Journal of Experimental Psychology:
Learning, Memory, and Cognition
2013, Vol. 39, No. 3, 965–971

0278-7393/13/$12.00 DOI: 10.1037/a0029198

RESEARCH REPORT

Failing to Forget: Prospective Memory Commission Errors Can Result From Spontaneous Retrieval and Impaired Executive Control

Michael K. Scullin
Washington University in St. Louis and Emory University School of Medicine

Julie M. Bugg
Washington University in St. Louis and DePauw University

Prospective memory (PM) research typically examines the ability to remember to execute delayed intentions but often ignores the ability to forget finished intentions. We had participants perform (or not perform; control group) a PM task and then instructed them that the PM task was finished. We later (re)presented the PM cue. Approximately 25% of participants made a *commission error*, the erroneous repetition of a PM response following intention completion. Comparisons between the PM groups and control group suggested that commission errors occurred in the absence of preparatory monitoring. Response time analyses additionally suggested that some participants experienced fatigue across the ongoing task block, and those who did were more susceptible to making a commission error. These results supported the hypothesis that commission errors can arise from the spontaneous retrieval of finished intentions and possibly the failure to exert executive control to oppose the PM response.

Keywords: prospective memory, commission errors, spontaneous retrieval, fatigue, executive control

Supplemental materials: http://dx.doi.org/10.1037/a0029198.supp

Investigations of *prospective memory* (PM) have typically examined the ability to remember to perform an intended action, such as remembering to take one's medication. Similarly important, but rarely studied, is the ability to forget, deactivate, or inhibit finished PM intentions. Failing to forget a finished intention could lead to the erroneous repetition of a no-longer-relevant intention, referred to as a *commission error*, and cause embarrassment (e.g., taking the same poster handout from a conference presenter twice), confusion and disorganization (e.g., an air traffic controller attempting to reroute an already rerouted aircraft), or even a medical emergency (e.g., overdosing on medication).

Conceptualizations of PM Forgetting

Conceptualizations of failures in PM forgetting, including conceptualizations of commission errors, are only beginning to emerge, and they mostly stem from existing theories of successful prospective remembering. The monitoring view argues that after intention formation, effortful preparatory monitoring processes are needed to maintain the intention in consciousness and search the environment for PM cues (e.g., Smith, 2003). By this view, failures in PM forgetting should emerge if the monitoring process is not discontinued upon intention completion. A second view arises from the intention superiority hypothesis (Goschke & Kuhl, 1993), which argues that encoded intentions have an elevated level of activation, which may persist following intention completion. Walser, Fischer, and Goschke (2012) proposed that the extent to which no-longer-relevant PM cues trigger spurious retrievals depends on the intention's residual level of activation and whether participants are engaging preparatory monitoring for PM intentions (i.e., similar to the monitoring view).

A third view arises from the finding that, in the absence of preparatory monitoring, PM cues that are strongly linked to an intention can spontaneously trigger intention retrieval (e.g., Einstein et al., 2005). Several studies have shown that individuals will not unnecessarily engage monitoring in contexts in which a PM task need not be performed (Knight et al., 2011; Marsh, Hicks, & Cook, 2006), and by the spontaneous retrieval view, commission errors may occur in such contexts if the PM cue–action link remains strong following intention completion.

Laboratory Method for Investigating PM Forgetting

The primary approach to investigating whether finished PM intentions are deactivated is depicted in Figure 1. First, participants

This article was published Online First July 16, 2012.

Michael K. Scullin, Department of Psychology, Washington University in St. Louis, and Department of Neurology, Emory University School of Medicine; Julie M. Bugg, Department of Psychology, Washington University in St. Louis, and Department of Psychology, DePauw University.

National Institute on Aging Grant F32AG041543 and a Cottrell Fellowship supported Michael K. Scullin. We thank Joshua Kim for his excellent assistance in collecting and analyzing data. We appreciate the helpful comments of Dawn McBride on an earlier version of this article.

Correspondence concerning this article should be addressed to Michael K. Scullin, Department of Neurology, Emory University School of Medicine, 1841 Clifton Road, Atlanta, GA 30329. E-mail: michael.scullin@emory.edu

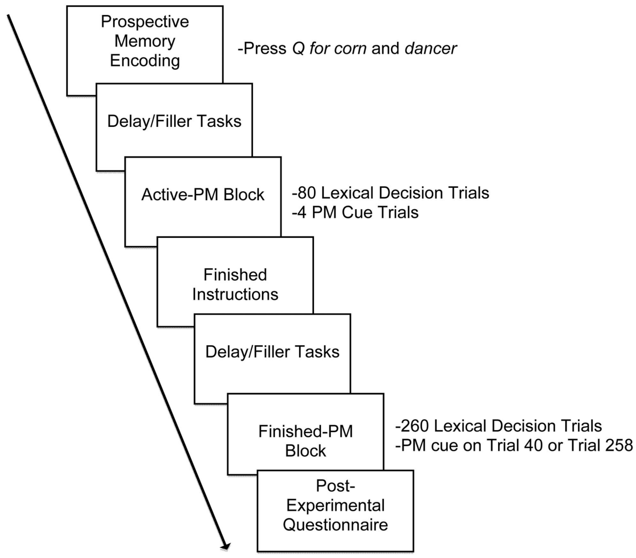

Figure 1. Schematic of the commission error procedure (see footnote 2). The procedure was identical in the no-PM control group except that those participants never encoded the PM task. PM = prospective memory.

encode a PM intention such as remembering to press the *Q* key when the word *corn* appears during a lexical decision task. Following completion of this *active-PM block*, participants are told that the PM task is finished[1]. In a later phase (the *finished-PM block*), the PM cue is (re)presented multiple times, and researchers examine responding to the finished-PM cue. If response times (RTs) are greater to the finished-PM cue than to matched control items, that suggests a failure in deactivation of the PM intention (Cohen, Dixon, & Lindsay, 2005; Scullin, Bugg, McDaniel, & Einstein, 2011). Additionally, some participants will actually repeat the PM response—that is, produce a commission error—during the finished-PM block (Scullin, Bugg, & McDaniel, 2012; Walser et al., 2012).[2]

Empirical Work on PM Forgetting

Early research evaluated whether finished intentions are deactivated, with some findings favoring intention deactivation (Marsh, Hicks, & Bink, 1998; Meilán, 2008; Scullin, Einstein, & McDaniel, 2009), other findings not supporting deactivation (Penningroth, 2011; West, McNerney, & Travers, 2007), and some findings producing mixed results (Cohen, Kantner, Dixon, & Lindsay, 2011). Of current interest are factors that promote spurious retrievals versus successful intention deactivation. One factor is the strength of the PM cue–action link. Failures in PM deactivation may be more likely if finished-PM cues are (re)presented shortly after intention completion (Walser et al., 2012; West et al., 2007), that is, before the cue–action link is significantly weakened. In addition, Scullin et al. (2012) found that 25% of younger adults produced commission errors when the PM cue was salient and was encountered during the same ongoing task context as the original active-PM block context; commission errors were eliminated in a nonsalient-cue/task-mismatch condition.

A second factor that is important to PM forgetting is executive control integrity. Scullin et al. (2012, 2011) found that individual differences in Stroop interference, Trail Making B, and Wisconsin Card Sorting Task perseveration predicted failures in PM deactivation. Older age, which covaries with executive control declines (e.g., Braver & Barch, 2002), was also associated with increased failures to deactivate finished intentions (Scullin et al., 2012, 2011; but see Cohen et al., 2005). Because Scullin et al. (2012) observed commission errors during a finished-PM block in which participants were assumed not to be monitoring and the likelihood of a commission error was associated with low executive control, they proposed that "commission errors occur when a completed intention is spontaneously retrieved and individuals fail to suppress executing the intention" (p. 52).

The Present Research

The present research had several goals. First, we aimed to replicate Scullin et al.'s (2012) finding of commission errors in younger adults using a refined approach in which the finished-PM block included only a single PM cue to reduce possible confusion effects related to repeating no-longer-relevant cues (Scullin et al., 2012, presented 10 PM cues and 10 salient control cues). Second, we investigated the effect of delay interval length on commission errors, and we did so by presenting the PM target cue either early (short-delay condition) or late (long-delay condition) during the finished-PM block. Third, we acquired qualitative data after the finished-PM block by asking participants whether they ever made a commission error (and to explain why).

A fourth goal was to rigorously test whether commission errors arise from spontaneous retrieval versus preparatory monitoring processes. No study of finished-PM intentions has utilized a between-subjects, no-PM control group to determine whether participants are monitoring for their PM intentions (inferred from slowed lexical decision responding; Smith, 2003). Specifically, we were interested in (a) replicating the finding of monitoring during an active-PM block (e.g., Harrison & Einstein, 2010), (b) determining whether such monitoring predicts later commission errors (proposed by Walser et al., 2012), and (c) determining whether PM group participants were monitoring during the finished-PM block. The theoretical relevance here is that the spontaneous retrieval view (e.g., Scullin et al., 2012), but not the monitoring view (e.g., Smith, 2003), predicts that commission errors can occur in the absence of monitoring. The residual activation view predicts that commission errors will be minimal in the absence of monitoring and that commission errors will correlate positively with degree of monitoring (Walser et al., 2012).

[1] Some studies give "canceled" instructions after PM encoding and do not allow participants to ever execute the PM intention (e.g., West et al., 2007). It is unclear whether canceled instructions represent a qualitatively different situation from finished instructions, but some have suggested that canceling the PM instructions may lead to a Zeigarnik effect (e.g., Scullin et al., 2009), which could plausibly increase commission errors if the intention is maintained at a heightened level of activation (Walser et al., 2012).

[2] The commission error paradigm (see Figure 1) differs from the repetition error paradigm (e.g., Einstein, McDaniel, Smith, & Shaw, 1998; Marsh, Hicks, Hancock, & Munsayac, 2002) in that commission errors are observed during a context that does not require constant output monitoring and/or memory updating of the status of the PM intention (i.e., the active-PM block has ended and is never reinstated).

Method

Participants and Design

Washington University undergraduate students (N = 103; M_{age} = 19.40 years; 50.49% female) who had not participated in previous commission error studies participated for partial class credit. Participants were randomly assigned to no-PM control (n = 33), short-delay (n = 34), and long-delay (n = 36) conditions.

Procedure

The procedure (see Figure 1) was similar to Scullin et al.'s (2012) salient-cue/task-match condition. Participants first received the lexical decision task instructions to respond whether a string of letters forms a word or not by pressing number pad keys marked *Y* (5) and *N* (6). They then completed a practice phase in which control words appeared twice (to control for PM target preexposure; Guynn & McDaniel, 2007).

Participants in the short- and long-delay conditions, but not the no-PM control condition, were then told that if they saw either *fish* or *writer* (*corn*/*dancer*, in a counterbalance) on a blue background (red background, in a counterbalance) during the lexical decision task, then they should press the *Q* key either immediately or as soon as they remember.[3] Encoding was confirmed (or corrected) by having participants write down their target words and response key. Participants were instructed to use only their dominant hand for all keyboard responses and to keep their nondominant hand in their lap. This setup kept participants from resting their nondominant hand on the *Q* key and ensured that PM (and commission error) responses would require an overt behavior rather than a minor finger slip. The experimenter checked for compliance during the following practice phase, which included each PM cue.

We instituted a delay interval between encoding and performance in which participants filled out a demographics questionnaire and took a vocabulary test. Then they performed an active-PM block, which was an 80-trial lexical decision block in which all stimuli appeared in white font against a black background except for four PM and four control trials. PM and control trials appeared on blue and red backgrounds, respectively (or vice versa). When the PM words were *fish/writer* the control words were *corn/dancer* (and vice versa). The control trials were included to determine false alarm rate (*Q* presses to active-PM block control trials).

Consistent with our previous finished-PM studies (Scullin et al., 2012, 2011, 2009), after completing the lexical decision task, participants in the short- and long-delay conditions read the following: *PLEASE NOTE THAT YOU NO LONGER NEED TO REMEMBER TO PRESS 'Q' IN THE PRESENCE OF TARGET WORDS. THAT TASK IS FINISHED.* Typical PM protocols include a delay between PM instructions and testing, and we adhered to this norm by next having participants perform a short lexical decision task[4] (no target words appeared) and a second vocabulary test prior to completing the finished-PM block.

The finished-PM block was a 260-trial lexical decision block. The PM cue (either *dancer* or *fish*) occurred on Trial 40 in the short-delay condition and on Trial 258 in the long-delay condition. No nontarget stimuli were forwardly associated with the target words (according to free association norms; Nelson, McEvoy, & Schreiber, 1998; cf. Scullin, McDaniel, & Einstein, 2010). Participants next completed a postexperimental questionnaire in which they recalled the target words and target key, were asked whether they believed that the PM task was finished when they received those instructions, rated how often they continued to think about the PM task (0 = *never*, 2 = *rarely*, 5 = *sometimes*, 8 = *frequently*, 10 = *always*), and answered whether they ever pressed *Q* after they were instructed not to, and if so, to describe why.

Results

Alpha was set to .05 for determining statistical significance.

Active-PM Block

We first examined PM hits and false alarms by assessing *Q* presses during the active-PM block that occurred on PM and control trials (or within the following two trials), respectively. As expected with salient cues (e.g., Scullin et al., 2012), proportion of PM hits was high and did not significantly differ between the short delay (M = .98) and long delay (M = .94) conditions, $t(68)$ = 1.65. False alarms were relatively rare and did not significantly differ between the short (M = .05) and long (M = .04) delay conditions ($t < 1$).

We tested for monitoring during the active-PM block by comparing mean RTs (restricted to nontarget, noncontrol trials on which the lexical decision was correct) between PM groups and the no-PM control group. The idea here is that monitoring for PM cues should draw attention away from lexical decisions and result in slower RTs (Smith, 2003). We observed that, relative to the no-PM control condition (M = 670 ms), mean RTs were significantly slower in the short-delay condition (M = 794 ms), $t(65)$ = 3.54, d = 0.88, and the long-delay condition (M = 735 ms), $t(67)$ = 2.52, d = 0.62. The PM conditions did not differ significantly, $t(68)$ = 1.59. These results were consistent with previous findings showing that participants may monitor for PM cues during active-PM blocks if they are not discouraged from doing so (Harrison & Einstein, 2010).

Finished-PM Block

To assess for commission errors, we examined *Q* presses during the finished-PM block that occurred on the PM cue or the following two trials. Approximately 25% of participants made a commission error, and risk for commission errors did not reliably differ

[3] Some protocols discourage participants from monitoring by emphasizing the ongoing task and deemphasizing the PM task (e.g., Einstein et al., 2005). No such effort was made in the present study because we were interested in whether initial monitoring predicted later commission errors as well as in contrasting the presence of monitoring during the active-PM block with the absence of monitoring during the finished-PM block.

[4] Lexical decision performance during this delay block was congruent with what was observed at the beginning of the finished-PM block (i.e., Trials 1–20; see Figure 2). RTs did not differ between the no-PM control (M = 595 ms), short-delay (M = 571 ms), and long-delay (M = 542 ms) conditions, $F(2, 100)$ = 1.34, MSE = 18,028.05. There were no RT differences between those who made a commission error (M = 568 ms) and those who did not (M = 552 ms; $F < 1$).

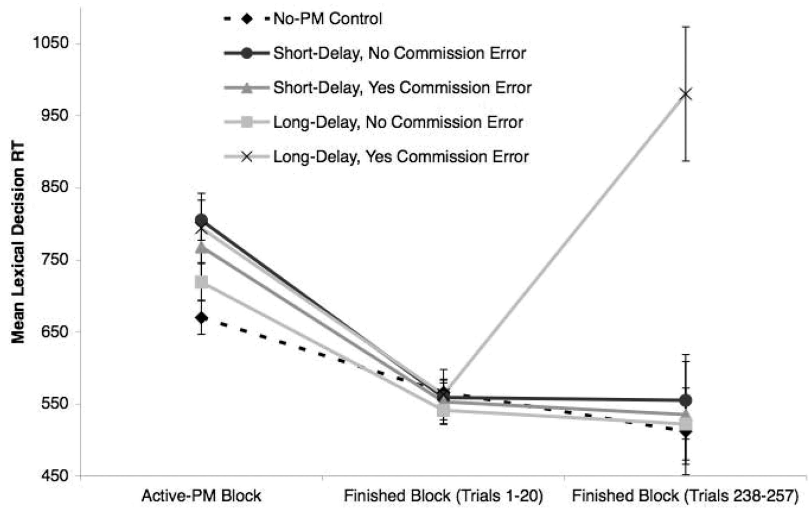

Figure 2. Mean lexical decision response times (RTs) during the active-PM and finished-PM (Trials 1–20 and 238–257) blocks across no-PM control, short-delay, and long-delay conditions and split between participants who made a commission error and those who did not. PM = prospective memory. A version of Figure 2 in color can be found in the supplemental materials for this article.

across the short (M = .29) and long (M = .22) delay conditions ($\chi^2 < 1$).

To examine RTs[5] during the finished-PM block, we utilized a more refined approach rather than averaging across all trials. Specifically, we examined RTs to the 20 trials preceding PM cues, an approach that, compared with averaging RTs for all trials, has been demonstrated to more precisely inform the underlying cognitive processes (Scullin et al., 2010). First, we examined the 20 trials immediately prior to the early PM target cue (Trials 20–39), and we found no significant difference between the no-PM control condition (M = 574 ms) and the short-delay condition (M = 593 ms; $t < 1$). Critically, there was no difference in mean RTs on these early trials between those who made a commission error (M = 577 ms) and those who did not (M = 600 ms; $t < 1$). These results demonstrate for the first time that commission errors can occur in the absence of preparatory monitoring, and are likely driven by spontaneous retrieval processes.

We next examined RTs on the 20 trials that preceded the late target trial (Trials 238–257). As illustrated in Figure 2, mean RTs did not differ between the no-PM control condition and long-delay, no-commission-error participants ($t < 1$) but were significantly slower in long-delay participants who made a commission error, $t(39) = 3.00$, $d = 0.96$. This effect was somewhat surprising, given that there was no relationship between RTs and commission errors in the short-delay condition. One possible explanation was that long-delay participants who made a commission error did not believe the finished instructions and continued to monitor during the finished-PM block. This interpretation seems improbable because (a) there is no reason to expect the short- and long-delay conditions should differ in believing the finished instructions, (b) previous experiments reported that monitoring decreases with time (e.g., Loft, Kearney, & Remington, 2008), and (c) no nontarget stimulus was forwardly associated with the PM cue (i.e., there were no external cues that would have created confusion across the block). An alternative interpretation is that the slowed responding reflects fatigue that aggregated across the 260 trials in the finished-PM block. Fatigue may be a viable explanation because fatigue impairs executive control (van der Linden, Frese, & Meijman, 2003), and executive control impairments have previously been linked to commission errors (Scullin et al., 2012).

To help adjudicate between the monitoring and fatigue interpretations of commission errors in the long-delay condition, we examined mean RTs on the first 20 trials (Trials 1–20) of the finished-PM block (see Figure 2). The rationale here is that if participants who made a commission error in the long-delay condition did not believe the finished instructions and were indeed monitoring during the finished-PM block, then they should show the greatest amount of monitoring (i.e., the slowest RTs) during early trials (e.g., Loft et al., 2008). By contrast, according to the explanation that fatigue is aggregating in some participants across the finished-PM block, there should be no RT difference at the onset of the finished-PM block between long-delay condition participants who made a commission error and the no-PM control group. There were no significant differences on Trials 1–20 of the finished-PM block ($t < 1$), which was consistent with the fatigue account.

A remaining question concerned whether RT slowing across the finished-PM block was unique to long-delay condition participants who made a commission error. Figure 2 demonstrates group-level speed-ups (not slowing) in both short-delay condition participants and in long-delay, no-commission-error participants. The reader should note that three individuals in the short-delay condition who did not make a commission error also demonstrated RT slowing of at least 100 ms in the finished-PM block; presumably, had these individuals encountered the PM cue late in the finished-PM block

[5] There were no group or commission error-related differences for lexical decision accuracy during the finished-PM block (all Fs < 1).

they would have been at increased risk to make a commission error.

Active- and Finished-PM Block Associations

Do active-PM block measures predict finished-PM block commission errors? Walser et al. (2012) proposed that monitoring for an intention during an active-PM block may decrease one's ability to subsequently deactivate that intention. However, we observed no differences in RTs during the active-PM block between individuals who did versus did not subsequently make a commission error ($t < 1$; see Figure 2).

We also investigated whether misunderstanding of when to press the *Q* key predicted commission errors. To answer this question, we evaluated whether false alarms during the active-PM block predicted finished-PM block commission errors. There was not a significant relationship between false alarms and commission errors ($M_{Yes\text{-}Commission} = .07$, $M_{No\text{-}Commission} = .04$), $t(68) = 1.16$. Commission errors therefore do not reflect a global misunderstanding of when to press *Q*.

Postexperimental Reports

On the postexperimental questionnaire, participants responded whether they believed the PM task was finished, rated how often they continued to think about the PM intention, and answered whether they made a commission error (and why). Consistent with our previous findings (Scullin et al., 2012, 2011), most participants (94.3%) responded unambiguously that they believed that the PM task was finished when they received such instructions. All results reported herein replicate after eliminating individuals who expressed even minimal doubt about the instructions.

Most participants reported that they rarely thought about the PM intention following its completion (mode rating = 2, mean rating = 3.07). Ratings did not vary as a function of delay condition, $t(68) = 1.62$, or commission error, $t(68) = 1.12$. Mean rating was nominally the lowest in the long-delay condition participants who made a commission error ($M = 1.75$).

Two participants who made a commission error reported on the postexperimental questionnaire that they did not, and two participants who did not make a commission error mistakenly circled that they did. These misreports may reflect embarrassment, cognitive dissonance, and/or reality-monitoring challenges.

The participant reports for why they made a commission error are presented in full in the online Supplemental Materials. Some reports suggested that the PM response was repeated automatically (e.g., "I felt like I automatically hit the *Q*, while part of mind said no, don't."), whereas other reports indicated potential confusion (e.g., "better safe than sorry," "I was confused as to whether or not in this stage I was supposed to click it"). We recommend treating postexperimental reports with caution because we cannot tease apart the participants' intuition at the moment of the commission error from the attributions they applied after learning that a commission error should not have been made.

Discussion

The most important findings of the present research stemmed from our utilization of a no-PM control group, which allowed us to detect the presence of preparatory monitoring (via group differences in lexical decision responding; Smith, 2003). The results were unambiguous: Participants monitored during the active-PM block but not during the finished-PM block.[6] Therefore, in paradigms that do not require constant memory-updating and/or output-monitoring processes (cf. Walser et al., 2012; West et al., 2007), individuals can and will disengage PM-monitoring processes. The implications for views of PM forgetting are elaborated below.

Spontaneously Triggered Commission Errors

The absence of preparatory monitoring during the finished-PM block allowed us to answer whether encountering a no-longer-relevant PM cue could still spontaneously trigger intention retrieval and result in some individuals erroneously repeating the PM response. Consistent with Scullin et al.'s (2012) findings, approximately 25% of the participants did make such a commission error, and in the short-delay condition, lexical decision responding was similar between individuals who did versus did not make a commission error (and the no-PM control condition). These results were inconsistent with the monitoring view (derived from Smith, 2003), which argues that retrieval should not occur in the absence of preparatory monitoring, and the residual-activation view (Walser et al., 2012), which argues for minimal failures in PM forgetting in the absence of monitoring. Instead, the results were most consistent with the spontaneous-retrieval view (Scullin et al., 2012), which argues that in the absence of preparatory monitoring, a strong cue–action link will spontaneously deliver an intention to consciousness.

Interpretations of the Delay Effect

The manipulation of delay between intention completion and the Finished-PM block target cue also yielded informative results. The finding of a similar probability of commission errors between the short- and long-delay conditions initially suggested no delay effects, but the analyses of the relationship between RTs in the finished-PM block and commission errors indicated that this conclusion was premature. Specifically, there was no evidence that RTs were associated with commission errors in the short-delay condition (consistent with the view that commission errors can arise from spontaneous-retrieval processes; Scullin et al., 2012), but RTs were positively associated with commission errors in the long-delay condition. The increase in RTs in participants who made commission errors in the long-delay condition might be due to monitoring, confusion over instructions, or fatigue. We suggest that the results are unlikely to reflect monitoring because these participants did not show RT slowing early in the finished-PM block, and empirical research has shown that monitoring is greatest early in a block (Loft et al., 2008). Moreover, relative to control group participants, the long-delay participants who made a com-

[6] The results cannot be explained as insufficient statistical power, because group differences in lexical decision responding were easily detected during the active-PM block, and lexical decision responding during the finished-PM block often did not even fall in the direction anticipated by monitoring (i.e., responding was nonsignificantly faster in the PM groups than in the no-PM control group).

mission error demonstrated a much larger degree of RT slowing late in the finished-PM block (468 ms) than the level of RT slowing that was caused by monitoring during the active-PM block (124 ms; see Figure 2). The results are also unlikely to reflect confusion over instructions because (a) almost all participants reported that they believed that the PM task was finished, (b) commission errors were not related to frequency of PM thoughts following intention completion, (c) false alarms during the active-PM block did not predict commission errors, and (d) there was no clear environmental factor—such as nontarget stimuli being forwardly associated to target cues—during the finished-PM block that would have caused increasing confusion across the finished-PM block. We believe that fatigue is the most viable explanation, because fatigue has been linked to executive control impairments (van der Linden et al., 2003), and impaired executive control is associated with heightened commission errors (Scullin et al., 2012). The limitation of the fatigue account in explaining the delay effect relates to the lack of an independent measure of fatigue in the present study.

If fatigue increased commission error risk in the long-delay condition, then one might query why this pattern was not evident in the short-delay condition. The most parsimonious explanation is that participants were not fatigued at the onset of the finished-PM block. In the absence of fatigue, the spontaneous-retrieval view is that strong cue–action links can result in commission errors (as observed). Shortly after an intention is finished, the cue–action link remains relatively strong (e.g., Cohen et al., 2005; Walser et al., 2012), but it does weaken with increasing time (Scullin & McDaniel, 2010), which could result in fewer commission errors. The current findings, however, show that with a weaker cue–action link, a commission error may still occur if executive control is impaired, for example, by fatigue (as in the long-delay condition).

Alternative Explanations

Alternative explanations for why commission errors occur, such as cue salience, deserve consideration. Scullin et al. (2012) found that a salient PM cue, when presented in the same ongoing task context during the finished-PM block as during the active-PM block, results in many commission errors; however, if the salient PM cue is (re)presented in a novel ongoing task context, then fewer commission errors are made. We argue that any factor that increases the probability of spontaneously retrieving a finished intention (e.g., salience) may also increase the probability of a commission error, but the available experimental evidence (Scullin et al., 2012) suggests that cue salience alone does not explain all commission errors.

Are Finished-PM Intentions Deactivated?

Though early research suggested that finished intentions are immediately and completely deactivated (Marsh et al., 1998; Meilán, 2008; Scullin et al., 2009), the present research found that some, but not all, participants made a commission error to a no-longer-relevant PM cue. Therefore, the majority of available evidence (see also Cohen et al., 2005, 2011; Penningroth, 2011; Scullin et al., 2012; Walser et al., 2012; West et al., 2007) suggests that younger adults only partially, but not completely, deactivate intentions (at least within the time intervals that have been investigated). Previous research (Scullin et al., 2012, 2011) has suggested that the factors that discriminate individuals who make commission errors from those who do not include individual differences in executive control as well as environmental factors (e.g., contextual overlap between active- and finished-PM blocks). Stronger initial PM encoding may also increase commission error risk (Bugg, Scullin, & McDaniel, 2012).

Conclusions

The present research extends the understanding of finished intentions by demonstrating that participants can disengage monitoring after intention completion yet sometimes still spontaneously retrieve their finished intention. Whether a commission error was subsequently observed was related to whether a participant was fatigued, which presumably indicates a lack of sufficient executive control. The present study and the existing literature collectively support the hypothesis that commission errors can result from spurious spontaneous retrievals and failed executive control.

References

Braver, T. S., & Barch, D. M. (2002). A theory of cognitive control, aging cognition, and neuromodulation. *Neuroscience and Biobehavioral Reviews, 26,* 809–817. doi:10.1016/S0149-7634(02)00067-2

Bugg, J. M., Scullin, M. K., & McDaniel, M. A. (2012). *The effects of encoding on prospective memory commission errors: A test of the persistent retrieval hypothesis.* Manuscript in preparation.

Cohen, A.-L., Dixon, R. A., & Lindsay, D. S. (2005). The intention interference effect and aging: Similar magnitude of effects for young and old adults. *Applied Cognitive Psychology, 19,* 1177–1197. doi:10.1002/acp.1154

Cohen, A.-L., Kantner, J., Dixon, R. A., & Lindsay, D. S. (2011). The intention interference effect: The difficulty of ignoring what you intend to do. *Experimental Psychology, 58,* 425–433. doi:10.1027/1618-3169/a000110

Einstein, G. O., McDaniel, M. A., Smith, R. E., & Shaw, P. (1998). Habitual prospective memory and aging: Remembering intentions and forgetting actions. *Psychological Science, 9,* 284–288. doi:10.1111/1467-9280.00056

Einstein, G. O., McDaniel, M. A., Thomas, R., Mayfield, S., Shank, H., Morrisette, N., & Breneiser, J. (2005). Multiple processes in prospective memory retrieval: Factors determining monitoring versus spontaneous retrieval. *Journal of Experimental Psychology: General, 134,* 327–342. doi:10.1037/0096-3445.134.3.327

Goschke, T., & Kuhl, J. (1993). The representation of intentions: Persisting activation in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 1211–1226. doi:10.1037/0278-7393.19.5.1211

Guynn, M. J., & McDaniel, M. A. (2007). Target preexposure eliminates the effect of distraction on event-based prospective memory. *Psychonomic Bulletin & Review, 14,* 484–488. doi:10.3758/BF03194094

Harrison, T. L., & Einstein, G. O. (2010). Prospective memory: Are preparatory attentional processes necessary for a single focal cue? *Memory & Cognition, 38,* 860–867. doi:10.3758/MC.38.7.860

Knight, J. B., Meeks, J. T., Marsh, R. L., Cook, G. I., Brewer, G. A., & Hicks, J. L. (2011). An observation on the spontaneous noticing of prospective memory event-based cues. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37,* 298–307. doi:10.1037/a0021969

Loft, S., Kearney, R., & Remington, R. (2008). Is task interference in event-based prospective memory dependent on cue presentation? *Memory & Cognition, 36,* 139–148. doi:10.3758/MC.36.1.139

Marsh, R. L., Hicks, J. L., & Bink, M. L. (1998). Activation of completed, uncompleted, and partially completed intentions. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24,* 350–361. doi:10.1037/0278-7393.24.2.350

Marsh, R. L., Hicks, J. L., & Cook, G. I. (2006). Task interference from prospective memories covaries with contextual associations of fulfilling them. *Memory & Cognition, 34,* 1037–1045. doi:10.3758/BF03193250

Marsh, R. L., Hicks, J. L., Hancock, T. W., & Munsayac, K. (2002). Investigating the output monitoring component of event-based prospective memory performance. *Memory & Cognition, 30,* 302–311. doi:10.3758/BF03195291

Meilán, J. J. G. (2008). Activation and deactivation processes in the postponed intention paradigm. *Psychologia, 51,* 89–97. doi:10.2117/psysoc.2008.89

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (1998). *The University of South Florida word association, rhyme, and word fragment norms.* Retrieved from http://w3.usf.edu/FreeAssociation/

Penningroth, S. L. (2011). When does the intention-superiority effect occur? Activation patterns before and after task completion, and moderating variables. *Journal of Cognitive Psychology, 23,* 140–156. doi:10.1080/20445911.2011.474195

Scullin, M. K., Bugg, J. M., & McDaniel, M. A. (2012). Whoops, I did it again: Commission errors in prospective memory. *Psychology and Aging, 27,* 46–53. doi:10.1037/a0026112

Scullin, M. K., Bugg, J. M., McDaniel, M. A., & Einstein, G. O. (2011). Prospective memory and aging: Preserved spontaneous retrieval, but impaired deactivation, in older adults. *Memory & Cognition, 39,* 1232–1240. doi:10.3758/s13421-011-0106-z

Scullin, M. K., Einstein, G. O., & McDaniel, M. A. (2009). Evidence for spontaneous retrieval of suspended but not finished prospective memories. *Memory & Cognition, 37,* 425–433. doi:10.3758/MC.37.4.425

Scullin, M. K., & McDaniel, M. A. (2010). Remembering to execute a goal: Sleep on it! *Psychological Science, 21,* 1028–1035. doi:10.1177/0956797610373373

Scullin, M. K., McDaniel, M. A., & Einstein, G. O. (2010). Control of cost in prospective memory: Evidence for spontaneous retrieval processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 36,* 190–203. doi:10.1037/a0017732

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. doi:10.1037/0278-7393.29.3.347

van der Linden, D., Frese, M., & Meijman, T. F. (2003). Mental fatigue and the control of cognitive processes: Effects on perseveration and planning. *Acta Psychologica, 113,* 45–65. doi:10.1016/S0001-6918(02)00150-6

Walser, M., Fischer, R., & Goschke, T. (2012). The failure of deactivating intentions: Aftereffects of completed intentions in the repeated prospective memory cue paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition.* Advance online publication. doi:10.1037/a0027000

West, R., McNerney, M. W., & Travers, S. (2007). Gone but not forgotten: The effects of cancelled intentions on the neural correlates of prospective memory. *International Journal of Psychophysiology, 64,* 215–225. doi:10.1016/j.ijpsycho.2006.09.004

Received February 22, 2012
Revision received May 11, 2012
Accepted May 21, 2012 ■