yap MJ, Cortese MJ, Hutchison KA, Kessler B, Loftis B, Neely JH, Nelson DL, Simpson GB, Treiman R. The English Lexicon Project. Behavior Research Methods. 2007; 39:445–459. [PubMed: 17958156]

Breneiser J, McDaniel MA. Discrepancy processes in prospective memory retrieval. Psychonomic Bulletin & Review. 2006; 13:837– 841. [PubMed: 17328382]

Cohen, J. Statistical power analysis for the behavioral sciences. 2. Hillsdale, NJ: Erlbaum; 1988.

Dosher BA. Preexperimenal (semantic) from learned (episodic) associations: A speed-accuracy study. Cognitive Psychology. 1984; 16:519–555.

Einstein GO, McDaniel MA. Normal aging and prospective memory. Journal of Experimental Psychology: Learning, Memory, and Cognition. 1990; 16:717– 726.

Einstein, GO.; McDaniel, MA. Prospective memory and metamemory: The skilled use of basic attentional and memory processes. In: Benjamin, AS.; Ross, B., editors. The psychology of learning and motivation. Vol. 48. San Diego, CA: Elsevier; 2008. p. 145-173.

Einstein GO, McDaniel MA. Prospective memory and what costs do not reveal about retrieval processes: A commentary on Smith, Hunt, McVay, and McConnell (2007). Journal of Experimental Psychology: Learning, Memory, and Cognition. 2010; 36:1082– 1088.

Einstein GO, McDaniel MA, Manzi M, Cochran B, Baker M. Prospective memory and aging: Forgetting intentions over short delays. Psychology and Aging. 2000; 15:671– 683. [PubMed: 11144326]

Einstein GO, McDaniel MA, Thomas R, Mayfield S, Shank H, Morrisette N, Breneiser J. Multiple retrieval processes in prospective memory retrieval: Factors determining monitoring versus spontaneous retrieval. Journal of Experimental Psychology: General. 2005; 134:327– 342. [PubMed: 16131267]

Einstein GO, McDaniel MA, Williford CL, Pagan JL, Dismukes K. Forgetting of intentions in demanding situations is rapid. Journal of Experimental Psychology: Applied. 2003; 9:147– 162. [PubMed: 14570509]

Fritz CO, Morris PE, Richler JJ. Effect size estimates: Current use, calculations and interpretation. Journal of Experimental Psychology: General. in press.

Hertzog C, Dixon RA, Hultsch DF, MacDonald SWS. Latent change models of adult cognition: Are changes in processing speed and working memory associated with changes in episodic memory? Psychology and Aging. 2003; 18:755– 769. [PubMed: 14692862]

Hines JC, Touron DR, Hertzog C. Metacognitive influences on study time allocation in an associative recognition task: An analysis of adult age differences. Psychology and Aging. 2009; 24:462– 475. [PubMed: 19485662]

Kidder DP, Park DC, Hertzog C, Morrell RW. Prospective memory and aging: The effects of working memory and prospective memory task load. Aging, Neuropsychology, and Cognition. 1997; 4:93–112.

Kligel M, Jäger T. Delayed-execute prospective memory performance: The effects of age and working memory. Developmental Neuropsychology. 2006; 30:819–843. [PubMed: 17083295]

Kliegel M, Jäger T, Phillips LH. Adult age differences in event-based prospective memory: A meta-analysis on the role of focal versus nonfocal cues. Psychology and Aging. 2008; 23:203– 208. [PubMed: 18361667]

Kvavilashvili L, Fisher L. Is time-based prospective remembering mediated by self-initiated rehearsals? Effects of incidental cues, ongoing activity, age, and motivation. Journal of Experimental Psychology: General. 2007; 136:122–132.

McDaniel MA, Einstein GO. Strategic and automatic processes in prospective memory retrieval: A multiprocess framework. Applied Cognitive Psychology. 2000; 14:S127– S144.

McDaniel, MA.; Einstein, GO. Prospective memory: An overview and synthesis of an emerging field. Thousand Oaks, CA: Sage; 2007.

McDaniel, MA.; Einstein, GO.; Rendell, PG. The puzzle of inconsistent age-related declines in prospective memory: A multiprocess explanation. In: Kliegel, M.; McDaniel, M.; Einstein, G., editors. Prospective memory: Cognitive, neuroscience, developmental, and applied perspectives. Mahwah, NJ: Erlbaum; 2008. p. 141-160.

McDaniel MA, Einstein GO, Stout AC, Morgan Z. Aging and maintaining intentions over delays: Do it or lose it. Psychology and Aging. 2003; 18:823–835. [PubMed: 14692867]

Park DC, Lautenschlager G, Hedden T, Davidson NS, Smith AD, Smith PK. Models of visuospatial and verbal memory across the adult life span. Psychology and Aging. 2002; 17:299– 320. [PubMed: 12061414]

Park DC, Smith AD, Dudley WN, Lafronza VN. Effects of age and a divided attention task presented during encoding and retrieval on memory. Journal of Experimental Psychology: Learning, Memory, and Cognition. 1989; 15:1185– 1191.

Park DC, Smith AD, Lautenschlager G, Earles JLK. Mediators of long-term memory performance across the life span. Psychology and Aging. 1996; 11:621–637. [PubMed: 9000294]

Salthouse TA, Babcock RL. Decomposing adult age differences in working memory. Developmental Psychology. 1991; 27:763– 776.

Scullin MK, Bugg JM, McDaniel MA, Einstein GO. Prospective memory and aging: Preserved spontaneous retrieval, but impaired deactivation, in older adults. Memory & Cognition. in press.

Smith RE. The cost of remembering to remember in event-based prospective memory: Investigating the capacity demands of delayed intention performance. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2003; 29:347– 361.

Smith, RE. Connecting the past and the future: Attention, memory, and delayed intentions. In: Kliegel, M.; McDaniel, M.; Einstein, G., editors. Prospective memory: Cognitive, neuroscience, developmental, and applied perspectives. Mahwah, NJ: Erlbaum; 2008. p. 29-52.

Smith RE. What costs do reveal and moving beyond the cost debate: Rely to Einstein and McDaniel (2010). Journal of Experimental Psychology: Learning, Memory, and Cognition. 2010; 36:1089–1095.

Smith RE, Hunt RR, McVay JC, McConnell MD. The cost of event-based prospective memory: Salient target events. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2007; 33:734– 746.

Unsworth N, Heitz RP, Schrock JC, Engle RW. An automated version of the operation span task. Behavior Research Methods. 2005; 37:498– 505. [PubMed: 16405146]

Uttl B. Transparent meta-analysis: Does aging spare prospective memory with focal vs. non-focal cues? PLos One. 2011; 6:e16618. [PubMed: 21304905]

Zachary, RA. Shipley Institute of Living Scale, Revised Manual. Los Angeles, CA: Western Psychological Services; 1986.

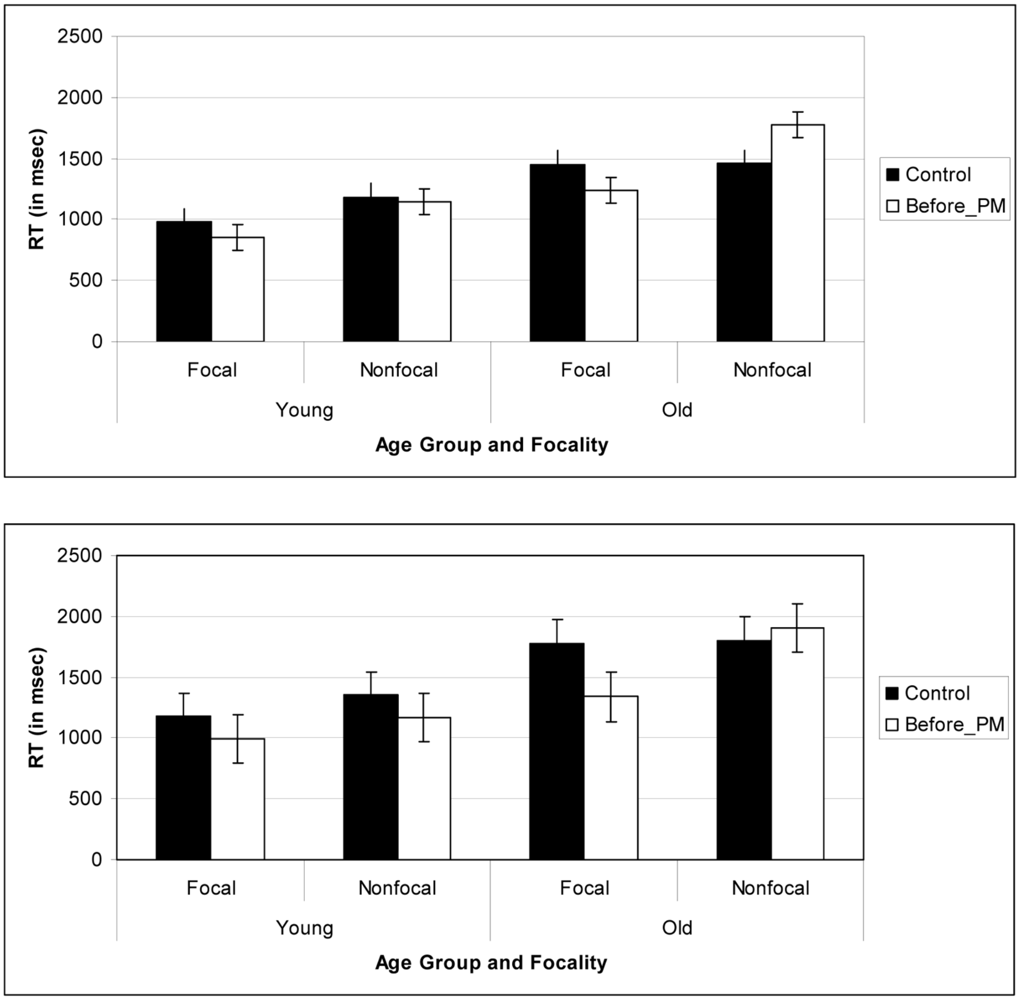



**Figure 1.**
Reaction time to the ongoing task during trials where the PM cue was responded to. The upper panel demonstrates results for word trials and the lower panel demonstrates results for nonword trials.

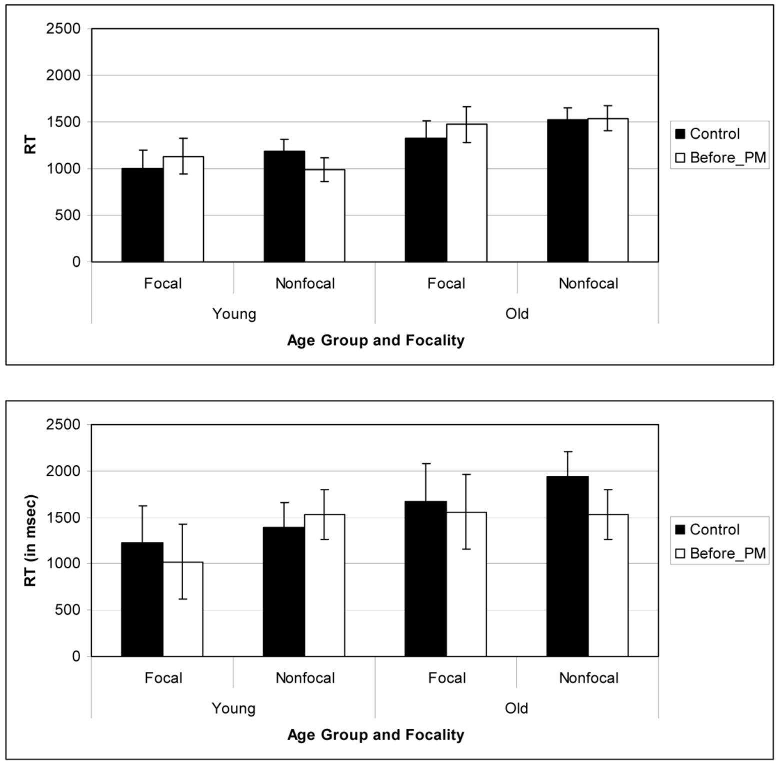
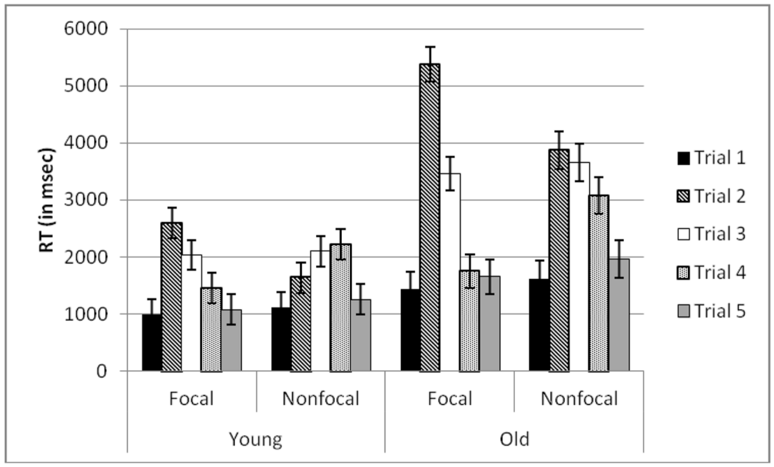
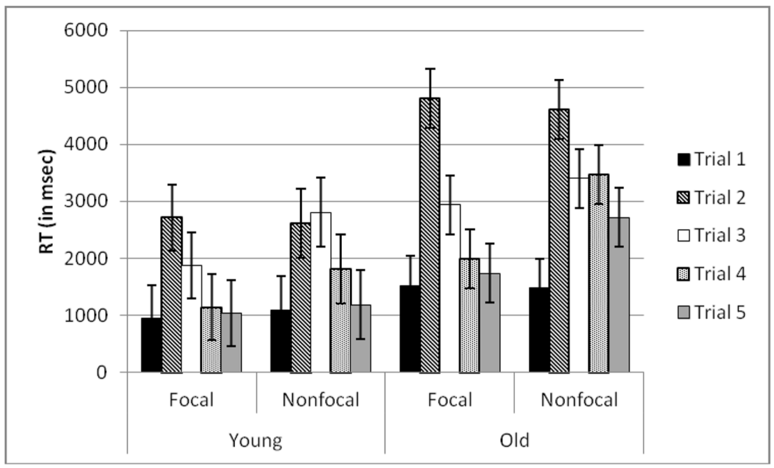



**Figure 2.**
Reaction time to the ongoing task during trials where the PM cue was not responded to. The upper panel demonstrates results for word trials and the lower panel demonstrates results for nonword trials.

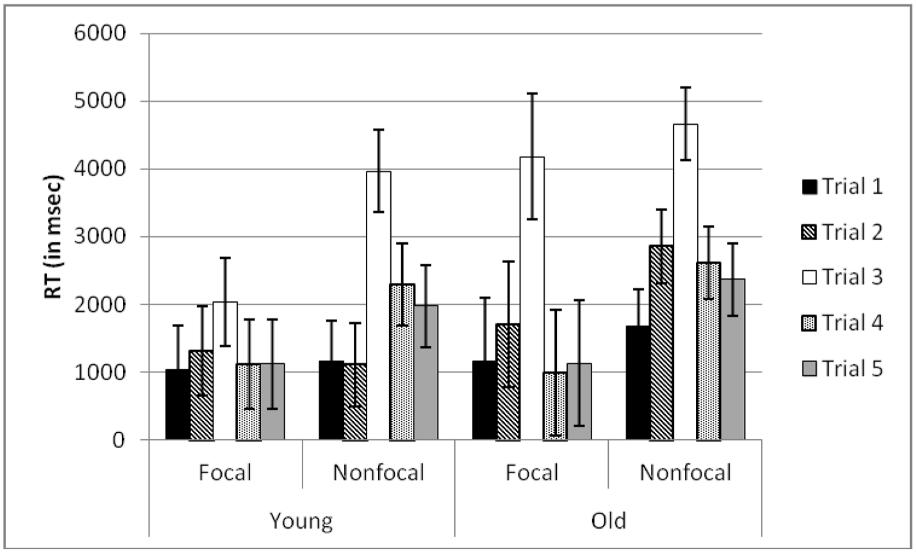
A.


6000
5000
4000
3000
2000
1000
0
RT (in msec)
Focal
Nonfocal
Focal
Nonfocal
Young
Old
Trial 1
Trial 2
Trial 3
Trial 4
Trial 5

B.


6000
5000
4000
3000
2000
1000
0
RT (in msec)
Focal
Nonfocal
Focal
Nonfocal
Young
Old
Trial 1
Trial 2
Trial 3
Trial 4
Trial 5

C.




D.

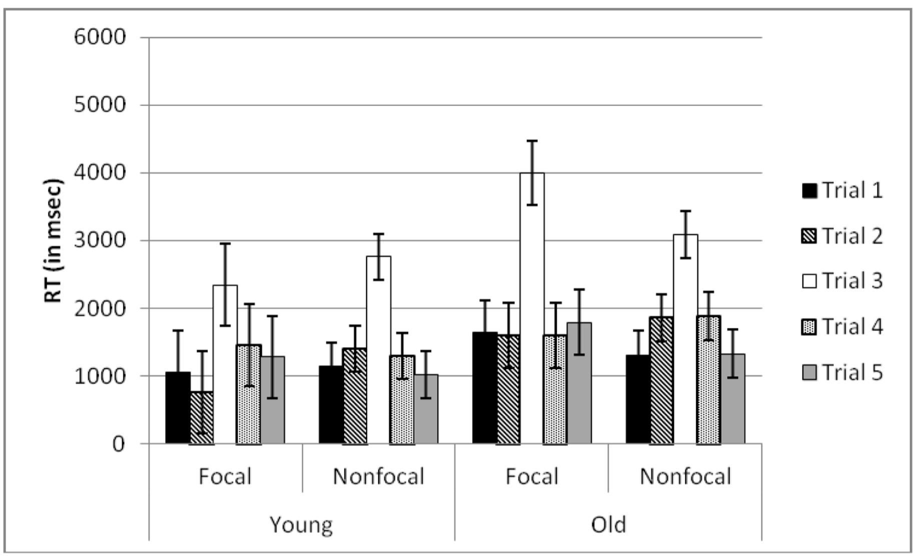



**Figure 3.**
Reaction time to the ongoing task surrounding the PM cue for (A.) Yes-Yes trials (B.) Yes-No trials, (C.) No-Yes trials, and (D.) No-No trials. Error bars represent standard errors.

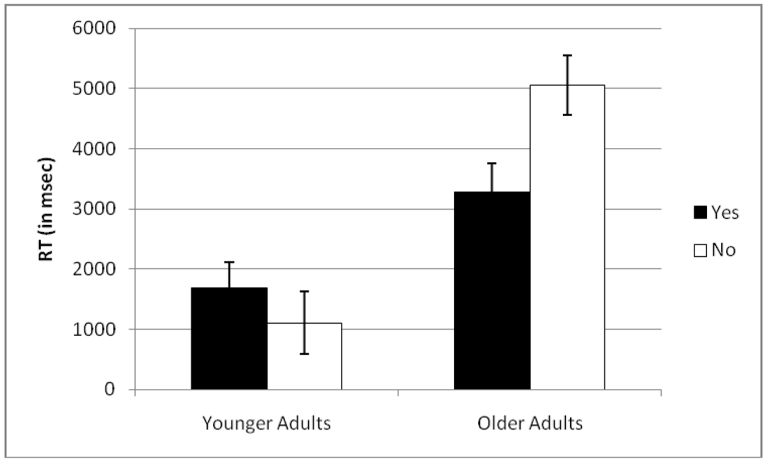



**Figure 4.**
Reaction time at the end of the block where the second PM response should be made. Yes trials refer to when the intention was executed and 'No' trials refer to when the intention was not executed. Error bars represent standard errors.

## Table 1

Participant Characteristics by Age Group and Focality

| Variable | Younger Adults | | Older Adults | | Statistical Value |
|---|---|---|---|---|---|
| | Focal | Nonfocal | Focal | Nonfocal | |
| Education | 13.5 (1.3) | 14.0 (1.2) | 16.4 (3.0) | 15.7 (2.5) | $t = -5.22$; $p < .001$ |
| Vocabulary | 31.2 (4.0) | 30.7 (2.8) | 33.9 (4.7) | 33.0 (4.7) | $t = -3.14$; $p = .002$ |
| Free Recall | .35 (2.7) | .35 (3.6) | .21 (.08) | .20 (.10) | $t = -6.41$; $p < .001$ |
| Letter Comparison | 26.1 (5.2) | 24.8 (3.5) | 16.2 (3.1) | 16.6 (4.5) | $t = 10.79$; $p < .001$ |
| Pattern Comparison | 45.0 (8.1) | 45.1 (6.2) | 27.4 (5.6) | 29.3 (4.8) | $t = 13.07$; $p < .001$ |
| Number Comparison | 33.6 (6.2) | 32.3 (4.1) | 22.1 (4.6) | 24.0 (5.8) | $t = 9.12$; $p < .001$ |

*Note*. Standard deviations are presented in parentheses. Statistical value is based on an independent-samples t-test with older and younger adults, collapsing over focality.

## Table 2

Immediate and Delay-Execute PM Performance by Age Group and Focality

| | Younger Adults | | Older Adults | |
|---|---|---|---|---|
| **Prospective Memory** | **Focal** | **Nonfocal** | **Focal** | **Nonfocal** |
| Immediate | .85 (.25) | .68 (.23) | .83 (.30) | .57 (.31) |
| Delay-Execute | .74 (.37) | .61 (.36) | .51 (.42) | .41 (.45) |

*Note*. Standard deviations are presented in parentheses

## Table 3

Accuracy to the Ongoing Lexical Decision Task for Correct and Incorrect Immediate PM Responses

| | Younger Adults | | | | Older Adults | | | |
|---|---|---|---|---|---|---|---|---|
| | Focal | | Nonfocal | | Focal | | Nonfocal | |
| | **Before** | **After** | **Before** | **After** | **Before** | **After** | **Before** | **After** |
| | Correct PM Trials | | | | | | | |
| Words | .91 (.02) | .90 (.02) | .93 (.02) | .87 (.02) | .96 (.01) | .96 (.01) | .93 (.01) | .90 (.01) |
| Nonwords | .92 (.02) | .92 (.02) | .90 (.02) | .94 (.02) | .93 (.02) | .93 (.02) | .91 (.02) | .90 (.02) |
| | Incorrect PM Trials | | | | | | | |
| Words | .95 (.02) | .89 (.02) | .93 (.02) | .89 (.02) | .92 (.03) | .89 (.03) | .92 (.02) | .88 (.02) |
| Nonwords | .93 (.03) | .94 (.04) | .90 (.02) | .93 (.02) | .86 (.03) | .91 (.03) | .89 (.02) | .96 (.02) |

*Note*. Standard errors are presented in parentheses below the mean.

## Table 4

Accuracy to the Ongoing Lexical Decision Task for Delay-Execute PM Memory

| | Younger Adults | | | | Older Adults | | | |
|---|---|---|---|---|---|---|---|---|
| | Focal | | Nonfocal | | Focal | | Nonfocal | |
| | Before | After | Before | After | Before | After | Before | After |
| | | | | Yes-Yes Trials | | | | |
| Words | .91 (.02) | .93 (.02) | .90 (.02) | .88 (.02) | .97 (.02) | .97 (.02) | .90 (.02) | .90 (.02) |
| Nonwords | .93 (.02) | .95 (.02) | .93 (.02) | .91 (.02) | .92 (.02) | .93 (.02) | .98 (.03) | .91 (.03) |
| | | | | Yes-No Trials | | | | |
| Words | .91 (.03) | .98 (.03) | .84 (.03) | .83 (.03) | .95 (.03) | .96 (.03) | .89 (.03) | .85 (.03) |
| Nonwords | .88 (.03) | .92 (.03) | .95 (.03) | .92 (.03) | .93 (.03) | .91 (.03) | .98 (.02) | .90 (.02) |
| | | | | No-Yes Trials | | | | |
| Words | .87 (.04) | .92 (.04) | .90 (.04) | .88 (.04) | .91 (.07) | 1.0 (.07) | .88 (.03) | .88 (.03) |
| Nonwords | .89 (.04) | .90 (.04) | .94 (.04) | .93 (.04) | .98 (.07) | 1.0 (.07) | .96 (.03) | .89 (.03) |
| | | | | No-No Trials | | | | |
| Words | .95 (.06) | .99 (.05) | .89 (.03) | .94 (.03) | .87 (.04) | .91 (.04) | .90 (.03) | .88 (.03) |
| Nonwords | .95 (.06) | .94 (.06) | .91 (.03) | .90 (.03) | .88 (.05) | .84 (.05) | .96 (.03) | .98 (.03) |

*Note*. Standard errors are presented in parentheses below the mean.