Prospective Memory Training

Sharda Umanath, Joan Toglia, Francis Anderson, Erin Foster, and Mark A. McDaniel

Contents

Abstract Prospective memory (PM) involves remembering to perform intended actions in the future. PM failures are especially problematic for older adults, both in terms of frequency of occurrence and severity of consequences. As such, we tackle the challenge of developing a cognitive training program for PM specifically geared towards older adults. Departing from other popular cognitive training, our focus has been and continues to be on teaching effective and efficient strategies with the intention of promoting transfer to real-world PM challenges. We discuss several considerations in cognitive training including matching the type of PM task (focal or nonfocal) with effective strategies, variability and characteristics of training materials, and differences in methods used to train strategies. For example, training can involve explicit direct instruction or guided instruction aimed at helping a person self-generate and self-evaluate strategy effectiveness. Existing data and ongoing work aimed at identifying the key intervention components that enhance successful outcomes are presented. We report a new study with healthy older adults that includes these components and develops a metacognitive-strategy intervention for

---

S. Umanath
Claremont McKenna College, Claremont, CA, USA

J. Toglia
Mercy College, Palakkad, India

F. Anderson · E. Foster · M. A. McDaniel (✉)
Washington University in St. Louis, St. Louis, MO, USA
e-mail: markmcdaniel@wustl.edu

T. Strobach, J. Karbach (eds.), *Cognitive Training*,
https://doi.org/10.1007/978-3-030-39292-5_13

prospective memory that guides participants in analysis of task demands and self-generation of strategies. We also describe some initial prospective-memory training work with Parkinson's disease patients.

Prospective Memory

Prospective memory (PM) refers to tasks in which one must remember to carry out an intended action at some point in the future. Good PM is vital in everyday life (McDaniel and Einstein 2007), whether remembering an appointment, paying a bill, or taking a prescription. While PM is important for everyone, the consequences of failure can be much greater for older adults. A missed doctor's appointment or a forgotten pill can have dire repercussions. In addition, older adults complain most about PM failures compared to other memory issues (McDaniel and Einstein), and PM ability declines with age, at least for some types of PM (for a review, see Henry et al. 2004). Given the potential beneficial impact, PM is an ideal target for training, especially in older adults. Yet, very few cognitive training programs in general, or specifically for older adults, have attempted to train PM (see Waldum et al. 2014, for review). Here, we first discuss the theoretical approach—including *what* to train and *how* to train it—that has guided our attempts to train PM. We then provide evidence from existing data and current preliminary work supporting and informing this approach.

Theoretical Approach

The fundamental goal in developing a training protocol for PM and a standard goal in cognitive training is to promote transfer or generalization beyond the context of learning. That is, training that learners undergo should be helpful beyond the laboratory and applicable in the real world (see also Guye et al., chapter "Cognitive Training Across the Adult Lifespan", Karbach and Kray, chapter "Executive Function Training", Könen et al., chapter "Working Memory Training", Rueda et al., chapter "Cognitive Training in Childhood and Adolescence", Strobach and Schubert, chapter "Video-Game Training and Effects on Executive Functions", Swaminathan and Schellenberg, chapter "Music Training", this volume). However, transfer following cognitive training has been elusive (see Hertzog et al. 2009; McDaniel and Bugg 2012). With this challenge in mind, our broad approach is to look at existing literature and focus on identifying effective PM strategies that learners can be explicitly taught to apply and generalize more broadly. This is a somewhat innovative approach as other cognitive training protocols have embraced different underlying assumptions. For example, some cognitive training has taken a *restor-*

ative approach, attempting to enhance the underlying neural physiology to improve cognition (see Lustig et al. 2009, for review; Taatgen, chapter "Theoretical Models of Training and Transfer Effects", Wenger et al., chapter "Episodic memory training" this volume). Other cognitive training programs include only practice of relevant tasks rather than explicit instruction on how to approach them (e.g., for attentional control: Karbach and Kray 2009; Kramer et al. 1995; Mackay-Brandt 2011; for retrospective-memory control: Jennings and Jacoby 2003; for working memory: Harrison et al. 2013; Redick et al. 2013; see Könen et al., chapter "Working memory training", this volume). Even one of the very few training programs aimed at improving PM used only practice and was only somewhat successful in producing transfer (Rose et al. 2015). In contrast, rather than attempting to modify the nervous system or rely on learners gaining spontaneous insights into how to best handle PM tasks through repetitive practice, our approach is to teach effective, efficient strategies with which learners can tackle PM tasks.

We adopted such an approach for several interrelated reasons. First, the PM literature has revealed that dissociated processes underlie different PM tasks (described below), as opposed to perhaps more unitary skills (tasks) that seem to submit to restorative or practice-alone regimens (e.g., attentional control and working memory). Second, PM strategies have been identified that we assume are directly useful in everyday PM tasks (unlike some trained retrospective memory strategies; cf. McDaniel and Bugg 2012). Of note is that PM in the laboratory is quite different than PM in the real world. PM tasks that are encountered in everyday life are widely variable and occur in a myriad of contexts; for example, they include remembering to put a rent check in the mail every month, remembering to pick up a friend at the airport, and remembering to give a housemate a message. By contrast, laboratory PM tasks involve remembering to press a particular key when a given target appears (e.g., the word *president* or the syllable *tor*) during an ongoing task (e.g., answering trivia questions; Einstein et al. 1995). Thus, a challenge for a PM training program is creating strong connections between the laboratory training context and the situations learners are faced with in their daily lives (see also Guye et al., chapter "Cognitive Training Across the Adult Lifespan", this volume). Because practice alone can produce brittle skills that are tightly tied to training (e.g., Healy et al. 2005), we felt that appropriately selected strategies and training could better allow learners to link the laboratory context to everyday PM situations. In fact, Bottiroli et al. (2013) found benefits of a strategy approach for promoting transfer—on retrospective memory tasks—specifically with older adults (see also Wenger et al., chapter "Episodic Memory Training", this volume; PRIMs Theory in Taatgen, chapter "Theoretical Models of Training and Transfer Effects", this volume). Third, available evidence suggested that these strategies might help override age-related cognitive limitations that attenuate PM performance for older adults (e.g., Liu and Park 2004). In sum, for PM our aim has been to create and test a cognitive training intervention that is applicable for improving PM in the real world and teaches learners effective practical strategies informed by the basic PM literature.

Despite little work on *training* PM, the broader PM literature indicates a number of strategies that learners could use to improve their PM. As just noted, there are different types of PM that rely on different processes (McDaniel and Einstein 2007), and accordingly are associated with different effective strategies. Focal PM tasks involve cues that are presented in the focus of attention and thus are easy to recognize as a cue for performing the related task. For example, seeing a coworker in the hallway can act as a focal cue to give that person a message. In other words, simply seeing that coworker might automatically bring to mind the PM task of relaying the message. Because PM intentions like this are associated with focal cues that can stimulate spontaneous retrieval of the intention, they can be performed without actively looking for the cue. Previous research indicates that creating a strong association between the anticipated cue and the PM intention (an implementation intention strategy taking the general form, "When X occurs, I will remember to perform Y") can improve performance on focal tasks (e.g., McDaniel and Scullin 2010). This strategy has been explored more broadly and shows effectiveness beyond healthy aging: In a subsequent section, we report recent research with Parkinson's disease (PD) patients that train an implementation-intention strategy.

In contrast, nonfocal tasks involve cues that occur outside the focus of attention and are therefore more difficult to notice. For instance, one may need to stop at the grocery store after work, but the store itself is not easy to notice in the midst of a routine drive home where one must pay attention to traffic, etc. Here, actively monitoring for the cue is needed in order to successfully notice (Einstein et al. 2005), otherwise one might drive right by the store. The implementation intention strategy that is effective for focal tasks would not be as helpful in nonfocal PM tasks since the key is to notice the cue in the first place (Breneiser 2007). Thus, the best strategy for nonfocal tasks may be to simply check for the cue frequently and actively attend to that intention (an event monitoring strategy; see also Wenger et al., chapter "Episodic Memory Traininzg", this volume).

Similarly, time-based PM tasks, wherein an intended action must occur at a particular time, require this type of active monitoring. Furthermore, the only cue is the time itself, whereas in focal and nonfocal tasks, events are the cues. This type of task is especially challenging for older adults (Einstein et al. 1995). Prior work indicates that learners who check the clock more often as the target time nears perform intended actions more frequently (Einstein et al.). Consistent with this finding, older adults are less likely than younger adults to ramp up their monitoring as the target time approaches (Einstein et al.; Park et al. 1997). Teaching older adults to use this strategic clock-checking may be the most effective strategy for improving their performance on time-based tasks.

Beyond the specific strategies to teach older adults, an important question is how to implement the training. In what form should these strategies be taught such that older adults learn them well and learn to apply them outside the context of learning? Several key factors may be critical for designing the most beneficial training program.

Key Factors for Training: The EXACT Study

As part of a larger cognitive training and aerobic exercise program (EXACT; McDaniel et al. 2014), McDaniel and colleagues developed a protocol specifically aimed at improving PM through strategy use (Waldum et al. 2014 describe this protocol in detail; see also Pothier and Bherer, chapter "Physical Activity and Exercise", this volume). Five main components were implemented in an 8-week intensive intervention. First, learners were given explicit instructions about effective strategies to use in PM tasks, specifically tailored for each type of task. Second, both to increase the generalizability of training and capitalize on previous memory research, the training context varied greatly. In terms of generalizability, as mentioned above, PM tasks are widely variable, both in task type (focal, non-focal, and time-based) and in context. Accordingly, learners were trained using several ongoing tasks that tapped different types of PM. Encountering various scenarios during training might make learners' approach more flexible and resilient in the face of new PM challenges. Additionally, learners may start to be able to identify the different types of PM tasks and then transfer the appropriate strategies accordingly. This line of reasoning is also consistent with memory research on encoding variability wherein multiple contexts at the learning stage can improve later memory for the to-be-remembered material (Hintzman and Stern 1978).

Third, combined with the wide variety of laboratory tasks, homework was added to the program. That is, learners were given assignments to complete outside the laboratory regarding PM situations they faced in daily life. Explicit practice applying the training they received in the lab to their regular lives is likely to be beneficial for later transfer (e.g., Schmidt et al. 2001). Fourth, as the training program went on, the difficulty of the tasks increased. Learners were asked to keep in mind more PM objectives, and the nature of the tasks also became more challenging. Simultaneously, the trainer's involvement decreased from initially providing explicit strategy instruction prior to each training task to later expecting the learners to use the relevant strategies without prompting. This idea of increasing the difficulty across the training program is consistent with the broader literature on cognitive training. In the restorative approach, the demands of the task are incrementally increased to push the ultimate level of acquisition of the trained skill (e.g., retrospective memory training: Jennings and Jacoby 2003; attentional training: Mackay-Brandt 2011). Additionally, in the occupational therapy domain, strategies are trained such that learners are required to initiate and apply the strategies across activities that systematically differ in physical similarity and context but remain at the same level of complexity. In this sideways approach, task difficulty is only increased after strategy transfer has been observed (Toglia 2011). Again, intervention is designed to encourage transfer and generalize the training to learners' everyday lives.

Fifth, a key component of the EXACT project was to evaluate the training effects with computer simulations of cognitively challenging real-world tasks (e.g., cooking breakfast, Craik and Bialystok 2006; remembering health-related information and the sources of that information). To evaluate the PM training effects, older adults completed (pre- and posttraining) a simulation of going through the course of a day for three successive days (the Virtual Week task; Rose et al. 2010). During the course of each day, the older adults have to remember a number of prospective tasks, such as "remember to drop off dry cleaning when you go shopping" and "remember to take asthma medication at 11 a.m. and 9 p.m." (in the game, a person's token passes squares that indicate the virtual time for the day).

The results of the EXACT study were especially encouraging with regard to training PM (see McDaniel et al. 2014). Eight weeks of cognitive training on laboratory PM tasks with the components discussed above produced significant gains (from pre to posttests) in remembering to perform the real-world Virtual Week PM tasks relative to a control that did not receive PM training or an aerobic exercise control (a real clock, time-based task did not show training effects). By contrast, cognitive training did not produce significant gains for cooking breakfast or memory for health information tasks. However, the EXACT study was not designed to isolate the impact of particular training components to the success of the training protocol for improving PM; accordingly, many basic issues remain unanswered (see Waldum et al. 2014, for detailed discussion).

Briefly, the cognitive training included attentional control training tasks and retrospective training tasks in addition to PM training; thus, though plausible, it remains uncertain that the PM training alone would be sufficient to produce transfer to the ecologically valid VW tasks. Also, the PM training protocol included a number of components—including using a different laboratory task each week (variable training) and explicit strategy instruction—either or both theoretically could have been instrumental in promoting transfer. Initial support for the value of these components comes from noting that in the EXACT protocol, the attentional control training, and the retrospective memory training, following the precedent from the literature, generally did not include explicit strategy instruction and repeatedly used the same training task over the course of 8 weeks. As just mentioned, there was no significant transfer of training to the real-world attentional control task (cooking breakfast) or to the real-world retrospective memory task (memory for health information). Clearly, experiments that directly compare variable training (varying the parameters of the practice task, rather than keeping it constant; e.g., Kerr and Booth 1978; Goode et al. 2008) to single-task training and directly compare explicit strategy instruction with a typical practice-only procedure (e.g., Kramer et al. 1995; Jennings and Jacoby 2003) would provide valuable insights as to the importance of these factors in promoting the generalizability of cognitive training.

Finally, a feature of the EXACT project that poses practical limitations is that the cognitive training was a huge undertaking, requiring a great deal of commitment and investment from the trainers and the learners. A major practical issue is whether a more efficient training program focusing on PM per se and restricting training to one session (rather than multiple sessions as in EXACT) could support transfer of strategies to real-world PM tasks. Initial studies have reported significant improvements with older adults in everyday-like PM tasks using a brief implementation-intention instruction for the target PM task (Liu and Park 2004, with healthy adults; Shelton et al. 2016, with older adults with mild Alzheimer's disease; see also, Lee et al. 2016, for effective implementation-intention use with AD patients). Accordingly, it seemed possible that a single PM strategy training session could support transfer, and if so, then an efficient and nondemanding training protocol could be provided to older adults to improve their everyday PM success. We tested this possibility in a new experiment, reported next.

An Initial Experiment with Healthy Older Adults

The focus in our new experiment was to evaluate the success of PM training for a single 60–90 minute training session that compared the success of explicit prospective-memory strategy training relative to a practice-only condition and a test-retest control condition. We also included a new prospective-memory strategy training condition that we developed: *Guided metacognitive* training, described in the next section.

Metacognitive Strategy Training

It may be that neither explicit strategy instruction nor practice alone is most optimal. Instead, guided use of effective strategies that integrates metacognitive components may extend benefits of strategy training by helping a person recognize when and why a particular strategy is applicable and thus increase the probability of generalization (see Schäffner et al., chapter "Meta-cognitive Training", this volume). Metacognitive strategy training focuses on the general process of how to go about a task, including analyzing task demands, strategy generation and selection, and self-monitoring and self-evaluation of performance (Toglia 2018). A learner-centered approach that actively engages the participant in a collaborative process of planning or choosing strategies and evaluating effectiveness can be integrated with metacognitive strategy training by using systematic questions and guided prompts to facilitate self-generation of strategies (McEwen et al. 2018; Toglia 2018). Learner-centered approaches, such as guided discovery, are rooted in constructivism theories of learning that suggest that learning is enhanced when the learner is actively engaged in the process of discovering solutions themselves (e.g., McDaniel and Schlager 1990).

Preliminary evidence supporting the use of guided metacognitive strategy techniques in enhancing transfer of learning or generalization has been reported for older adults (Bottiroli et al. 2013; Dawson et al. 2013) as well as for cognitive rehabilitation of executive functions in individuals with stroke or brain injury (Skidmore et al. 2014; Toglia et al. 2010). For example, Bottiroli et al. (2013) found that transfer of learning was facilitated in older adults by encouraging active involvement in analyzing memory tasks involving lists, stories, locations, or paired-associates and adapting strategies to meet task demands. Guided metacognitive strategy training, however, has not been applied to PM training. Another important question, therefore, is whether PM strategies are best learned through explicit instruction or through guided metacognitive methods.

In the following experiment, we adapted a guided metacognitive strategy framework described by Toglia (2018) to the training of PM. The framework is outlined in Table 1 and consists of three components: (1) preactivity discussion on analyzing task demands, identifying similarities with meaningful activities, and self-generation of strategies; (2) mediation during the task to facilitate self-monitoring and the use of alternative strategies when needed; and (3) after-task questioning aimed at promoting self-evaluation of performance and strategy use (Table 2).

AU2

Healthy older adults were assigned to one of four separate experimental groups: metacognitive strategy training, explicit strategy training, practice only, and a no-training control. Approximately 20 participants were assigned to each group (tested at both Washington University in St. Louis and Mercy College). To give some indication of the sample characteristics, participants' ages ranged from 60 to 90 with a mean age of 69.65, and all participants were living independently in the community. Montreal Cognitive Assessment (MoCA) scores ranged from 18 to 30, with a mean of 26.85 (for 61 out of 81 participants); 20 participants came from a subject pool with preexisting archival data (Knight Alzheimer's Disease Research Center at Washington University in St. Louis) and did not have MoCA scores, but were all screened as cognitively normal.

To assess PM, the Virtual Week task (VW task, previously described) was administered approximately 1 week before and after a single strategy training session. After completing the pretraining VW task, participants returned 1 week later for the training session (the retest control did not return to the lab at this point). This session included three different computerized PM games, previously described by Waldum et al. (2014), with increasing difficulty across the tasks (focal + time-based, nonfocal + time-based, a combination of focal + nonfocal + time-based).

For the metacognitive strategy group, after a general introduction to types of PM (i.e., time-based, focal, and nonfocal tasks), participants were then presented with

Table 1 Guided metacognitive strategy framework for prospective memory training

Treatment session components		Metacognitive focus
Preactivity discussion	Identify the type of PM	Analysis of task demands
	Identify everyday activities that involve similar PM requirements	Connect PM task with everyday activities. Identify similarities of task characteristics
	Generate strategies for PM	Plan and choose strategies that match task demands
During task	Stop and mediate after errors are observed. Guide generation of alternate strategies if needed	Self-monitoring skills. Strategy adjustment based on performance
After task	Participant summarizes methods used and comments on strategy effectiveness	Self-evaluation of performance

Table 2 Means as a function of the type of prospective memory task and the time of test, with paired t-tests of pre- and post-differences ($n = 15$)

	Pretest		Posttest	
Outcome	M	SD	M	SD
Regular event based	0.623	0.35	0.845	0.25
Regular time based	0.555	0.43	0.823	0.22
Irregular event based	0.667	0.67	0.823	0.21
Irregular time based	0.333	0.36	0.667	0.36

$^{*}p < 0.01$

PM tasks and asked to identify the type of PM required by the task. Next, guided questioning was used to help the person identify how the PM training task was similar to everyday activities or situations, and the person was given the opportunity to try the PM games using their own methods. During the activity, the examiner stopped and mediated performance as errors occurred and guided the person to reassess the effectiveness of their method. If needed, the person was encouraged to adjust or generate alternative strategies.

For the explicit strategy group, participants were instructed on different strategies depending on task demands (i.e., focal + time-based, nonfocal + time-based, or focal + nonfocal + time-based). The strategy training for focal tasks was to use implementation intention encoding (e.g., "When the focal target X occurs, I will remember to perform Y") repeated aloud and visualized (see McDaniel and Scullin 2010). The strategy training for time-based tasks encouraged participants to ramp up clock monitoring behavior when approaching the appropriate time (see Einstein et al. 1995). Finally, the strategy trained for nonfocal tasks was active monitoring, which involved trying to maintain a state of active cue-searching (Einstein et al., 2005).

The practice-only condition, after receiving a general introduction to types of PM, received no strategy instructions, and simply practiced the PM tasks during the training session. The control condition received no training. One week after completing the training session, participants completed the VW assessment again. The control completed the pre- and posttest VW assessments separated by 2 weeks.

The proportions of correctly detected PM targets as a function of assessment time (pre and post) and training condition (control, explicit, practice-only, and metacognitive) are shown in Fig. 1. There was a significant increase in scores from pretest ($M = 0.49$, $SE = 0.03$) to posttest ($M = 0.63$, $SE = 0.03$). However, there was no effect of training approach, nor was there any interaction between the two variables. The explicit and practice-only conditions obtained modest gains from pre- to posttest (0.08 and 0.10, respectively) and the metacognitive group obtained the greatest increase (0.18).

This pattern is initially encouraging regarding the benefits of metacognitive training; however, the control group performed surprisingly well, too, also increasing by 0.18 from pre- to posttest. One interpretation is that, due to low sample size, random assignment did not adequately balance individual differences across groups,

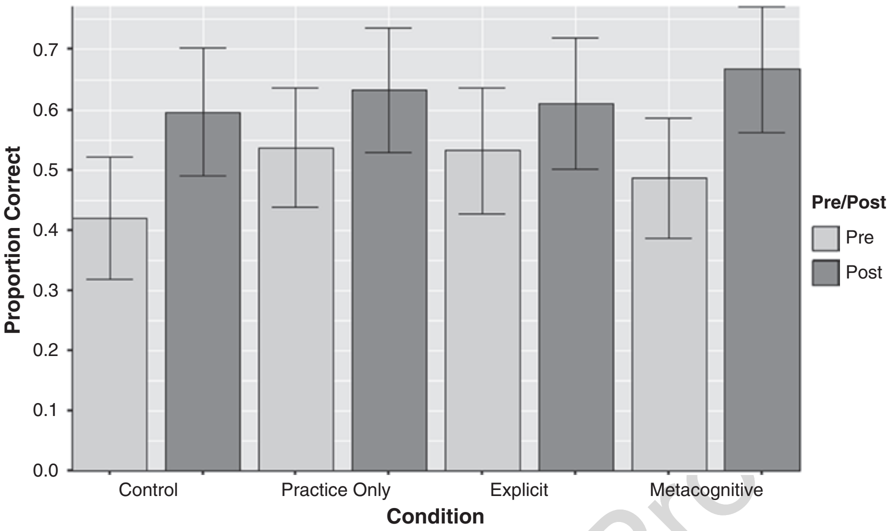

Fig. 1 Proportion of PM targets detected on Virtual Week from pre- to posttest as a function of training condition

such that participants in the control group were by chance more able learners compared to those in the other groups. Another interpretation rests on the following feature of the experiment: The pre- and posttest VW versions were identical to one another. Accordingly, it is possible that the increases in performance on VW, for at least the control group, reflected practice of the specific PM tasks encountered during both pre- and posttesting, rather than acquisition of more general PM skills and strategies. We had not expected this improvement on VW in a no-trained control given previous research with repeated administration of VW (e.g., McDaniel et al. 2014); however, that research used intervals of 6 months between pre- and posttesting, not the 2 weeks used here. In retrospect, the experiment could have been more sensitive had we used different versions of VW at pre- and posttesting that incorporated different particular PM tasks.

Nevertheless, two speculative conclusions might be offered. First, the metacognitive strategy training seems more promising for training PM transfer than does practice alone or even explicit strategy training. The second conclusion follows from the observation that the improvement from pre- to posttest in the training groups was not more robust than that displayed in the control group. It may be that a brief one-session training is not sufficient to adequately train PM skills and strategies that significantly transfer. Clearly, these possibilities merit further research.

PM Training in Pathological Aging Older Adults: Evidence from Parkinson's Disease Patients

Effective training of PM also has important applications beyond healthy aging. Some work has extended findings in healthy aging to attempts to improve PM in pathological aging. Here, we mainly focus on our findings regarding Parkinson's disease, though work has also been done on very mild Alzheimer's disease and other forms of dementia (e.g., Burkhard et al. 2014). For example, prior work on older adults with very mild Alzheimer's disease indicated that a simple implementation intention encoding intervention can improve focal PM performance in both laboratory tasks (Lee et al. 2016) and simulated real-world tasks (the VW task; Shelton et al. 2015). Similar work has been done for those with Parkinson's disease (PD) because this disease seems to cause PM impairments in forming and remembering intentions (Kliegel et al. 2011).

Foster et al. (2017) studied individuals with mild to moderate PD without dementia on the VW PM task described above. First, participants completed the VW task without any special instructions. Then, a week later participants again performed the VW task. Prior to doing so, half were instructed to form implementation intentions. That is, they were told to create a "When X, I will do Y" statement, repeat it out loud three times, and then visualize performing the task at the correct time in the game. The other half simply repeated the PM tasks out loud three times. Regardless of the instructions, participants improved compared to their initial performance. This was especially true for event-based compared to the time-based tasks. More importantly, the implementation intention strategy training led to better performance than the verbal repetition task when participants completed nonrepeated tasks—tasks that were only presented once during the overall VM task—compared to the ones that were repeated.

These strategies were then extended to self-reports of naturalistic PM experiences. Goedeken et al. (2018) examined PD patients' experience of PM via the Prospective and Retrospective Memory Questionnaire Prospective Scale (PRMQ-Pro) 1 week before and 1 month after the same two training techniques: implementation intention strategy training and verbal repetition. The training occurred within the context of the VW task, but participants were then instructed to use the strategies as much as possible in their daily lives. Those in the verbal repetition actually showed a decline on the PRMQ-Pro, whereas those in the implementation intention group showed no change. Here, the effectiveness of the implementation intention training seemed to be in preventing decline rather than in improving PM. Of course, a limitation of this work is that it is based on patients' self-reports rather than actual performance on naturalistic PM tasks. Still, taken together, the findings are heartening in that training strategies can not only be taught and implemented by PD patients but can lead to maintenance of PM, if not even improvements. As progress is made in understanding the mechanisms and strategies for effective improvement of PM for healthy older adults, it appears fruitful to then test these techniques for those with clinical issues.

Conclusions

A unique aspect of our research is the appreciation of different types of PM tasks, with training oriented toward informing learners of these differences and highlighting particular strategies targeted at the different types of tasks. It seems that a parallel approach for retrospective memory training might be considered to improve outcomes for assisting older adults with their everyday retrospective memory challenges (cf. McDaniel and Bugg 2012). However, our new, though preliminary, results suggest that a relatively brief training session may not be enough to produce transfer of learned PM strategies to at least a simulation of real-world PM tasks. At this point, we remain optimistic that the present training approach, with training extended beyond one session, might benefit older (and younger) adults in improving their everyday prospective remembering. Clearly, however, a definitive conclusion awaits more complete experimental findings.

More generally, our research is attempting to examine and identify essential ingredients of cognitive training that enhance successful outcomes and generalization. There are many choices to be made in developing cognitive training, and as researchers, we need to be confident that those decisions will provide the greatest improvement (Cochrane and Green, Schmiedek, chapter "New Directions in Training Designs", this volume). Fundamentally of interest is what we are trying to train. Many programs have targeted cognitive capacities themselves (see Guye et al., chapter "Cognitive Training Across the Adult Lifespan", Könen et al., chapter "Working Memory Training", Rueda et al., chapter "Cognitive Training in Childhood and Adolescence", Wenger et al., chapter "Episodic Memory Training", this volume). Instead, our approach is to focus on teaching effective strategies that older adults can then use to tackle the PM situations they face.

One concern is how to implement this kind of strategy training, starting with how extensive the training ought to be. Though several sessions may be beneficial, the *right* kind of single training session may help older adults, which is a more practical proposition. In such a single session, the variability of the tasks that participants are exposed to in training is likely to be critical to later generalizability; experiencing a few different tasks may allow for more robust and flexible strategy development and application. In strategy training, it seems that guided metacognitive strategy training might be the best (see Schäffner et al., chapter "Meta-cognitive Training", this volume). Having such support in instruction has promise for older adults in comparison to allowing them to try and develop their own approach to PM tasks on their own.

Finally, the ecological validity of the training and the assessments of learning and transfer are critical. PM looks quite different inside and outside the laboratory. Thus, it is an important goal to foster the transfer of effective strategy use from training to the real world. As such, training programs must consider the balance and inclusion of laboratory training, homework, and simulated real-world activities during training such as the VW task. As these different considerations are explored, we are confident that an effective and efficient PM training for older adults will emerge, one that promotes transfer and generalizability to the real-world PM challenges.

Acknowledgments A special thanks is extended to Mercy College OT students Kim Havel, Mary Tremmel, Teresa Sanchez, and Hasena Punwasie for their assistance with the guided metacognitive strategy condition. The authors would also like to thank Deborah Koh and Amulya Joseph for their help with the prospective memory training work at Washington University. Some of the research discussed was supported by the National Institute on Aging Grant T32 AG000030 awarded to SU. AU4 AU5

References

Bottiroli, S., Cavallini, E., Dunlosky, J., Vecchi, T., & Hertzog, C. (2013). The importance of training strategy adaptation: A learner-oriented approach for improving older adults' memory and transfer. *Journal of Experimental Psychology: Applied, 19*, 205–218.

Breneiser, J. (2007). *Implementation intentions and cost in prospective memory retrieval*. Unpublished doctoral dissertation. St. Louis: Washington University.

Burkhard, C., Rochat, L., Van der Linden, A. J., Gold, G., & Van der Linden, M. (2014). Is working memory necessary for implementation intentions to enhance prospective memory in older adults with cognitive problems? *Journal of Applied Research in Memory and Cognition, 3*, 37–43.

Chasteen, A., Bottiroli, S., Cavallini, E., Dunlosky, J., Vecchi, T., & Hertzog, C. (2013). The importance of training strategy adaptation: A learner-oriented approach for improving older adults' memory and transfer. *Journal of Experimental Psychology: Applied*, 1–14. https://doi.org/10.1037/a0034078.

Craik, F. I. M., & Bialystok, E. (2006). Planning and task management in older adults: Cooking breakfast. *Memory & Cognition, 34*, 1236–2124.

Dawson, D., Richardson, J., Troyer, A., Binns, M., Clark, A., Polatajko, H., Winocur, G., Hunt, A., & Bar, Y. (2013). An occupation-based strategy training approach to managing age-related executive changes: A pilot randomized controlled trial. *Clinical Rehabilitation*, 1–10. https://doi.org/10.1177/0269215513492541.

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., 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.

Foster, E. R., McDaniel, M. A., & Rendell, P. G. (2017). Improving prospective memory in persons with Parkinson disease: A randomized controlled trial. *Neurorehabilitation and Neural Repair, 31*, 451–461.

Goedeken, S., Potempa, C., Prager, E. M., & Foster, E. R. (2018). Encoding strategy training and self-reported everyday prospective memory in people with Parkinson disease: A randomized-controlled trial. *The Clinical Neuropsychologist, 32*, 1282–1302.

Goode, M. K., Geraci, L., & Roediger, H. L. (2008). Superiority of variable to repeated practice in transfer on anagram solution. *Psychonomic Bulletin & Review, 15*, 662–666.

Harrison, T. L., Shipstead, Z., Hicks, K. L., Hambrick, D. Z., Redick, T. S., & Engle, R. W. (2013). Working memory training may increase working memory capacity but not fluid intelligence. *Psychological Science, 24*, 2409–2419. https://doi.org/10.1177/0956797613492984.

Healy, A. F., Wohldmann, E. L., Parker, J. T., & Bourne, L. E. (2005). Skill training, retention, and transfer: The effects of a concurrent secondary task. *Memory & Cognition, 33*(8), 1457–1471.

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.

Hertzog, C., Kramer, A. F., Wilson, R. S., & Lindenberger, U. (2009). Enrichment effects on adult cognitive development: Can the functional capacity of older adults be preserved and enhanced? *Psychological Science in the Public Interest, 9*, 1–65.

Hintzman, D. L., & Stern, L. D. (1978). Contextual variability and memory for frequency. *Journal of Experimental Psychology: Human Learning and Memory, 4*, 539–549.

Jennings, J. M., & Jacoby, L. L. (2003). Improving memory in older adults: Training recollection. *Neuropsychological Rehabilitation, 13*, 417–440. https://doi.org/10.1080/09602010244000390.

Karbach, J., & Kray, J. (2009). How useful is executive control training? Age differences in near and far transfer of task-switching training. *Developmental Science, 12*, 978–990. https://doi.org/10.1111/j.1467-7687.2009.00846.x.

Kerr, R., & Booth, B. (1978). Specific and varied practice of a motor skill. *Perceptual and Motor Skills, 46*, 395–401.

Kramer, A. F., Larish, J. F., & Strayer, D. L. (1995). Training for attentional control in dual task settings: A comparison of young and oldadults. *Journal of Experimental Psychology: Applied, 1*, 50–76. https://doi.org/10.1037/1076-898X.1.1.50.

Lee, J. H., Shelton, J. T., Scullin, M. K., & McDaniel, M. A. (2016). An implementation intention strategy can improve prospective memory in older adults with very mild Alzheimer's disease. *British Journal of Clinical Psychology, 55*, 154–166.

Liu, L. L., & Park, D. C. (2004). Aging and medical adherence: The use of automatic processes to achieve effortful things. *Psychology and Aging, 19*, 318–325.

Lustig, C., Shah, P., Seidler, R., & Reuter-Lorenz, P. A. (2009). Aging, training, and the brain: A review and future directions. *Neuropsychology Review, 19*, 504–522.

MacKay-Brandt, A. (2011). Training attentional control in older adults. *Aging, Neuropsychology, and Cognition, 18*, 432–451.

McDaniel, M. A., & Bugg, J. M. (2012). Memory training interventions: What has been forgotten? *Journal of Applied Research in Memory and Cognition, 1*, 45–50.

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

McDaniel, M. A., & Schlager, M. S. (1990). Discovery learning and transfer of problem solving skills. *Cognition and Instruction, 7*, 129–159.

McDaniel, M. A., & Scullin, M. K. (2010). Implementation intention encoding does not automatize prospective memory responding. *Memory & Cognition, 38*, 221–232.

McDaniel, M. A., Binder, E. F., Bugg, J. M., Waldum, E. R., Dufault, C., Meyer, A., Johanning, J., Zheng, J., Schechtman, K. B., & Kudelka, C. (2014). Effects of cognitive training with and without aerobic exercise in cognitively-demanding everyday activities. *Psychology and Aging, 29*, 717–730.

McEwen, S. E., Mandich, A., & Polatajko, H. J. (2018). CO-OP approach™: A cognitive-based intervention for children and adults. In N. Katz & J. Toglia (Eds.), *Cognition, occupation, and participation across the lifespan* (4th. ed., pp. 315–334). Bethesda: American Occsupational Therapy Association. https://doi.org/10.7139/2017.978-1-56900-479-1.

Park, D., Herzog, C., Kiddor, D., Morrell, R., & Mayhorn, C. (1997). Effect of age on eventbased and time-based prospective memory. *Psychology and Aging, 12*, 314–327.

Redick, T. S., Shipstead, Z., Harrison, T. L., Hicks, K. L., Fried, D. E., Hambrick, D. Z., Kane, M. J., & Engle, R. W. (2013). No evidence of intelligence improvement after working memory training: A randomized, placebo-controlled study. *Journal of Experimental Psychology: General, 142*, 359–379.

Rose, N., Rendell, P. G., McDaniel, M. A., Aberle, I., & Kliegel, M. (2010). Age and individual differences in prospective memory during a "Virtual Week": The roles of working memory, vigilance, task regularity, and cue focality. *Psychology and Aging, 25*, 595–605.

Rose, N. S., Rendell, P. G., Hering, A., Kliegel, M., Bidelman, G. M., & Craik, F. I. M. (2015). Cognitive and neural plasticity in older adults' prospective memory following training with the virtual week computer game. *Frontiers in Human Neuroscience, 9*, 592. https://doi.org/10.3389/fnhum.2015.00592.

Schmidt, W., Berg, I. J., & Deelman, B. G. (2001). Prospective memory training in older adults. *Educational Gerontology, 27*, 455–478.

Shelton, J. T., Lee, J. H., Scullin, M. K., Rose, N. S., Rendell, P. G., & McDaniel, M. A. (2016). Improving prospective memory in healthy older adults and very mild Alzheimer's disease Patients. *Journal of the American Geriatrics Society, 64*, 1307–1312.

Skidmore, E. R., Dawson, D. R., Butters, M. A., Grattan, E. S., Juengst, S. B., Whyte, E. M., Begley, A., Holm, M. B., & Becker, J. T. (2014). Strategy training shows promise for addressing disability in the first 6 months after stroke. *Neurorehabilitation and Neural Repair*, 1–9. https://doi.org/10.1177/1545968314562113.

Toglia, J. (2018). The dynamic interactional model and the multicontext approach. In N. Katz & J. Toglia (Eds.), *Cognition, occupation, and participation across the lifespan* (4th ed., pp. 355–385). Bethesda: American Occupational Therapy Association. https://doi.org/10.7139/2017.978-1-56900-479-1.

Toglia, J., Johnston, M. V., Goverover, Y., & Dain, B. (2010). A multicontext approach to promoting transfer of strategy use and self-regulation after brain injury: An exploratory study. *Brain Injury, 24*(4), 664–677. https://doi.org/10.3109/02699051003610474.

Waldum, E. R., Dufault, C., & McDaniel, M. A. (2014). Prospective memory training: Outlining a new approach. *Journal of Applied Gerontology*. Advanced online publication. https://doi.org/10.1177/073346814559418.

Author Queries

Chapter No.: 13 335299_2_En_13_Chapter

Queries	Details Required	Author's Response
AU1	Ref. "Toglia 2011; Shelton et al. 2015; Kliegel et al. 2011" is cited in text but not provided in the reference list. Please provide details in the list or delete the citation from the text.	
AU2	Please confirm the inserted table citation for Table 2.	
AU3	Please provide significance for "*" in Table 2.	
AU4	Please provide in text citation for Reference "Chasteen et al. (2013).	
AU5	Reference "Chasteen et al. (2013)" was not cited anywhere in the text. Please provide in text citation or delete the reference from the reference list.	