J Adult Dev (2013) 20:151–157
DOI 10.1007/s10804-013-9166-6

Age, Focal Processing, and Monitoring in Event-Based Prospective Memory

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Published online: 25 June 2013

Abstract While there is some consensus that prospective memory (PM) declines with age, the reasons for differences in performance across age groups are not fully understood. This experiment examines two factors that are likely to affect the magnitude of observed age group differences: type of PM task and whether participants monitor the task environment for the opportunity to complete the PM task. Younger and older adults were engaged in an ongoing test of short-term memory and were asked to perform one of two different event-based PM tasks. Younger adults performed better than older adults on both focal and nonfocal PM tasks. In addition, younger adults were able to perform both types of tasks equally well, but older adults were more successful on the focal task than on the nonfocal task. Age group differences in self-reported PM monitoring were also evident and were related to performance. These findings and their implications for current theoretical conceptions of PM aging are discussed.

Keywords Aging · Memory · Prospective memory · Monitoring · Focal processing

Introduction

Prospective memory (PM) is important in the lives of older adults because of its relevance to healthy, independent living. Two examples of PM that illustrate its importance are that many older adults must remember to take medication and all must remember to turn off a stove after it has been used. Since the 1980s, research attention has been directed toward understanding the relationship between age and PM (e.g., West 1988; Einstein and McDaniel 1990). That relationship has turned out to be much more complex than expected. For example, a meta-analysis by Henry et al. (2004) revealed that older adults perform better than younger adults when PM is tested under naturalistic conditions, but they perform worse than younger adults in laboratory settings.

McDaniel and Einstein (2000, 2007) put forward a multiprocess framework that clarified the conditions under which older adults are likely to perform well on PM tasks and when such tasks are likely to be more challenging. One of the distinctions in this framework is the extent to which the PM task relies on what they term *focal processing*. The task Einstein and McDaniel (1990) employed in their first study of PM relied on focal processing. Participants in this study were asked to make a key press whenever they saw a designated target word as part of a short-term memory (STM) word set during an ongoing test of STM. This was a focal task because the participant's attention was focused on the ongoing STM task and the PM target appeared as one of the to-be-remembered words. Older and younger adults in their study performed equivalently. Some PM tasks, however, rely on *nonfocal processing*. A nonfocal task is one in which the PM target is not central to completion of the ongoing task. For example, Park et al. (1997) employed a nonfocal task in which participants were asked to make a key press whenever a particular background pattern appeared behind words that were presented as part of an ongoing working memory task. They found that the performance of younger adults exceeded that of older adults on this type of task.

In a discussion of the multiprocess framework, Einstein et al. (2012) proposed that older adults perform well on

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focal PM tasks because such tasks rely on spontaneous retrieval processes for completion. In contrast, nonfocal tasks are more difficult for older adults because they require strategic monitoring for completion. Engaging in such monitoring is effortful and should draw on the more limited processing resources of older adults, resulting in lower PM performance on nonfocal tasks compared to focal tasks and compared to the performance of younger adults on nonfocal tasks. It is important to note, however, that whether focal tasks rely on automatic (i.e., spontaneous) retrieval is still a subject of theoretical debate. Smith (2003) provided evidence that even focal PM tasks may rely on strategic monitoring because successfully performing such tasks can come at a cost to the ongoing task.

A meta-analysis by Kliegel et al. (2008) revealed additional information regarding the occurrence of age differences on focal and nonfocal PM tasks. Their work showed that age group differences were greatly reduced under focal conditions compared to nonfocal conditions. However, their work also provided evidence that there is still an age group effect under focal conditions such that older adults are disadvantaged compared to younger adults. Their conclusion was that the meta-analysis supports a weaker version of the multiprocess framework where age group differences are typically still observed for focal tasks, but the differences are attenuated compared to age group differences on nonfocal tasks.

There is consensus that nonfocal tasks require more effortful professing, perhaps in the form of monitoring, than focal tasks (Einstein et al. 2012; Smith 2010). A number of studies have demonstrated that PM performance on a nonfocal task comes at a cost to the ongoing task. More specifically, performance on the ongoing task may be slower and/or less accurate when the PM task requires nonfocal processing compared to when focal processing is required (McDaniel and Einstein 2007). The cost may occur because participants are using limited resources to monitor the experimental environment for the nonfocal PM cue. In contrast, monitoring may not be necessary when the PM cue is a focal one that is processed as a matter of course while performing the ongoing task. Reese and Cherry (2002) examined self-reported monitoring during and after a focal PM task and found that during the task few people reported thinking about the PM task, but post-test reports of monitoring were positively related to PM performance. They did not, however, include a nonfocal condition, so it is not clear whether self-reported monitoring would differ depending on the focality of the PM task.

The aims of the present study were twofold. First, we wanted to compare the performance of younger and older adults on focal and nonfocal tasks in one experiment where the stimuli were the same for all participants and the only difference was the PM instructions provided to participants. To this end, we combined the methods of Einstein and McDaniel (1990) with those of Park et al. (1997) such that participants were presented with an ongoing STM task in which short lists of words were presented in front of a changing background. Participants in the focal condition were asked to make a designated key press in response to the appearance of a particular word as part of an STM word set. Participants in the nonfocal condition were asked to make a key press whenever a particular background pattern appeared behind the word sets. Based on McDaniel and Einstein's (2000) framework, the hypothesis was that younger and older adults would perform equivalently on the focal task, but younger adults would perform better than older adults on the nonfocal task. Our second aim was to examine differences in the extent to which younger and older adults monitor the PM task during tasks that rely on focal and nonfocal processing. We examined monitoring in two ways. First, we periodically interrupted participants while they were engaged in the STM/PM task and asked them to report what they were thinking (Reese and Cherry 2002). Our reasoning was that if participants are strategically monitoring, we should obtain reports of thoughts related to the PM task. We also administered a post-test monitoring questionnaire that asked participants to report how often they thought about the PM task during the different phases of the STM task. Again, based on the multiprocess framework, we expected to find evidence of more monitoring under nonfocal conditions than under focal ones, and we expected such monitoring to be positively related to PM performance.

Methods

Participants

A total of 68 individuals (50 women and 18 men) participated in the study. Thirty-four younger adults (*M* age = 20.4 years, SD = 4.3) were recruited from psychology courses at Oklahoma State University and received course credit in exchange for their participation. Thirty-four older adults (*M* age = 71.7 years, SD = 8.0) were recruited through advertisements and civic groups and received ten dollars for their participation. Participants completed a demographic questionnaire that included questions about self-perceived health (OARS; Duke University 1975). Most participants described their health as either *excellent* or *good*, but three younger and one older adult described their health as *fair*. Younger and older adults differed significantly on educational attainment, $t(66) = 6.32$, $p < .01$. Younger adults had completed an average of 1 year of college, whereas the average educational attainment for older adults was a college degree. Younger and older adults also differed significantly on Gardner and Monge's (1977) 30-item measure of verbal ability $t(66) = 6.55$, $p < .01$. The vocabulary scores of younger adults ($M = 14.38$) were less than those of older adults ($M = 21.5$).

Materials

The materials and general procedure were modeled after Reese and Cherry (2002). The stimuli used in the STM task were 60 words drawn from Snodgrass and Vanderwart's (1980) word set. Free recall items were 24 familiar words selected from Toglia and Battig's (1978) word series. Recognition memory was assessed using a modified version of the Warrington Recognition Memory Test (Warrington 1984). A four-item post-test questionnaire adapted from Cherry and LeCompte (1999) was administered as an additional measure of PM task monitoring. For this measure, participants were asked to indicate on a 7-point scale (1 = *not at all* and 7 = *all the time*) how often they thought about the PM task across the four phases of the STM trials. The four phases were the *prepare for trial* phase, which informed the participants that the STM words would soon appear on the computer screen, the *word presentation* phase when the short sets of words appeared briefly on the screen, the *recall* phase when the participant recalled the words aloud, and the *rest* phase, which lasted 10 s and occurred after each block of eight trials was completed.

Procedure

Participants were informed that the primary purpose of the study was to examine STM ability and received three practice trials on a computerized test of STM. To equate the demands of the ongoing STM task, the number of words presented in each trial ranged from four to nine words for younger adults and three to eight words for older adults (see Reese and Cherry 2002 for discussion of this approach). Words were presented at a rate of 1-s per word. After the practice trials, participants were informed of a secondary interest in their ability to remember to perform an action in the future and were randomly assigned to either a focal or a nonfocal PM condition. The focal PM task was based on one designed by Einstein and McDaniel (1990) in which participants were asked to press a designated key when the word *boat* appeared as part of a STM word set. The nonfocal task was adapted from Park et al. [1997; see also Kidder et al. (1997)]. In this condition, participants were asked to press the designated key whenever a particular background pattern appeared behind the STM word sets. When every new word set appeared on the screen, the background pattern changed to one of eight patterns for all participants, but only those in the nonfocal condition received instructions related to the pattern. Participants completed six blocks of eight STM trials, for a total of 48 trials. The PM target (either the word or pattern) appeared once in each block, resulting in six PM opportunities. After receiving the PM instructions, participants completed a free recall and a recognition memory test. Completing these two tasks at this point in the experiment built in a delay between the time the PM instructions were given and the opportunity to perform the PM task. This type of delay is thought to keep the PM task from becoming a vigilance task. Finally, participants received three more practice trials followed by the 48 STM trials with the embedded PM task.

As a measure of online monitoring, participants were interrupted once during each STM block and were asked to report aloud what they were thinking at that moment. This prompt occurred either immediately before or immediately after a statement reading *prepare for trial* alerted participants that a new word set would soon appear on the computer screen. The participant's oral response was recorded and the STM task continued.

After the STM trials, participants were asked to recall the PM target and designated key press and complete the post-test measure of monitoring. Then, the Backward Digit Span (BDS; Wechsler 1955) and the Size Judgment Span (SJS; Cherry and Park 1993) tasks were administered as measures of working memory. Next, participants completed the vocabulary and demographic questionnaires. The session ended with a vision test and debriefing.

Results

Prospective Memory

Prospective memory performance was scored as the proportion correct out of six exposures to the target word. A 2 (age) × 2 (condition) between-subjects ANOVA on the PM proportion scores yielded main effects of age, $F(1, 64) = 37.54$, $p < .01$ and condition, $F\ (1,\ 64) = 4.35$, $p < .05$. These effects were qualified by a significant age × condition interaction, $F(1, 64) = 4.35$, $p < .05$. As revealed in Fig. 1, younger adults performed identically in the two conditions ($M = 0.80$), but older adults performed better in the focal processing condition ($M = 0.49$) than in the nonfocal processing condition ($M = 0.17$).

Retrospective Memory

Free recall was scored as the proportion of items correctly recalled. Means are displayed in Table 1. A 2 (age) × 2

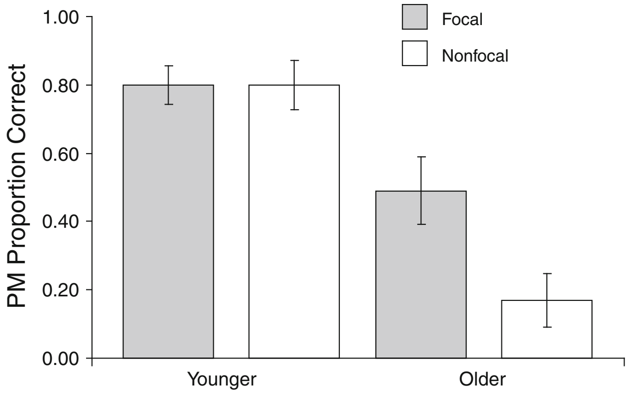

Fig. 1 Mean proportion correct on the PM task as a function of age and PM processing condition. *Error bars* reflect standard error values

Table 1 Mean scores on retrospective memory measures

Dependent measure	Young		Older	
	Focal	Nonfocal	Focal	Nonfocal
STM[a]				
M	0.72	0.63	0.73	0.74
SD	0.14	0.22	0.10	0.10
Free recall[b]				
M	0.39	0.38	0.22	0.25
SD	0.11	0.12	0.08	0.11
Recognition[c]				
M	1.14	1.30	1.19	1.11
SD	0.34	0.60	0.42	0.54
Backward digit span[d]				
M	5.27	5.09	4.09	4.62
SD	1.13	1.16	1.12	1.08
Size judgment span[d]				
M	4.68	4.56	4.03	4.21
SD	0.71	0.75	0.72	0.61

[a] Short-term memory. Mean proportion of items recalled per trial

[b] Free recall score. Proportion correct

[c] Recognition score. d' values

[d] Working memory. Mean number of items recalled in proper sequence

(condition) ANOVA on the free recall scores yielded only a main effect of age, $F(1, 64) = 33.60$, $p < .001$. Younger adults ($M = 0.39$) recalled more items than did older adults ($M = 0.23$). Recognition memory was scored by deriving d' values based on the hit and false-alarm rates of each participant. An ANOVA on the d' scores yielded no significant effects of age or condition (p's > .31). For STM data, the average proportion of items correctly recalled per trial was calculated. An ANOVA on the STM data yielded no significant effects of age or condition (p's > .13). A composite working memory score was calculated by converting participants' scores on the BDS and SJS to z scores and averaging the two. A 2 × 2 ANOVA on the WM composite scores revealed only a significant effect of age, $F(3, 64) = 13.03$, $p < .001$. Younger adults exhibited larger WM spans than did older adults.

Immediately after the STM trials, we asked participants to tell us what they had been asked to do in addition to recalling the STM words. Participants in the focal condition were asked to recall the target word, and those in the nonfocal condition were asked to identify the target pattern from an array of the eight patterns that were used. Two older participants in the focal condition were unable to recall the target word. Data from all participants were retained.

Online Monitoring

Online monitoring responses were scored as follows. First, judges who were blind to the age and condition of the participants coded the responses. Responses that indicated thoughts related directly to the prospective task were categorized as *on-task-prospective* (OTP). Responses that indicated thoughts related to memory performance but were not specific to the prospective task were categorized as *on-task-memory* (OTM). Responses indicating thoughts that were off-task or unrelated to the experiment were categorized as *task-irrelevant* (TI). Instances where participants reported having no thoughts at the time of the probe were categorized as *no thoughts* (NT). Interrater reliability was 90 % (Nunnally and Bernstein 1994), and discrepancies were resolved by a third judge. A proportion score was calculated for each participant based on the number of responses falling into each category divided by the total number of responses.

A 2 (age) × 2 (condition) × 4 (response type) mixed factorial ANOVA on the online monitoring data revealed a significant effect of response type, $F(3, 64) = 117.28$, $p < .01$. Most online monitoring reports were categorized as OTM ($M = 0.70$) followed by TI ($M = 0.14$), NT ($M = 0.10$), and OTP ($M = 0.06$). This effect was qualified by a significant interaction between age and response type, $F(3, 64) = 4.27$, $p = .02$. The interaction occurred because a larger proportion of responses from older adults ($M = 0.79$) were classified as OTM than were the responses of younger adults ($M = 0.62$), $t(66) = 2.25$, $p = .01$. The two age groups did not differ significantly on any other type of response, and no other effects were significant. To determine whether online monitoring was related to PM and STM performance, we calculated intercorrelations among these variables. OTM responses were negatively related to PM performance ($r = -25$, $p = .04$), but OTP responses were positively related to PM performance ($r = 0.26$, $p = .03$). For exploratory purposes, we examined the correlation between online monitoring and PM performance within each age/condition group. Examined this way, the only significant correlation was for the older adults in the nonfocal condition. Their OTP reports were highly correlated with PM performance ($r = 0.89$, $p < .001$). STM performance was not correlated with online monitoring.

Post-test Monitoring

Monitoring estimates obtained from the post-test questionnaire were scored by calculating mean ratings for each group across the four phases of the STM task. A 2 (age) × 2 (condition) × 4 (STM phase) mixed ANOVA on the post-test monitoring estimates revealed a main effect of age, $F(1, 64) = 7.16$, $p < .01$. Younger adults ($M = 3.45$) reported thinking about the PM task more often than did older adults ($M = 2.49$) across the different phases of the STM task. The main effect of STM phase was also significant, $F(3, 64) = 14.01$, $p < .001$. Self-reports of PM monitoring were highest for the *word presentation* phase ($M = 3.99$) followed by the *prepare for trial* phase ($M = 2.85$), the *recall* phase ($M = 2.59$), and the *rest* phase ($M = 2.44$). The effect of STM phase was qualified by a significant age by phase interaction, $F(3, 64) = 3.34$, $p = .03$. The interaction occurred because younger adults reported thinking about the prospective task more often during the *prepare for trial* phase ($M = 3.7$) and the *word presentation* phase ($M = 4.68$) than did older adults (M's = 2.00 and 3.29, respectively), but the age groups did not differ on ratings for the other two STM phases. No other effects were significant, which means that contrary to expectation, we did not find evidence of more monitoring among those in the nonfocal condition. Post-test monitoring was correlated with performance such that reports of monitoring during the *prepare for trial* phase and the *word presentation* phase were positively correlated with PM performance (r's = 0.29 and 0.58, respectively, p's < .02). The only other significant relationship was a negative one between monitoring during the prepare for trial phase and STM performance ($r = -0.28$, $p = .02$).

Discussion

The main findings of interest that emerged from the present study can be summarized as follows. First, younger adults performed better than older adults on both focal and nonfocal PM tasks. Second, younger adults were able to perform both types of tasks equally well, but older adults were more successful on the focal PM task than they were on the nonfocal PM task. Third, the online monitoring reports suggested that participants were primarily thinking about the ongoing task, but thoughts about the PM task were related to successful PM performance, especially among older adults in the nonfocal condition. Finally, post-test monitoring ratings were positively related to PM, and the results indicated that younger adults monitored the PM task more frequently than did older adults. These findings and their theoretical implications are described in the paragraphs that follow.

Younger adults outperformed older adults on two different types of event-based PM tasks. This result was expected in the nonfocal condition because it is consistent with previous research where nonfocal tasks were employed (e.g., Park et al. 1997; Maylor 1996). However, such a finding was not expected in the focal processing condition. Although there is research showing a disadvantage for older adults under focal processing conditions (Maylor et al. 2002), such a finding is not typically observed when the demands of the ongoing task are equated for younger and older adults (Cherry and LeCompte 1999; Einstein and McDaniel 1990; Einstein et al. 1995; Reese and Cherry 2002), as they were in the present study. The results presented here suggest that older adults can be at a disadvantage for remembering focal PM tasks even when the ongoing task is presumably no more demanding for them than for younger adults.

Of particular importance, younger adults performed equivalently on the two types of PM tasks, but older adults were better at the focal task than they were at the nonfocal task. These findings support the weaker version of McDaniel and Einstein's multiprocess framework (2000) that Kliegel et al. (2008) proposed, and they conceptually replicate the results of Rendell et al. (2007) who also found that age differences were attenuated under focal conditions relative to nonfocal conditions. An additional prediction of the multiprocess framework is that successful PM performance under nonfocal conditions will be associated with costs to the ongoing activity. That is, if one is monitoring the PM task, as is necessary in nonfocal tasks, limited resources are being diverted away from the ongoing task and performance on it will suffer. Ideally, this is measured by including a comparison group who completes only the ongoing task (e.g., Rendell et al. 2007) or by using an ongoing task that produces reaction time data so that costs in the form of slowing can be observed (McDaniel et al. 2008; Smith 2003). The ongoing task in the present study did not rely on reaction time data, but there is a hint that costs to the ongoing task may exist in the present study. The STM performance of the younger adults in the nonfocal condition was approximately 10 % less than that observed in younger adults in the focal condition or older adults in either condition. This finding suggests that the younger adults who performed the nonfocal task at the same level as those in the focal condition may have done so at the expense of their STM performance. Costs are not evident, nor would they be expected, among older adults because so few older adults remembered the nonfocal task.

Two types of self-reported monitoring were examined in the present study. First, an online measure of monitoring was implemented in which participants were interrupted during the STM/PM tasks and were asked to report their current thoughts. The results revealed that people were mostly thinking about the ongoing STM task. For example, one participant reported, "the words escape my mind as soon as they disappear from the screen." Older adults were even more likely than younger adults to have their reports fall into the OTM category rather than one of the others. These findings support those of Reese and Cherry (2002) where they also found that most online reports were related to the ongoing task. Importantly, online monitoring reports of thoughts about the PM task (categorized as OTP) were positively correlated with PM performance. Additionally, of the five older adults who successfully performed the PM task in the nonfocal condition, four had at least one online monitoring report related to the PM task. For example, one participant remarked that they were "waiting for that pattern to show up." This finding suggests that the older adults who were successful in the nonfocal condition were strategically monitoring, as predicted by McDaniel and Einstein (2000).

According to the post-test monitoring reports, both younger and older adults were monitoring the PM task more during the *prepare for trial* and *word presentation* phases of the ongoing task than during the other two phases (i.e., the *recall* and *rest* phases). This type of monitoring should be effective because the *prepare for trial* phase indicates that a PM target could soon appear, and the *word presentation* phase is the phase when PM targets actually do appear and responses should be made. Importantly, high levels of monitoring during these two phases were associated with better PM performance. However, younger adults reported monitoring more during these two critical phases than did older adults. These findings support those of Maylor (1998) who found that older adults may need to monitor more than younger adults to achieve the same level of performance. In the present study, older adults monitored less than younger adults, and their performance was substantially worse.

Overall, the results of this study are in keeping with current theoretical perspectives on the underlying mechanisms that may account for memory aging. In particular, Craik (1986) proposed that as human age, they become less able to employ self-initiated retrieval cues. In the experiment here, the PM task conditions varied in terms of their reliance on self-initiated retrieval cues. The nonfocal task required participants to cue themselves about the PM intention because the changing background pattern was not relevant to the ongoing task of recalling the STM word sets. In contrast, the focal task had a built-in retrieval cue in that one of the STM words was the cue for the PM intention. The finding that older participants had more difficulty with the nonfocal task than with the focal task supports Craik's proposal. In keeping with Craik's (1994) environmental support hypothesis, these findings suggest that for certain types of PM tasks, older adults should benefit from building retrieval cues into their environment so that they do not have to remind themselves to complete the task.

Two limitations of the present study warrant mention and point toward avenues for future research. First, both monitoring measures are based on self-report and therefore should be interpreted cautiously. In particular, it is not currently known whether post-test monitoring ratings reflect actual thoughts about the PM task or whether they reflect memory for having performed the PM task. Marsh et al. (2007) found age-related differences in memory for having performed a PM task. Future research employing their methodology could provide a better understanding of whether participants are able to accurately report on monitoring. Second, the focal and nonfocal tasks employed in the present study differ in more than one respect. By definition they differ in the extent to which they require a participant to direct his or her attention away from the ongoing task and toward the PM task, but they also differ in that the focal task is a verbal one (i.e., press the key when the target word appears) and the nonfocal task is a nonverbal one (i.e., press the key when a particular pattern appears). From the perspective of ecological validity, this is not necessarily a drawback because the PM cues that are available in everyday life are often contextually different from ongoing tasks (e.g., remembering to stop reading and get off the train when one's station is reached). However, controlling this difference in future research may provide a more complete picture of the relationships among age, focal processing, and self-reported monitoring.

Acknowledgments Special appreciation goes to Jeremy Allison, Terra Bower, Katie Lindenberg, Amanda Reed, Julie Rice, and Rachel Stricklin for their assistance in data collection and data scoring.

References

Cherry, K. E., & LeCompte, D. C. (1999). Age and individual differences influence prospective memory. *Psychology and Aging, 14*, 1–17.

Cherry, K. E., & Park, D. C. (1993). Individual difference and contextual variables influence spatial memory in younger and older adults. *Psychology and Aging, 8*, 517–526.

Craik, F. I. M. (1986). A functional account of age differences in memory. In F. Klix & H. Hagendorf (Eds.), *Human memory and* *cognitive capabilities: Mechanisms and performances* (pp. 409–422). NY: Elsevier Science.

Craik, F. I. M. (1994). Memory changes in normal aging. *Current Directions in Psychological Science, 3*, 155–158.

Duke University Center for the Study of Aging and Human Development. (1975). *Older Americans Resources and Services (OARS) Multidimensional Functional Assessment Questionnaire*. Durham, NC: Duke University Press.

Einstein, G. O., & McDaniel, M. A. (1990). Normal aging and prospective memory. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 16*, 717–726.

Einstein, G. O., McDaniel, M. A., Richardson, S. L., Guynn, M. J., & Cunfer, A. R. (1995). Aging and prospective memory: Examining the influences of self-initiated retrieval processes. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 21*, 996–1007.

Einstein, G. O., McDaniel, M. A., & Scullin, M. K. (2012). Prospective memory and aging: Understanding the variability. In M. Naveh-Benjamin & N. Ohta (Eds.), *Memory and aging, current issues and future directions* (pp. 153–179). New York, NY: Psychology Press.

Gardner, E., & Monge, R. (1977). Adult age differences in cognitive abilities and educational background. *Experimental Aging Research, 8*, 337–383.

Henry, J. D., MacLeod, M. S., Phillips, L. H., & Crawford, J. R. (2004). A meta-analytic review of prospective memory and aging. *Psychology and Aging, 19*, 27–39.

Kidder, D. P., Park, D. C., Hertzog, C., & Morrell, R. W. (1997). Prospective memory and aging: The effects of working memory and prospective memory task load. *Aging, Neuropsychology, & Cognition, 4*, 93–112.

Kliegel, M., Jager, T., & Phillips, L. (2008). Adult age differences in event-based prospective memory: A meta-analysis on the role of focal versus nonfocal cues. *Psychology and Aging, 23*, 203–208.

Marsh, R. L., Hicks, J. L., Cook, G. I., & Mayhorn, C. B. (2007). Comparing older and younger adults in an event-based prospective memory paradigm containing an output monitoring component. *Aging, Neuropsychology, and Cognition, 14*, 168–188.

Maylor, E. A. (1996). Age-related impairment in an event-based prospective memory task. *Psychology and Aging, 11*, 74–78.

Maylor, E. A. (1998). Changes in event-based prospective memory across adulthood. *Aging, Neuropsychology, and Cognition, 5*, 107–128.

Maylor, E. A., Darby, R. J., Logie, R. H., Della Sala, S., & Smith, G. (2002). Prospective memory across the lifespan. In P. Graf & N. Ohta (Eds.), *Lifespan development of human memory* (pp. 235–256). Cambridge, MA: MIT Press.

McDaniel, M. A., & Einstein, G. O. (2000). Strategic and automatic processes in prospective memory retrieval: A multiprocess framework. *Applied Cognitive Psychology, 14*, S127–S144.

McDaniel, M. A., & Einstein, G. O. (2007). *Prospective memory: An overview and synthesis of an emerging field*. Thousand Oaks, CA: Sage.

McDaniel, M. A., Einstein, G. O., & Rendell, P. G. (2008). The puzzle of inconsistent age-related declines in prospective memory: A multiprocess explanation. In M. Kliegel, M. A. McDaniel, & G. O. Einstein (Eds.), *Prospective memory: Cognitive, neuroscience, developmental, and applied perspectives* (pp. 141–160). Mahwah, NJ: Erlbaum.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Park, D. C., Hertzog, C., Kidder, D. P., Morrell, R. W., & Mayhorn, C. B. (1997). Effect of age on event-based and time-based prospective memory. *Psychology and Aging, 12*, 314–327.

Reese, C. M., & Cherry, K. E. (2002). The effects of age, ability, and memory monitoring on prospective memory task performance. *Aging, Neuropsychology and Cognition, 9*, 98–113.

Rendell, P. G., McDaniel, M. A., Forbes, R. D., & Einstein, G. O. (2007). Age-related effects in prospective memory are modulated by ongoing task complexity and relation to target cue. *Aging, Neuropsychology, and Cognition, 14*, 236–256.

Smith, R. E. (2003). 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, 29*, 347–361.

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

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory, 6*, 174–215.

Toglia, M. P., & Battig, W. F. (1978). *Handbook of semantic word names*. Hillsdale, NJ: Erlbaum.

Warrington, E. K. (1984). *Recognition memory test: Manual*. Windsor: NFER-Nelson.

Wechsler, D. (1955). *Wechsler Adult Intelligence Scale (WAIS)*. New York: Psychological Corporation.

West, R. L. (1988). Prospective memory and aging. In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), *Practical aspects of memory: Current research and issues* (Vol. 2, pp. 119–125). New York: John Wiley & Sons.