THE ECOLOGICAL VALIDITY OF PROSPECTIVE MEMORY EXPERIMENTATION

By

Anna M. Pusser

Jill Talley Shelton
UC Foundation Associate Professor of Psychology
(Chair)

Julie Madden
Associate Lecturer of Psychology
(Committee Member)

Amanda Clark
Associate Dean, College of Arts and Sciences
Associate Professor of Psychology
(Committee Member)

THE ECOLOGICAL VALIDITY OF PROSPECTIVE MEMORY EXPERIMENTATION

By

Anna M. Pusser

A Thesis Submitted to the Faculty of the University of
Tennessee at Chattanooga in Partial
Fulfillment of the Requirements of the Degree
of Master of Science: Psychology

The University of Tennessee at Chattanooga
Chattanooga, Tennessee

August 2023

ABSTRACT

Prospective memory (PM) is the ability to remember and fulfill future intentions, a crucial ability in everyday life. Discrepancies between performance in standard laboratory tasks versus naturalistic tasks has led to translational concerns to everyday life. Validity concerns surrounding laboratory PM tasks have been raised due to the lack of relationship between PM performance and measures of strategic monitoring, which is believed to be how much attention participants dedicate to the PM task. The present study (N=82) compares an eye tracking task, a standard laboratory task, and a naturalistic task. The findings support previous research indicating that performance in laboratory PM tasks is not a good predictor of performance in everyday life. Notably, both the eye tracking and standard laboratory tasks demonstrate a correlation between strategic monitoring and PM accuracy. Finally, participants were better at predicting their PM performance on each laboratory task but were overconfident in the naturalistic task.

TABLE OF CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Remembering to execute a plan or task in the future is termed prospective memory (PM) (Einstein & McDaniel, 1990). Examples of this include remembering to take medication or to grab your car keys before getting in your car. PM failures can have significant implications in real-world settings like patient safety in the medical field (Dieckmann et al., 2006; Loft et al., 2019). For example, if a doctor or nurse has a PM failure and forgets to document that a patient has an allergic reaction to Penicillin this could gravely affect the patient's medical safety. Therefore, research has utilized both laboratory and naturalistic experiments to examine PM performance (Aberle et al., 2010; Rendell & Thomson, 1999). Specifically, naturalistic experiments have been utilized to portray PM in a real-life setting (Aberle et al., 2010; Rendell & Thomson, 1999). Standard laboratory experiments are utilized to simulate PM in a controlled environment (Hicks et al., 2005; Rummel & Meiser, 2013). Indeed, the experimental control afforded by laboratory studies has led to significant advancements in the field by isolating the cognitive processes supporting successful PM (Scullin et al., 2013). However, the critical importance of PM for daily functioning has led to a growing body of studies using naturalistic approaches, and the findings suggest that standard laboratory experiments are lacking in ecological validity (i.e., the findings do not translate well to the real-world) (Aberle et al., 2010; Bailey et al., 2010; Unsworth et al., 2012). The primary purpose of the current study is to compare PM performance across a standard laboratory task, an eye tracking task, and a naturalistic task. A secondary goal of the present study is to compare participants' metacognitive accuracy across task contexts.

Ecological Validity

Historically, ecological validity within cognitive psychology has posed concerns for experimental psychologists (Gibbs, 1979). Ecological validity refers to the relationship between real-world experiences and the investigation of these experiences in a laboratory context (Schmuckler, 2001). A considerable amount of research has found that laboratory tasks do not simulate an individual's everyday setting (Gibbs, 1979; Gump & Kounin, 1960; Holleman et al., 2020). Thus, experimental research is not accurately assessing these real-world experiences in a laboratory context for the sake of maintaining experimental control. Cognitive psychologists have argued that ecological validity is necessary for standard laboratory experiments because without it the results of those experiments do not predict behaviors in everyday life (Gibbs, 1979; Gump & Kounin, 1960; Holleman et al., 2020). According to a review paper from Kvavilashvili and Ellis (2004) ecological validity has been a major concern within the cognitive psychology field in general, but memory research has been at the center of this debate for decades. For example, Neisser (1985) notes that memory experiments performed in a laboratory setting are artificial and unlikely to predict or accurately portray an individual's everyday environment. Within the eyewitness testimony literature researchers have discussed the issue of generalizability of laboratory studies, voicing concerns that behavior observed in the laboratory does not translate to an individuals' behavior in a real-life setting (Wells, 1993). In contrast, experiments conducted in the participants' natural environment are believed to provide an accurate assessment of their cognitive performance in everyday life (Wells 1993). Within the PM literature similar concerns have been raised about the ecological validity of laboratory tasks (McDaniel & Einstein, 2007). McDaniel and Einstein (2007) suggest that when designing laboratory tasks, we must keep in mind the features of real-world PM tasks that we are attempting to simulate in the laboratory. Past research utilizing the laboratory PM paradigm have favored experimental control over ecological validity. According to Unsworth et al. (2012) this may be a major contributor to laboratory tasks not being predictive of everyday PM performance.

Unsworth et al. (2012) assessed whether PM in the laboratory was able to predict everyday PM. Unsworth et al. (2012) utilized a standard laboratory paradigm in the PM literature, in which participants complete an ongoing task while also remembering to respond to PM target items in designated segments of the ongoing task. Specifically, in this study the ongoing task was a lexical decision task in which participants were asked to decide whether a string of letters forms a word (e.g., trail) or non-word (e.g., swonk). The PM component of the task that was integrated within the throughout the PM block of ongoing task trials was to remember to respond to specific items that appeared occasionally during the lexical decision task. Specifically, participants in Unsworth and colleagues' (2012) study were told during the PM block of the first lexical decision task to type a specific phrase when the participant saw any of the four target words given in the instructions. For the second lexical decision task participants were asked to press a designated key on a keyboard if the string of letters had the syllable "tor". This standard paradigm is supposed to simulate an everyday setting in which individuals are typically engaged in an ongoing task and their PM task is integrated within the ongoing task. For example, in an individual's everyday setting they could be engaged in a typical workday sending emails or writing reports, but they have a specific task they need to complete by the end of the day, such as sending a report to their supervisor. Naturalistic tasks are typically completed in an individual’s everyday environment. For example, in Unsworth and colleagues’ (2012) study they utilized a diary method where participants were asked to record the PM failures in a diary for a week. They found that PM performance in standard laboratory tasks did not predict everyday PM in the naturalistic task. These findings suggest that how individuals perform in tasks typically utilized in a laboratory setting may not accurately predict how individuals would perform in real-life situations.

Similarly, Kim and Mayhorn (2008) measured introductory psychology students' abilities to complete their PM intentions through a laboratory and naturalistic task. Participants were asked to complete a laboratory task that consisted of answering trivia questions while remembering to complete various PM tasks in different contexts. For example, in this study participants had to remember to write their initials every three minutes while completing the ongoing task (e.g., answering trivia questions). The naturalistic component of this experiment included participants keeping a diary where they were instructed to write down their daily PM goals that were academic, and work related for the next 7 days. Regarding PM performance, Kim and Mayhorn (2008) found that participants performed better in the naturalistic setting. The results highlight discrepancies in PM performance in which individuals perform better in naturalistic settings compared to the performance in laboratory tasks. Further research is warranted to examine the direct relationship between laboratory and naturalistic tasks to understand how individual differences may contribute to discrepancies in PM performance.

Participants’ age is one individual difference factor that has been associated with discrepancies when comparing PM performance in laboratory experiments versus naturalistic experiments. This discrepancy is termed the age PM paradox, in which older adults perform worse on laboratory tasks while simultaneously performing as well, or even outperforming, younger adults in naturalistic tasks (Aberle et al., 2010; Bailey et al., 2010; Rendell & Craik, 2000). While the current study does not focus on the age PM paradox it is important to further highlight studies that have found discrepancies observed between laboratory versus naturalistic tasks. For example, Rendall and Craik (2000) conducted two experiments to examine age-related differences across task settings. Participants were categorized into three groups: young (19-24), young-old (61-73), and old-old (75-84). The experiments included: a PM laboratory task called “Virtual Week” where it is structured as a board game as well as a naturalistic task termed “Actual Week” where participants completed daily tasks in their everyday setting. The virtual week board game was designed to simulate tasks people complete in everyday life. An example of a simulated everyday PM task could include taking medicine at breakfast or dinner. Such tasks can be regular or routine as well as irregular tasks meaning they are not routine. An example of a regular task would be taking medication at a specific time. While an irregular task might include calling a plumber. Participants circle the board seven times to simulate a normal week where they complete and remember daily tasks. This included time-based tasks which were completed at a specific time **(**e.g., take medicine at 9 am) and event-based tasks which are completed in response to a certain event (e.g.., returning books to the library when you arrive). They predicted that the age discrepancy would be eliminated in the laboratory board game task for older adults because they typically have routines and strategies for daily remembering. However, they found that younger adults still outperformed older adults on the virtual week laboratory task. In contrast, older adults outperformed younger adults in the Actual Week naturalistic task. Notably, there were also discrepancies in performance regarding the type of task participants had to complete within each setting. For example, the old-old and young-old groups performed worse on regular and irregular tasks in the Virtual Week, but performance was significantly worse in the irregular task. For Actual Week, the old-old group performed better on the regular tasks but did not perform better on the irregular tasks compared to the young-old group. In addition, they found discrepancies between time and event-based tasks such that participants performed significantly better on the event-based tasks regardless of age in both the Virtual Week and Actual Week. Similarly, Aberle et al. (2010) observed that older adults performed significantly worse on the irregular tasks. These results indicate that the type of task (irregular versus regular) impacts PM performance in younger versus older adults, highlighting the importance of identifying the processes supporting PM in different situations.

Strategic Monitoring versus Spontaneous Retrieval

One of the primary goals of laboratory studies has been to isolate the cognitive processes theorized to support PM, such as strategic monitoring and spontaneous retrieval. Strategic monitoring is maintaining the PM task or goal in memory while searching the environment for the PM target event to occur (Scullin et al., 2010). Strategic monitoring is typically characterized by slower response times to the ongoing task items when a PM demand is present versus when it is not (Scullin et al., 2010). Conversely, when no strategic monitoring is observed despite participants performing well on the PM task, retrieval of the intention is believed to be supported by a more reflexive, spontaneous retrieval process (Anderson et al., 2017). Spontaneous retrieval happens when the PM intention is consciously brought to memory after encountering a cue (e.g., reminder) that triggers the retrieval of the PM intention (Scullin et al., 2013). Naturalistic studies have attempted to isolate these processes in an everyday setting (Hacker et al. paper under review;

Kvavilashvilli & Fisher 2007). For example, Kvavilashvilli and Fisher (2007) had participants call them on the seventh day of the experiment and during those seven days participants would keep a diary to record when they would rehearse (e.g., strategically monitor) or recall (e.g., spontaneous retrieval) how they remembered to call the experimenter. Similarly, Hacker et al. (under review) had participants contact them by text message two times a day and indicate how they remembered their PM task. The choices they provided were designed to indicate if they were utilizing strategic monitoring (e.g., I thought about it constantly) or spontaneous retrieval (e.g., it popped into my mind). Past research has centered on whether strategic monitoring is always necessary or if spontaneous retrieval can sometimes support successful PM.

Several theoretical stances have been taken to explain how processes, such as strategic monitoring and spontaneous retrieval, serve as underlying processes for prospective remembering. Smith's (2003) preparatory, attention and memory process (PAM) theory suggests that a future intention cannot be retrieved unless an individual is allocating resources to strategically monitor for the PM cue (e.g., a particular time of day or event). Additionally, PAM theory suggests that strategic monitoring is essential for successfully retrieving a PM intention. McDaniel and Einstein (2000) proposed the Multi-process Framework which suggests that PM can be supported by both strategic monitoring and spontaneous retrieval. Furthermore, the strategy utilized is dependent on the individual and the context of the PM task or intention. Scullin et al. (2013) extended the Multi-process Framework by suggesting that both strategic monitoring and spontaneous retrieval interact to support the memory of a future intention, termed the Dynamic Multi-Process Framework. According to this theory, an individual may modify their PM strategy by rehearsing the intention or monitoring for the appropriate time to carry out that intention (strategic monitoring), but an external cue could cause them to remember (spontaneous retrieval). Essentially, the Dynamic

Multi-Process View suggests that PM does not rely solely on strategic monitoring or spontaneous retrieval. Rather, spontaneous retrieval and strategic monitoring, respectively, interact in a dynamic fashion to support PM (Shelton & Scullin, 2017; Shelton et al., 2019). An essential aspect of the standard laboratory paradigm is to test the predictions posed by different theories by examining how each of these processes are used to support PM performance.

The typical measure of strategic monitoring derived from the standard laboratory task compares average reaction time on the ongoing task during the no-PM, control block of trials relative to the PM, experimental block of trials. Relatively slower response times during the PM block indicates that the individual was strategically monitoring for the PM target to occur. Some earlier studies in the literature using standard laboratory tasks have found a relationship between strategic monitoring and PM performance (Smith, 2003; Smith & Bayen, 2004); however, more recent studies have failed to observe this relationship (Harrison & Einstein, 2010; McNerney & West, 2007; Scullin et al., 2010, 2013; Wang et al., 2011). Failure to observe a relationship between PM accuracy and strategic monitoring raises concern about the validity of the typical index of suggest that strategic monitoring, or possibly theoretical claims regarding the importance of this process to PM performance. Indeed, some researchers have suggested that laboratory measures of strategic monitoring may be capturing other processes, such as metacognition or spontaneous retrieval (Hicks et al., 2005; Rummel & Meiser, 2013; Shelton & Christopher, 2016).

Immersive technology such as eye tracking could provide a more direct measure of processes such as strategic monitoring (Brown et al., 2014; Shelton & Christopher, 2016). Several studies that have examined PM using an eye-tracking paradigm characterize strategic monitoring as the diversion of visual attention from an ongoing task region of the screen to the PM target region (Brown et al., 2014; Shelton & Christopher, 2016). Such a measure is analogous to a real-world setting we often must shift our attention to a separate stimulus while in the middle of an ongoing task. As an example, an individual watching the news but wanting to monitor for football scores must stop watching the news and direct their attention to the bottom of the screen to complete their PM intention. With eye tracking specifically, this is isolated by tracking an individual's eye fixations to a specific area of the visual field where PM targets would occur. For example, Brown et al. (2014) found that participants in the PM condition fixated more frequently on the PM target area compared to the control condition. This indicates that participants were strategically monitoring for the PM target.

Shelton & Christopher's (2016) study utilized a similar approach. Their index of strategic monitoring was operationalized as the number of fixations in the PM target region when a PM demand was present. They created an ongoing visual search task where participants were instructed to count the images with living objects while making a designated response when a PM target appeared. They found that by placing their PM target in a separate area from the ongoing task, they were able to directly observe overt strategic monitoring, with significantly more fixations in the PM target region when a PM demand was present relative to when no PM demand was present. Furthermore, the eye tracking paradigm was able to better capture a real-world setting by having individuals shift their attention to different regions of the visual area to monitor for the PM targets. Notably, Shelton and Christopher (2016) observed a significant positive relationship between PM performance and their measure of strategic monitoring. Additionally, other studies utilizing eye tracking and this similar procedure from Shelton and Christopher (2016) have also observed a relationship between strategic monitoring and PM performance (Koslov et al., 2022; Yörük & Cangöz-Tavat, 2022). Recent studies utilizing standard laboratory tasks have failed to observe this relationship between strategic monitoring and PM performance (Harrison & Einstein, 2010; McNerney & West, 2007; Scullin et al., 2010, 2013; Wang et al., 2011). Such inconsistent findings warrant additional research. Past research has suggested that the typical laboratory strategic monitoring measure could be tapping into other processes, such as metacognition (Hicks et al., 2005; Rummel & Meiser, 2013).

Metacognition

An individual's knowledge of their PM abilities is important for how they utilize strategies like strategic monitoring to successfully complete PM tasks (Kuhlmann, 2019)**.** Metacognition is defined as our ability to accurately assess and predict performance on a task (Kuhlmann, 2019). Minimal research exists concerning the relationship between metacognition and PM performance across laboratory and naturalistic tasks. Typically, within PM tasks metacognition is assessed by asking participants to predict how well they believe they will perform on a task before they begin (Hacker et al. paper under review; Kuhlmann, 2019). Using such an approach, Meeks et al. (2007) found moderate correlations between actual everyday PM and their laboratory PM predictions. This finding suggests that participants have a rudimentary understanding of their PM abilities; however, this understanding is far from precise. Notably, there are a limited number of studies that have examined PM performance prediction in naturalistic settings. Several studies have found that younger adults were overconfident in their PM performance (Devolder et al., 1990; Ihle et al., 2012; Schnitzspahn et al., 2011). In addition, Cauvin et al. (2019) found that younger adults were also overconfident about their predicted performance on naturalistic tasks and underconfident on laboratory tasks. In sum, there is limited research on metacognition and PM (Kuhlmann, 2019) and it has yielded mixed results regarding participants' ability to precisely accurately their PM performance. However, it is important to note that metacognitive predictions and PM performance can be affected by the experimenter generated nature of both laboratory and naturalistic tasks (Rummel & McDaniel, 2019).

Experimenter versus self-generated tasks are features of PM tasks that may influence performance (Bailey et al., 2010; Schnitzspahn et al., 2020). Schnitzspahn et al. (2020)'s study analyzed the age PM paradox accounting for time and event-based tasks as well as experimenter generated and self-set tasks. They found that the age discrepancy was eliminated in the naturalistic setting when participants identified their own tasks to complete. Bailey et al. (2010) found that older adults had worse PM when completing experimenter generated tasks. This discrepancy between self-generated goals versus experimenter generated goals may be due to how important individuals find the task or goal in a laboratory versus real-life setting. Additionally, having participants generate their own goals can influence PM performance. By having participants generate their own goals, participants may believe these goals are more attainable. In contrast, experimenter generated goals may seem less attainable because they do not reflect their daily PM tasks.

In sum, the existing literature reports several discrepancies between PM laboratory and naturalistic tasks. This includes discrepancies based on the type of task including event versus time based or task regularity (Kim & Mayhorn, 2008; Unsworth et al., 2012). Some of these discrepancies are argued to largely be due to age related differences indicated by the age PM paradox; however other researchers have indicated that the type of task affects PM performance regardless of age (McDaniel & Einstein, 2007). Additionally, the experimenter versus self-generated nature of the task can influence how participants approach completing PM goals as well as their abilities to predict their accuracy on that task (Aberle et al., 2010; Kuhlmann, 2019; Phillips et al., 2008; Rendell & Craik, 2000). Laboratory measures of PM are essential for isolating processes like strategic monitoring and spontaneous retrieval. However, concerns have been raised regarding the validity of the typical measure of strategic monitoring derived from the standard laboratory PM task (Harrison & Einstein, 2010; McNerney & West, 2007; Scullin et al., 2010, 2013; Wang et al., 2011). Standard laboratory PM measures have also been scrutinized for not being predictive of everyday PM (Horn et al., 2011; Shelton & Christopher, 2016; Smith, 2010). This is problematic when studies utilize these measures to predict PM performance in the general population or in settings like aviation or the medical field, where PM failures can be fatal. However, PM experiments conducted within a laboratory setting have been critical for isolating the cognitive processes underlying PM, and eye tracking technology could be leveraged to observe strategic monitoring behaviors more directly **(**Shelton & Christopher, 2016). Finally, past research has yielded inconsistent findings on individuals' metacognitive accuracy in laboratory and naturalistic based settings.

The Present Study

The primary goal for the present study was to assess the ecological validity of laboratory PM tasks. Additionally, a goal of the proposed study was to evaluate whether a recently developed eye-tracking paradigm would provide a more direct measure of strategic monitoring when compared to a standard laboratory task. An exploratory aim of the present study was to evaluate whether this eye tracking paradigm could establish ecological validity while maintaining experimental control. It is important to note that past research has found that PM performance in laboratory tasks do correlate with other laboratory tasks (Ball et al., 2019; Rose et al., 2010; Zuber et al., 2016). Finally, the present study aimed to compare metacognitive accuracy across two laboratory PM tasks that used experimenter generated tasks and a naturalistic PM task with self-generated goals. The present study utilized methodology from Shelton and Christopher's (2016) eye-tracking study as well as a standard PM laboratory and naturalistic task to directly compare each method. Thus, I had four hypotheses for the proposed study: (H1) I predicted that PM accuracy in the standard laboratory task would not be correlated with PM accuracy in the naturalistic task. (H2) I predicted that PM accuracy in the eye tracking task would be positively correlated with accuracy in the standard laboratory task. (H3) I predicted that the measure of strategic monitoring derived from the eye-tracking task would have a stronger relationship with PM performance in comparison to the correlation observed between strategic monitoring and PM performance in the standard laboratory task. (H4) I predicted that participants would be more accurate in predicting their performance in the standard laboratory task as well as the eye-tracking task relative to the naturalistic task.

CHAPTER II

METHODOLOGY

Participants

Data was collected from 58 undergraduate students at the University of Tennessee at Chattanooga through SONA. In addition, 23 participants were recruited from the Chattanooga community. A power analysis through G*Power indicated that 84 participants would be sufficient for a medium effect (0.3) with an 80% chance of significance. Participants recruited through SONA were compensated with SONA credits. Participants recruited through the Chattanooga community were compensated with a $15 Amazon gift card. The 81 participants who participated in this study ranged from 18 to 76 years of age (*M* = 27.70; *SD* = 13.61). Most participants identified as female (n = 59; 72.8%), the remaining identified as male (n = 20; 24.7%), or non-binary (n = 2; 2.5%). Additionally, most participants identified as white (n = 55; 71.4%), followed by African American (n = 9; 11.7%), Hispanic/Latinx (n = 6; 7.8%), multiracial (n = 5; 6.5%) and Asian (n = 2; 2.6.%). Exclusion criteria for the present study included: no prior history of a neurological disorders as well as normal to corrected vision and hearing.

Materials

Demographic Questionnaire

The demographic questionnaire for all participants included a series of questions where participants were asked to provide their age, race, gender, ethnicity, major, year in school (if applicable), major (if applicable), English-speaking status, sleep quality, and occupation (if applicable).

Apparatus

Binocular eye movements were measured with an Eyelink 1000 Plus at a 1000 Hz sampling rate with 0.5-degree approximate accuracy. The eye-to-screen viewing distance was approximately 60cm. The computer screen was 55.88cm and people were seated 68cm from the screen. Participants were calibrated with a 9-point calibration procedure (SR Research Ltd., version 3.2.1).

Eye Tracking Prospective Memory Task

Participants were asked to complete a task which was based on the eye tracking paradigm by Shelton and Christopher (2016). For the eye tracking task, an Eyelink 1000 Plus eye tracker was utilized. The computer utilized for each laboratory task was a Dell Precision 3650. The screen size was 55.88 cm. Stimuli were presented electronically using Experiment Builder 2.3.1 software (SR Research Experiment Builder, Mississauga, Ontario, Canada). Participants were instructed to sit at the eye tracking computer and to complete a visual search task where participants had to search for the number of living things. This task consisted of two practice trials, 60 no-PM trials (i.e, control block) and 60 PM, trials (i.e., experimental block),. The stimuli that were utilized for the eye-tracking task was taken from Vorwerk and colleagues (2019). The stimuli for this task were black and white images and consisted of various pictures of people, animals, plants, fruit, and inanimate objects like furniture that were displayed in a rectangular collage of pictures. Each trial consisted of 15 pictures that were displayed to the participant in the rectangular collage of pictures. This served as the ongoing task.

In the control block participants were instructed to search for pictures of living things in the rectangular collage of pictures. Participants were given nine seconds to say out loud how many living things in the rectangular collage of pictures that they found. In addition, participants were instructed to disregard the top right corner picture in their living things count. The top right corner had a square picture separate from the rectangular collage. The top right region changed every 3 seconds for each sub trial. However, this transition was seamless for the participant as the main ongoing task in the rectangular collage of pictures remained the same for nine seconds. There was a collection of images that ranged from inanimate objects, animals, food, etc that rotated and repeated several times in the top right region.

After participants completed the control block, they were instructed that for the experimental block they would still complete the living things visual search. In addition to this task, they were instructed to look for an apple image in the top right region of the screen and that when they see an apple image, they should inform the researcher that they remembered the task by saying “target”. The apple (the PM target) randomly appeared in that top right region of the screen six times out of 180 sub trials in the experimental block. Similar to the control block, participants were instructed to disregard the images in the upper right corner when counting living objects for the ongoing task. Thus, the only reason for fixating on the upper right region was to monitor for the PM target in the experimental block. The purpose of the sub-trials and the time constraint in the visual search task was to force participants to be strategic about balancing their ongoing task and PM task demands. Therefore, the measure of strategic monitoring for the eye tracking task was operationalized as the average sum of participant fixations on the PM target region in the experimental block relative to the average sum of fixations in the PM target region during the control block. PM accuracy in this task was operationalized as the percentage of PM targets or apple images that participants said “target” for out of the six PM targets. Participants were also asked to provide a prediction rating for how well they expected to perform on the experimental block between 0 to 100. After finishing the experimental block, they were asked to provide a post-diction rating for how well they believed they performed on the task after completing it between 0 to 100. Figure 1 depicts an example of a trial and sub trial in the visual search task for the eye tracking paradigm.

Figure 1   Example of a Trial and Sub Trial in the Eye Tracking Task

Standard Laboratory Prospective Memory Task

The PM task for the standard laboratory experiment was based on the non-focal task created by Scullin et al. (2010). Participants completed this task while seated at a Dell Precision 3650 computer. Stimuli were presented electronically using the E-Prime 3.0 software (Psychology Software Tools, Pittsburgh, PA). This task required participants to complete an ongoing lexical decision task. For the ongoing lexical decision task participants were prompted to look at a computer screen that displayed a string of letters (i.e., swonk) that either formed a word or non-word for each trial. Participants completed a control, no PM, block of trials as well as an experimental, PM, block of trials. There were 20 practice trials before the control block which consisted of 204 trials. There were 102 trials that were words (e.g. "trail") and 102 trials that were non-words (e.g. "zepri"). The experimental block consisted of 209 trials. There were 101-word trials in the experimental block. There were 102 non-word trials. Within the experimental block there were six PM targets embedded within the ongoing lexical decision task. For the PM task participants were instructed to press the "Q" key when they saw a word that starts with the letter "g" (Scullin et al., 2010). The "g" words included: give, generous, grooming, glancing, giant and galleries. Strategic monitoring was operationalized as the comparison of average reaction time in the control block and average reaction time in the experimental block, excluding participants' reaction time on PM target trials. PM accuracy in this task was operationalized as the percent of PM targets that participants successfully completed out of the six PM targets embedded within the experimental block. In this task participants were also asked to provide a prediction rating for how well they expected to perform on the experimental block between 0 to 100. In addition, after finishing the experimental block they were asked to provide a post-diction rating for how well they believed they performed on the task after completing it between 0 to 100.

Letter Fluency Task

A letter fluency task served as a filler task before they completed the PM experimental block in each laboratory task (Kaminski & Good, 1996). The purpose of including filler tasks in between receiving the PM instructions and performing the PM block of trials is to create a delay before encountering PM targets, similar to what is experienced in everyday life. The letter fluency task is a task where individuals had 60 seconds to list off every word, they know that began with a specific letter. Participants were told they could not say the names of people, places, numbers, or words with the same root word (e.g., take and taking). This process was repeated three times for three different letters.

Naturalistic Prospective Memory Task

An experimenter on the research team utilized a goal elicitation procedure to have participants generate their own six goals to submit photo evidence for the naturalistic PM task (Wells et al., 2022; Nuno et al., 2022). The researcher indicated that the goals the participant sets should be separate from their routine, obligatory tasks like attending a class or going to work. The experimenter indicated that they should not include any people in the photos including themselves. Participants were instructed to complete their six goals over the next three days, two per day and that their goals should be accomplished on the same day they set to complete their goal. To confirm encoding (e.g., properly storing information into the memory system) of their goals, participants were asked to repeat their self-generated goals back to the experimenter as well as if they feel confident in completing each goal. An example of the encoding phase includes: “Tomorrow is day one. Tell me your goal/task for day 1 which is Monday the 10th” “Imagine where you’ll specifically be when completing this task. Do you feel confident to submit picture evidence (without yourself in the image) that you’ve completed this task?”. After generating their goals participants were asked to rate how well they think they would do on this task on a scale of 0 to 100. To submit their goals for the naturalistic portion of this study, participants were given a link to a Qualtrics form. Participants were instructed to submit photo evidence when they completed each of their goals. If they did not complete the goal, they were asked to answer why they did not complete their goal(s) for that day. In this survey participants answered questions regarding how they remembered their goals whether they utilized an internal reminder or external reminder (e.g., cell phone alarm).

PM accuracy in this task was operationalized as the percentage of goals that participants successfully completed out of the six goals. Photo evidence was evaluated by multiple raters to ensure participants pictures lined up with the goals the participants set. The multiple raters checked the photo submission for the time and date as well to guarantee each participants’ accuracy in the task. An exception to this rule was a 30-minute grace period that was provided to participants. Goals that were submitted 15-minutes before or after their designated day (e.g., a participant set a goal for Tuesday but submitted their goal Wednesday at 12:00am) would still be considered complete.

Post Study Survey

In the post study survey participants were asked to recall each of their six goals from the naturalistic task. This was to help ascertain the reason for a PM failure, when applicable. For instance, a participant may have simply forgotten their tasks entirely (a retrospective memory failure) or they may have remembered their tasks but forgot to complete them (a prospective memory failure). Participants were then asked why they did not complete a task if they indicated they failed to complete it. Their response options included: I had to complete a different task instead, I completely forgot about my task, I was not motivated to complete the task, or Other. Lastly, participants were asked to provide a post-diction rating on how well they believed they performed on their six tasks.

Procedure

First, participants signed the informed consent and then answered all demographic questions as well as the Need for Cognition scale (NFC; Cacioppo et al., 1984) and the Attention-Related Cognitive Errors Scale (ARCES; Smilek et al., 2010). This data is not discussed in this paper. It is important to note that control and experimental blocks for each laboratory task were not counterbalanced because the naturalistic task always had to be completed outside of the laboratory setting, making it difficult to switch the task order. Additionally, my goal was to focus on variation due to individual differences, which can be masked when additional variance is caused by counter balancing task order.

After completing the informed consent and survey questions participants began the procedure. Participants were given the instructions for the control block in the eye tracking task. After reading the instructions for the control block participants were taken through the calibration and validation procedure for the eye tracker. Following the calibration and validation procedure participants completed practice trials. After the practice trials participants completed the control block of trials. Following completion of the control block participants were asked to read through the instructions for the experimental block. When participants finished reading the instructions for the experimental block, they were asked, “What image are you supposed to look for in the upper right corner?” Once the participant answered with “apple” the researcher asked, “What are you supposed to do when you see that image?” Once the participant answered with “target” the researcher moved onto the next question. The participant was then asked to provide their prediction by answering “How well do you believe you will perform on this task? Please provide an answer between 0 to 100. With 0 meaning the worst you could perform and 100 being the best you could perform.**”** Participants were then given instructions for the letter fluency task. Following completion of the letter fluency task participants completed the experimental block. Upon completion of the experimental block participants were again asked: “What image were you supposed to look for in the upper right corner?” and “What were you supposed to do when you saw that image?” Participants were then asked to provide their post-diction by asking “How well do you believe you performed on this task between 0 to 100?”

After completing the eye tracking task participants were given instructions for the control block in the lexical decision task. After reading the instructions participants were prompted to complete practice trials. After completing the practice trials participants completed the control block. Upon completing the control block participants were given instructions for the PM component of the experimental block. After reading the instructions for the experimental block participants were asked to type the PM task instructions they just received from memory. Then they were asked to again provide their prediction for how well they believe they would perform on the task between 0 to 100. Afterwards, participants were again given instructions for the letter fluency task and three new letters to complete. Upon completing the letter fluency task participants completed the experimental block. When participants finished the experimental block, they answered a series of questions about the PM task to check for retrospective memory errors. After completing the task participants were asked how well they believed they performed on the task between 0 to 100.

Upon finishing the two laboratory tasks participants were asked to complete a naturalistic task where they generated their own six goals to be completed outside of the laboratory over a three-day period. Participants were taken through a goal elicitation procedure which explained the criteria for the goals they needed to generate. Participants were instructed to list off six personal goals that met the requirements for the experiment. Participants were then asked to provide a prediction rating on how well they believed they would perform on their six tasks overall between 0 to 100. After goal selection was complete, participants were asked to recall all six of their goals to the researcher to ensure there were no issues with remembering their goals. Then participants were asked if they felt confident, they could provide picture evidence for each of the six goals they listed. If participants indicated that they were not confident in their ability to provide picture evidence for their goals, they were told to generate new goals. Afterwards, participants were instructed on how they would submit their photo evidence through Qualtrics. An example of an acceptable photo response would be taking a picture of a hiking trail if the participant indicated that their goal for that day was to take a hike. They were instructed to submit to Qualtrics twice per day for three days, submitting photo evidence of each task. Participants were sent the post-study survey after the three days which included their post-diction rating for this task. After participants completed the post-study survey, they were compensated with 10 SONA credits (students) or a $15 Amazon gift card if they were a community participant.

CHAPTER III

RESULTS

Prospective Memory Performance

Prospective memory (PM) performance in the eye tracking task was operationalized as the percentage of PM targets that participants successfully completed. If a participant said “target” within two sub trials of the PM target this was still counted as correct for their PM performance. Three participants were excluded for failing to recall either the PM target or the desired response in the eye tracking task. PM performance in the standard laboratory task was operationalized as the percentage of PM targets that participants successfully completed out of the six targets. If a participant pressed “Q” within two trials of the PM target this was still counted as correct for their PM performance. Nine participants were excluded for failing to recall the PM task instructions in the standard laboratory task.

Prospective memory performance in the naturalistic task was operationalized as the percentage of the six goals successfully completed on the appropriate day. Picture evidence provided by each participant through Qualtrics that was coded as correct by members on the research team was considered as the PM task completion. A team of researchers which included three individuals coded successful submissions for goal completion. The criteria for evaluation included checking participants’ time, date, and picture submissions. Goals were still considered complete if they were submitted 15 minutes before or after the designated day. The data was split between two members of the research team, with these individuals serving as coder one. The third member served as the second coder for all the data. Inter-rater reliability was calculated as the overall percent agreement. Total initial percent agreement between coders was 97%. I served as the third coder across conditions to establish 100% agreement. There were not any participants who experienced a retrospective memory error in the naturalistic task.

Prior to hypothesis testing, assumptions for normality, outliers, and linearity were checked. PM performance across each task fell within acceptable ranges of skewness and kurtosis with no outliers. A scatterplot indicated that PM performance in the standard laboratory and eye tracking task followed a linear pattern. As for reaction time there were no outliers indicated by a boxplot. The scores for overall reaction time between the control and experimental block were normally distributed, the skewness and kurtosis values were within acceptable range of -2 and +2. There were five outliers for fixation count as indicated by a boxplot. These outliers were removed from the analyses. The scores for fixation count between the control and experimental block were normally distributed, the skewness and kurtosis values were within acceptable range of -2 and +2.

Average PM performance was measured on the standard laboratory task (*M* = .75, *SD* = .29), the eye tracking task (*M* = .79, *SD* = .28) as well as the naturalistic task (*M* = .67, *SD* = .34). I used a repeated measures ANOVA to examine differences in average PM performance across the three tasks. The three levels for the independent variable of Task: standard laboratory, eye tracking, and naturalistic. The main effect of Task was just shy of reaching traditional significance values, $F(2,136) = 2.90$, $p = .06$, partial $\eta^2 = .04$. Despite their not being a main effect, there was a significant difference in performance between the naturalistic task and the eye tracking task ($p = .43$). This suggests that there is a trend for PM performance in the eye tracking task to be better than the naturalistic. However, there were no significant differences in PM performance between the other tasks.

For hypothesis one, I used a Pearson's correlation to compare PM performance across every task. These correlations revealed that PM performance in the naturalistic task had no relationship with PM performance in the eye tracking task $r(77) = -.02$, $p = .89$. As predicted, PM performance in the standard laboratory task and naturalistic task also did not share a significant relationship, $r(73) = .18$, $p = .13$. PM performance in both the standard laboratory task and the eye tracking task had no relationship with PM performance in the naturalistic task.

For hypothesis two, I used a Pearson's correlation to compare PM performance in the standard laboratory task and the eye tracking task. As predicted, I found that PM performance in the standard laboratory task and the eye tracking task shared a significant, positive relationship, $r(69) = .35$, $p = .003$. See Table 1 for PM performance descriptives and correlations.

Table 1 Descriptive Statistics and Correlations for PM Performance Across Tasks

Variable	*N*	*M*	*SD*	1	2	3
1. Naturalistic PM Accuracy	81	.67	.34	—		
2. Eye Tracking PM Accuracy	77	.79	.28	-.02	—	
3. Lexical Decision PM Accuracy	73	.75	.29	.18	.35**	—

Note. $^{**}p < .01$.

Strategic Monitoring

Strategic monitoring in the eye-tracking task was operationalized as the comparison of average fixations in the target region in the control block and experimental block. In the control block participants trials that exceeded 2.5 standard deviations from their mean and standard deviation of their fixation counts were excluded from analyses which included 3% of trials (Vorwerk et al., 2019). Utilizing the same criteria for the experimental block there were 1% of trials that were excluded from analyses. Additionally, the six PM target trials were excluded from strategic monitoring analyses in the eye tracking task because typically strategic monitoring occurs more on these trials (Vorwerk et al., 2019).

Strategic monitoring in the standard laboratory task was operationalized as the comparison of average reaction time for responding to the ongoing lexical decision task in the control block and the experimental block. Reaction time trimming were done separately for participants word and non-word trials where trials that exceeded 2.5 standard deviations from their personal mean and standard deviation of their reaction time were excluded from analyses which is common practice in the literature (Cohen et al., 2008; Einstein et al., 2005; Scullin et al., 2010). Based on these trimming criteria there were two percent of trials that were excluded from analyses in the control block. Additionally, one percent of trials were excluded from the experimental block. The six PM target trials were excluded from strategic monitoring analyses in the standard laboratory task as strategic monitoring occurs more frequently on these trials (Einstein et al., 2005; Scullin et al., 2010).

To determine if participants were engaging in strategic monitoring in the standard laboratory task, I conducted a paired samples *t* test to determine if there were significant differences in overall reaction time between the control and experimental blocks**.** Participants' overall reaction time was significantly slower in the experimental block (*M* = 835.11, *SD* = 167.77) compared to the control block (*M* =745.69, *SD* = 111.39) for the lexical decision task, *t*(79) = 7.61, *p* < .001, *d* = .85. This was a large effect. This significant difference between the control and experimental blocks indicated that participants utilized strategic monitoring in the experimental block for the PM task. See Figure 2 below for reaction time averages in the experimental and control block.

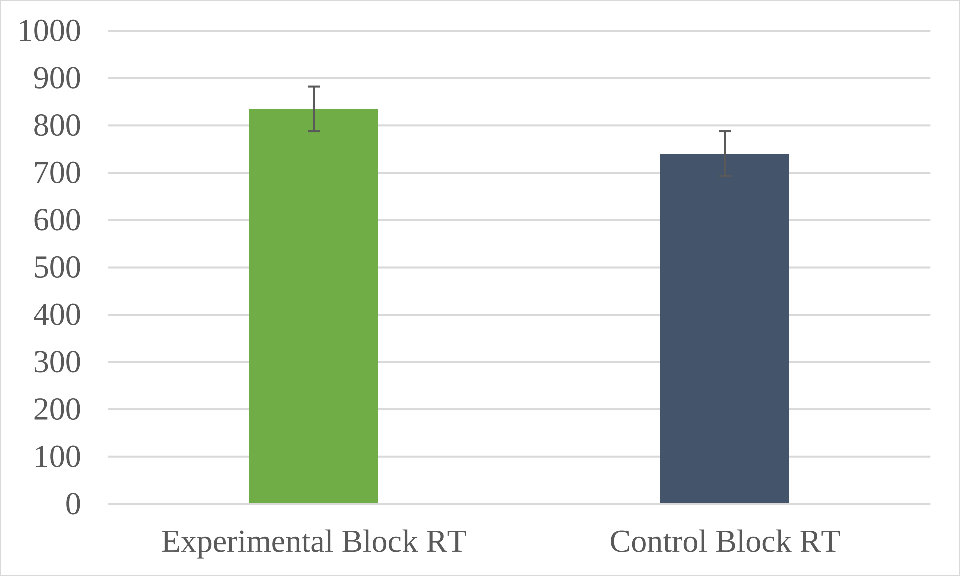


Figure 2 Strategic Monitoring in the Standard Laboratory Task

To analyze strategic monitoring in the eye tracking task, a paired samples *t* test was conducted to determine if there were significant differences in fixation counts between the control and experimental blocks. Participants' average fixation count was higher in the experimental block (*M* = 160.25, *SD* = 99.67) compared to the control block (*M* = 10.43, *SD* = 10.99) for the eye tracking task, *t*(68) = 12.73, *p* < .001, *d* = 1.53. This was a large effect. The significant difference between participants' fixation count in the control versus the experimental block suggests that participants engaged in strategic monitoring when a PM demand was present. See Figure 3 for average number of fixations in the target region in the experimental and control block.

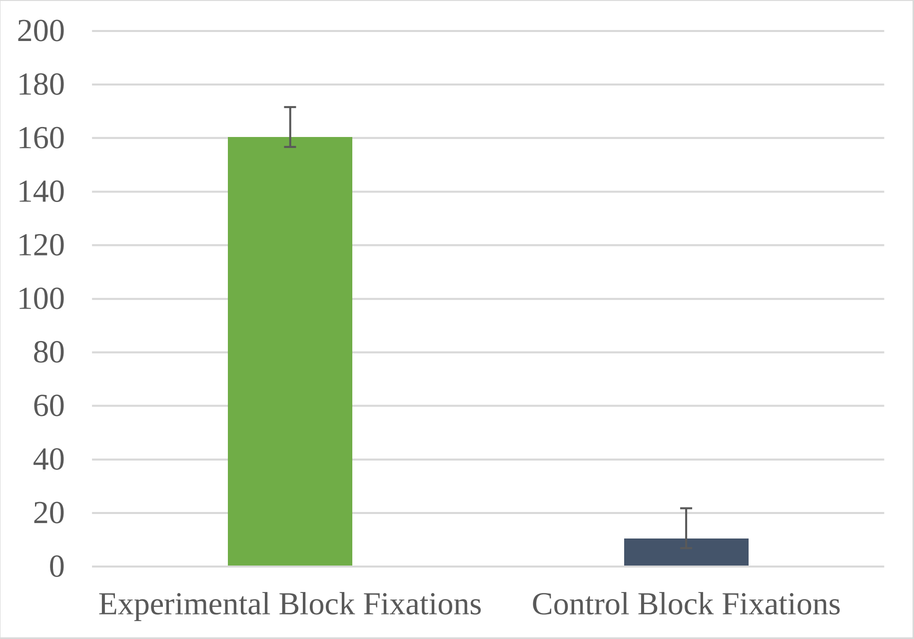


Figure 3 Strategic Monitoring in the Eye tracking Task

To test hypothesis three, two partial correlations were conducted in the standard laboratory and eye tracking task. For the partial correlation in the eye tracking task PM performance and fixations in the experimental block in the PM target region was compared while controlling for fixations in the PM target region in the control block. I controlled for fixations in the control block to ensure there was a direct relationship between strategic monitoring (e.g., fixations in the target region) and PM performance. We found that the average fixation count in the eye-tracking task had a significant and positive relationship with PM performance, *r*(69) = .40, p < .001.

For the standard laboratory task, PM performance and reaction time in the experimental block (e.g., strategic monitoring) was compared while controlling for reaction time in the control block. I controlled for reaction time in the control block to ensure that there was a direct relationship between strategic monitoring and PM performance. We found that average reaction time in the experimental block also shared a significant positive relationship with PM performance, *r*(73) = .29, p = .013. To test hypothesis three, I compared the magnitude of the two partial correlations above with Comparing Correlations (Cocor) (Diedenhofen, & Musch, 2015). The findings suggest that the index of strategic monitoring derived from the eye tracking task does not have a stronger relationship to PM performance relative to the standard laboratory task, *z* = .78, *p* = .43.

Metacognition

Performance Predictions

The primary interest in assessing metacognition in this study, was to determine if there were discrepancies between participants' predictions across each task. Predictions were operationalized as participants' average prediction ratings on a scale of 0-100. Average prediction ratings for the standard laboratory task (*M* = .67, *SD* = .19), eye tracking (*M* = .72, *SD* = .20), and the naturalistic task (*M* = .91, *SD* = .12) were measured. There was a significant main effect for predictions, *F*(2,152) = 63.21, *p* < .001, partial η^2 = .45. Least significant difference corrections revealed that predictions in the standard laboratory and eye tracking tasks were significantly different from one another (*p* = .02). In addition, prediction in the standard laboratory and naturalistic task were significantly different ($p < .001$). Predictions in the eye tracking task and naturalistic task were significantly different ($p < .001$). These findings suggest that participants prediction ratings varied significantly based on the type of task they were completing.

Performance Post-dictions

The sample for this analysis is lower (n = 53) because the post-diction rating for the naturalistic task was in the post-study survey and around 20 participants did not answer this survey. Most of these participants who did not answer this survey were college students. Post-dictions were operationalized as participants' average post diction ratings on a scale of 0-100. Average post-diction ratings for the standard laboratory task ($M = .65$, $SD = .25$), eye tracking ($M = .67$, $SD = .19$), and the naturalistic task ($M = .82$, $SD = .25$) were measured. A repeated measures ANOVA was conducted to compare post-dictions across every PM task. Our independent variable was Metacognitive Post-dictions with three levels. There was a main effect for post-dictions, $F(2,104) = 9.10$, $p < .001$, partial $\eta^2 = .15$. Least significant difference corrections revealed that post-dictions between the standard laboratory task and the eye tracking task ($p = .55$) did not significantly differ from one another. However, post-dictions between the standard laboratory task and the naturalistic task ($p < .001$) were significantly different. In addition, the eye tracking task, and the naturalistic task ($p = .002$) were significantly different. These data suggest that participants were equally confident in their post-dictions for their performance in both laboratory tasks. However, the findings for the naturalistic indicated that they felt more confident in their ability to provide a more accurate post-diction rating when compared to the laboratory tasks.

A 2 (Metacognitive Awareness: Predictions/Post-dictions) × 3 (Task: standard laboratory task, eye tracking, and naturalistic) repeated measures ANOVA was conducted to examine potential differences in prediction and post-diction ratings across tasks. Significant differences were observed in metacognitive awareness, $F(1,52) = 11.26$, $p < .001$, partial $\eta^2 = .18$, and task type, $F(2,104) = 31.01$, $p < .001$, partial $\eta^2 = .37$. The interaction was not significant, $F(2,104) = 1.84$, $p = .16$, partial $\eta^2 = .03$. Least significant difference corrections revealed that there was a significant difference between the standard laboratory and the naturalistic task ($p < .001$). There was a significant difference between the eye tracking and naturalistic task ($p < .001$). Lastly, there was not a significant difference between standard laboratory and eye tracking task ($p = .13$). The main effect for metacognitive awareness suggests that average prediction ratings were higher than the average post-diction ratings. The main effect of task type suggests that there were significant differences in prediction and post-diction ratings across the three tasks. The findings regarding the least significant difference corrections suggests that predictions and post-dictions in the standard laboratory and naturalistic task, as well as the eye tracking and naturalistic task varied significantly between these tasks. However, between the laboratory tasks participants prediction and post-diction ratings did not vary significantly across tasks.

Calibration

I analyzed a repeated measures ANOVA to examine potential differences between actual performance and prediction ratings across PM tasks for hypothesis four. The difference between actual performance and predictions served as the dependent variable. There was a main effect of predictions, $F(2,128) = 31.08$, $p < .001$, partial $\eta^2 = .33$, with significant discrepancies between the naturalistic task and both laboratory tasks. Participants were more accurate in predicting their performance in both laboratory tasks relative to the naturalistic task. This indicates that participants were less accurate in their predictions in the naturalistic task relative to both laboratory tasks.

I analyzed a repeated measures ANOVA to examine potential differences between actual performance and post-diction ratings across tasks. The difference between actual performance and post-dictions served as the dependent variable. There was a main effect of post-dictions, $F(2,92) = 17.55$, $p < .001$, partial $\eta^2 = .28$. Post-diction accuracy in the naturalistic task was statistically different from the standard laboratory task as well as the eye tracking task. These data suggest that participants were more accurate in their post-dictions for the lexical decision and eye tracking tasks. Participants were overconfident in their ability to provide an accurate post-diction in the naturalistic task relative to their actual performance. See Figure 4 for metacognitive awareness across each task.

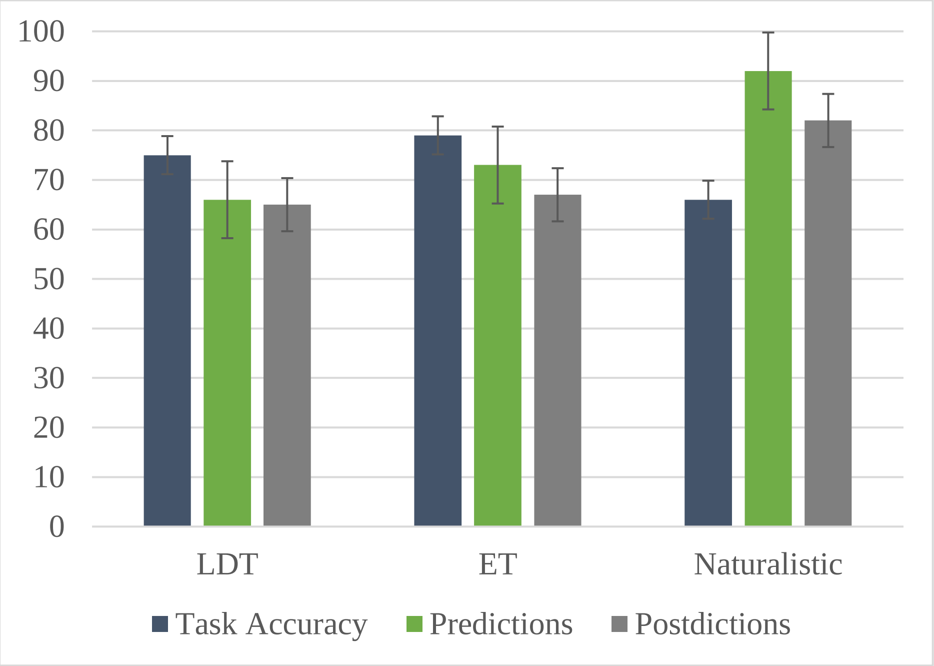


Figure 4 Metacognitive Awareness Across Tasks

CHAPTER IV

DISCUSSION

The present study had several goals which included: comparing two laboratory PM tasks and a naturalistic PM task, comparing methods for measuring strategic monitoring between two laboratory tasks, and to compare metacognitive accuracy across all the tasks. As predicted, PM performance in the standard laboratory task did not correlate with PM performance in the naturalistic task. Additionally, we found that PM performance in the eye tracking task had a positive and significant relationship with PM performance in the standard laboratory task. In addition, the measure of strategic monitoring in both laboratory tasks shared a significant relationship with PM accuracy in the respective tasks; however, the observed relationship between strategic monitoring and accuracy was not significantly different across the standard laboratory and eye-tracking tasks. Finally, as expected, we found that participants were better at predicting their performance in the laboratory tasks but were overconfident in their abilities for the naturalistic task. Below I discuss the implications of these findings.

Ecological Validity of Laboratory Prospective Memory Tasks

I found that the two laboratory tasks correlated with one another, which is in line with past research (Ball et al., 2019; Rose et al., 2010; Zuber et al., 2016). This is a notable finding as it establishes construct validity for the eye tracking task. In other words, the eye tracking task was able to assess strategic monitoring. Our findings regarding ecological validity of standard laboratory tasks are in line with past research. For example, Unsworth et al. (2012) found that standard PM laboratory tasks like the one used in the present study does not predict PM performance when compared to a naturalistic task. Comparably, Kim and Mayhorn (2008) found that PM performance in the naturalistic task was better when compared to performance in laboratory tasks. Therefore, the current study's main results are in line with past research suggesting that laboratory PM tasks are lacking in ecological validity.

A potential reason for why performance in the laboratory tasks did not translate well to the naturalistic task is the context in which participants completed these tasks. In the lab, participants are expected to complete the PM tasks in around an hour, while for the naturalistic task they submit two goals per day for three days after the laboratory session. The extended time in which participants had to complete their goals increases the memory burden. This is in line with previous research as studies have found worse PM performance with an increased time between when the PM goal is formed and executed (Martin et al., 2011; Rummel et al., 2023).

While PM laboratory tasks were designed to simulate PM in everyday life, there are notable discrepancies that influence performance across task settings. The setting in which participants complete each computerized task does not accurately simulate how they would complete their goals in the naturalistic portion of the study. For example, a participant could have set a goal to exercise for thirty minutes that day or to remember to take their dog to the dog park. In the naturalistic context participants have daily ongoing tasks like work or school that may interrupt them from completing their PM goals while in the laboratory distractions are relatively low (McDaniel & Einstein, 2007). Additionally, a characteristic of laboratory tasks is the delay between the control and experimental block where the PM task is embedded. In the present study, the delay in each laboratory task included a three-minute letter fluency task that was administered before each experimental block. However, in the real-world delays can often be hours. For example, if someone is planning to go exercise later in the day this can be a several hour delay or planning to attend your child's baseball game can be a several week delay (McDaniel & Einstein, 2007).

Another potential difference between PM tasks across laboratory and naturalistic settings is that PM retrieval in a naturalistic context may be more reliant on a spontaneous retrieval process compared to strategic monitoring in a laboratory context (e.g., seeing your dog's leash which prompts you to walk your dog) (Kvavilashvili & Fisher, 2007; McDaniel & Einstein, 2007). Naturalistic tasks are important for assessing PM in an individual's everyday setting. However, it is especially important that laboratory tasks are isolating constructs like strategic monitoring as well as spontaneous retrieval. These constructs are difficult to isolate and assess in naturalistic tasks.

Strategic Monitoring

The key purpose of laboratory tasks has been to isolate underlying cognitive processes, which has afforded researchers the opportunity to test predictions posed in prominent theoretical frameworks. In the present study we aimed to isolate and assess strategic monitoring in two laboratory tasks. Several theories attempt to account for the processes supporting successful prospective remembering. The PAM theory suggests that preparatory attention, or strategic monitoring, is essential for successful PM performance, and engaging in this monitoring will lead to performance decrements in other ongoing activities (Smith, 2003; Smith et al., 2007). Einstein (2005) found that participants relied on strategic monitoring and spontaneous retrieval under different manipulations to the PM tasks. Similarly, the Dynamic Multi-process Framework theorizes that both strategic monitoring and spontaneous retrieval interact to support PM (Scullin et al., 2013). More recently, standard measures of strategic monitoring have not related to PM performance (Harrison & Einstein, 2010; McNerney & West, 2007; Scullin et al., 2010, 2013; Wang et al., 2011). Notably, the present study observed a relationship between strategic monitoring and PM performance in the standard laboratory task. This is more in line with earlier research done on strategic monitoring (Smith, 2003; Smith & Bayen, 2004). Our findings are in line with previous theories in which strategic monitoring is an important process underlying PM in certain contexts, such as the laboratory tasks used in the present study (Einstein, 2005; Scullin et al., 2013; Smith, 2003)**.** Currently, it is unclear whether this finding will remain consistent in future research. However, our findings regarding strategic monitoring in the eye tracking task may provide a more consistent measure of strategic monitoring in which standard laboratory measures has not provided. This is encouraging for the field because eye tracking could be a reliable and valid alternative to standard measures of strategic monitoring.

In the eye tracking task strategic monitoring was indexed by fixations in the PM target region when the PM demand was present versus when no PM demand was present. Our measure of strategic monitoring did support successful PM performance. Indeed, PM accuracy was higher when participants fixated more on the target region in the experimental block. This finding replicated Shelton & Christopher's (2016) study in which they found that by placing the PM target separate from the ongoing task they were able to directly observe strategic monitoring. This finding suggests that this eye tracking paradigm was able to capture a direct measure of strategic monitoring. Additionally, eye tracking can provide future research with a more precise measure of monitoring that may not be consistently observed in typical laboratory paradigms. Although, the eye tracking task did not have a relationship with the naturalistic task this paradigm was able simulate the process of strategic monitoring in the lab. Typically, in a real-world context we shift our attention to different stimuli in the visual field while engaged in an ongoing task (Bowden et al., 2017; Shelton & Christopher, 2016). The magnitude of the relationship between PM performance and the measure of strategic monitoring was similar across both laboratory tasks. However, the eye tracking task may be better able to capture strategic monitoring by examining participants visual attention to the PM task. This has significant implications for future research. Recent studies utilizing eye tracking have consistently found a relationship between strategic monitoring and PM accuracy (Bowden et al., 2017; Koslov et al., 2022; Shelton & Christopher, 2016; Yörük & Cangöz-Tavat, 2022). By utilizing physiological measures such as eye tracking this could be a more consistent measure of strategic monitoring such that reaction time measures have failed to be consistent.

Metacognitive Awareness

There is limited research regarding metacognition in PM performance in laboratory and naturalistic tasks. Most research suggests that participants have minimal understanding of their PM abilities (Kuhlmann, 2019; Meeks et al., 2007). However, Cauvin et al. (2019) found in their naturalistic study that participants were overconfident in predicting their PM performance. In the current study, we found that participants were more accurate in predicting their performance on both laboratory tasks but were overconfident in their ability to predict their naturalistic performance. This finding does fall in line with past research in naturalistic contexts (Cauvin et al., 2019; Kuhlmann, 2019).

Kuhlmann (2019) suggests that people have some metacognitive awareness or expectations of their PM performance in different contexts. This can determine how individuals complete their PM tasks. For example, in naturalistic contexts completing future intentions is something participants are more familiar with compared to completing these intentions in a laboratory setting. Past research has indicated that having participants generate their goals is important because people are more motivated to complete goals that are concordant with their own interests (Walter & Meier, 2014, 2017). However, in the current study it seems that participants were overconfident in their ability to predict their PM performance in the naturalistic task, perhaps precisely because they generated their own goals to complete. These goals may seem more attainable to participants as they are related to their own self-interested motives and desires. Additionally, participants may have not anticipated distractions on the days that were intended for them to complete their goals. Participants may have been worse in predicting their performance on the naturalistic task due to the timeframe and context in which they had for this task relative to the laboratory tasks. For example, participants were told to complete two goals per day for three days while in the laboratory tasks they completed all the PM goals in the laboratory session. The naturalistic task context in which participants completed their PM tasks was a longer timeframe compared to the laboratory context. Our findings suggest that participants were more accurate in their predictions in the laboratory tasks relative to the naturalistic task which suggests that there is a more pronounced disparity in metacognitive accuracy in everyday contexts.

Limitations and Future Directions

Several limitations were present in the current study. First, participants only had one PM task to remember in each laboratory task (e.g., apple image and words starting with g) while six different tasks had to be remembered for the naturalistic task. Another limitation is that PM performance in the naturalistic task required participants to remember to complete their goal and remember to submit photo evidence, which is not the case for the laboratory tasks.

Additionally, this study utilized a novel goal setting paradigm for the naturalistic portion of the study. Given that this is a naturalistic design there are several limitations that arise with this type of design. First, it was not possible to control how participants completed their goals outside of the lab. In contrast, in the laboratory portion there was experimental control to observe the processes that supported PM. Arguably, it is essential for participants to generate their own goals for the sake of external validity. However, internal validity is a limitation for the naturalistic portion of this study as we could not isolate processes that could have supported PM in participants' everyday environments like strategic monitoring or spontaneous retrieval.

The observed relationship between strategic monitoring and PM performance and the standard laboratory task is inconsistent with several recent studies that have failed to find such a relationship. Having participants complete the eye tracking task first could have primed them to strategically monitor more than they would have. Additionally, because the naturalistic task always had to be completed outside of the lab session it was not possible to counterbalance each task. Future research should consider counterbalancing to control for any order effects that may occur to observe if this finding will remain consistent.

The present study did replicate the findings from Shelton and Christopher’s (2016) study where strategic monitoring and PM performance are related in the eye tracking task. Furthermore, studies replicating these findings are needed to establish the reliability and generalizability of these results. In addition, future studies could further investigate the cognitive processes as well as neural mechanisms associated with eye fixations to better understand its role in prospective remembering. Additionally, future research could investigate individual differences in strategic monitoring abilities which affect PM performance in laboratory tasks.

Finally, our metacognitive accuracy measurement has been scrutinized in the literature (Kuhlmann, 2019). The use of percentages for predictions in laboratory tasks are not the type of estimates that are encountered in everyday life. Future research should utilize more self-report measures like the Metacognitive Accuracy Inventory (MAI; Schraw & Dennison, 1994). Self-report measures like this could highlight more individual differences in the metacognition of prospective memory.

Conclusions

There are notable findings from the present study that extend our understanding of validity in laboratory PM tasks. First, our findings suggest that laboratory tasks do not accurately predict PM performance in a real-world context**.** This is in line with past research which suggests that future research needs to improve upon the existing laboratory paradigms to establish ecological validity with naturalistic tasks. Future studies should focus on developing and validating better laboratory paradigms that simulate real-life PM scenarios. For example, incorporating complex and realistic PM stimuli as well as context that better portrays decision-making processes that is similar to a real-world setting. Further research is needed to explore the factors that may influence the relationship between PM performance in a controlled laboratory setting versus a naturalistic or everyday environment. Second, we established construct validity for the eye tracking paradigm meaning that the eye tracking paradigm is a valid laboratory assessment. This is a notable finding as eye tracking could provide a more consistent measure of underlying constructs like strategic monitoring**.** The strategic monitoring measures derived from both laboratory tasks were positively related to PM performance, demonstrating the strength of laboratory PM research for isolating the cognitive processes underlying PM. Our findings have significant implications, as strategic monitoring and fixation count in the PM target region were found to be positively related to PM performance in the standard and eye tracking task. These findings provide support the PAM theory, Multi-process Framework, and Dynamic Multi-process Framework which suggests that strategic monitoring can help improve PM performance in certain situations (McDaniel & Einstein, 2000; Scullin et al., 2013; Smith, 2003).

In sum, the present study contributes to the PM field by investigating the ecological validity concerns in laboratory tasks as well as metacognitive accuracy in prospective remembering. The findings highlight the challenges of establishing ecological validity and emphasize the importance of future research needed to address these limitations as well as explore alternative approaches. However, the results of this study do suggest that there is a relationship between laboratory measures of strategic monitoring and PM performance which has not been consistent in past research. In addition, this study extended knowledge on metacognitive accuracy in PM as this awareness of one’s own abilities may differ based on the type of task. Future studies should address the mentioned limitations and other factors that may influence PM performance.

REFERENCES

Aberle, I., Rendell, P. G., Rose, N. S., McDaniel, M. A., & Kliegel, M. (2010). The age prospective memory paradox: young adults may not give their best outside of the lab. *Developmental Psychology*, *46*(6), 1444–1453. https://doi.org/10.1037/a0020718

Anderson, F. T., McDaniel, M. A., & Einstein, G. O. (2017). Remembering to remember: An examination of the cognitive processes underlying prospective memory ☆. In *Learning and Memory: A Comprehensive Reference* (pp. 451–463). Elsevier. https://doi.org/10.1016/B978-0-12-809324-5.21049-3

Ball, H., Vogel, A., & Brewer, G. A. (2019). Individual differences in prospective memory. In J. Rummel & M. A. McDaniel (Eds.), *Prospective Memory* (1st ed., pp. 116–134). Routledge. https://doi.org/10.4324/9781351000154-8

Bailey, P. E., Henry, J. D., Rendell, P. G., Phillips, L. H., & Kliegel, M. (2010). Dismantling the "age–prospective memory paradox": The classic laboratory paradigm simulated in a naturalistic setting. *Quarterly Journal of Experimental Psychology*, *63*(4), 646–652. https://doi.org/10.1080/17470210903521797

Bowden, V. K., Smith, R. E., & Loft, S. (2017). Eye movements provide insights into the conscious use of context in prospective memory. *Consciousness and Cognition*, *52*, 68–74. https://doi.org/10.1016/j.concog.2017.04.003

Brewer, G. A., Knight, J. B., Marsh, R. L., & Unsworth, N. (2010). Individual differences in event-based prospective memory: Evidence for multiple processes supporting cue detection. *Memory & Cognition*, *38*(3), 304–311. https://doi.org/10.3758/MC.38.3.304

Brown, N. L., Hicks, J. L., & Beck, M. R. (2014). *The impact of visual attention on prospective memory*. Paper presented at the 4th International Conference on Prospective Memory, Naples, Italy.

Cacioppo, J. T., Petty, R. E., & Feng Kao, C. (1984). The efficient assessment of need for cognition. Journal of personality assessment, 48(3), 306-307. https://doi.org/10.1207/s15327752jpa4803_13

Cauvin, S., Moulin, C., Souchay, C., Schnitzspahn, K., & Kliegel, M. (2019). Laboratory vs. naturalistic prospective memory task predictions: Young adults are overconfident outside of the laboratory. *Memory*, *27*(5), 592–602. https://doi.org/10.1080/09658211.2018.1540703

Cohen, A.-L., Jaudas, A., & Gollwitzer, P. M. (2008). Number of cues influences the cost of remembering to remember. *Memory & Cognition*, *36*(1), 149–156. https://doi.org/10.3758/MC.36.1.149

Devolder, P. A., Brigham, M. C., & Pressley, M. (1990). Memory performance awareness in younger and older adults. *Psychology and Aging*, *5*(2), 291–303. https://doi.org/10.1037/0882-7974.5.2.291

Dieckmann, P., Reddersen, S., Wehner, T., & Rall, M. (2006). Prospective memory failures as an unexplored threat to patient safety: Results from a pilot study using patient simulators to investigate the missed execution of intentions. *Ergonomics*, *49*(5–6), 526–543. https://doi.org/10.1080/00140130600568782

Diedenhofen, B. & Musch, J. (2015). cocor: A Comprehensive Solution for the Statistical Comparison of Correlations. *PLoS ONE*, *10*(4): e0121945. doi:10.1371/journal.pone.0121945

Einstein, G. O., & McDaniel, M. A. (1990). Normal aging and prospective memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16*(4), 717–726. https://doi.org/10.1037/0278-7393.16.4.717

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*(3), 327–342. https://doi.org/10.1037/0096-3445.134.3.327

Gibbs, J. C. (1979). The meaning of ecologically oriented inquiry in contemporary psychology. *American Psychologist*, *34*(2), 127–140. https://doi.org/10.1037/0003-066X.34.2.127

Gump, P. V., & Kounin, J. S. (1960). Issues raised by ecological and “classical” research efforts. *Merrill-Palmer Quarterly of Behavior and Development*, *6*(3), 145–152.

Hacker, J. Y., Shelton, J.T., & Bianchi, C. (2019). Motivational influences on prospective memory and metacognition in the laboratory and the real world. Paper Under Review.

Harrison, T. L., & Einstein, G. O. (2010). Prospective memory: Are preparatory attentional processes necessary for a single focal cue? *Memory & Cognition*, *38*(7), 860–867. https://doi.org/10.3758/MC.38.7.860

Hicks, J. L., Marsh, R. L., & Cook, G. I. (2005). Task interference in time-based, event-based, and dual intention prospective memory conditions. *Journal of Memory and Language*, *53*(3), 430–444. https://doi.org/10.1016/j.jml.2005.04.001

Holleman, G. A., Hooge, I. T. C., Kemner, C., & Hessels, R. S. (2020). The ‘real-world approach’ and its problems: A critique of the term ecological validity. *Frontiers in Psychology*, *11*, 721. https://doi.org/10.3389/fpsyg.2020.00721

Horn, S. S., Bayen, U. J., & Smith, R. E. (2011). What can the diffusion model tell us about prospective memory? *Canadian Journal of Experimental Psychology / Revue Canadienne de Psychologie Expérimentale*, *65*, 69–75. https://doi.org/10.1037/a0022808

Ihle, A., Schnitzspahn, K., Rendell, P. G., Luong, C., & Kliegel, M. (2012). Age benefits in everyday prospective memory: The influence of personal task importance, use of reminders and everyday stress. *Aging, Neuropsychology, and Cognition*, *19*(1–2), 84–101. https://doi.org/10.1080/13825585.2011.629288

Kim, P. Y., & Mayhorn, C. B. (2008). Exploring students' prospective memory inside and outside the lab. *The American Journal of Psychology*, *121*(2), 241–254. https://doi.org/10.2307/20445459

Kliegel, M., Martin, M., McDaniel, M. A., & Einstein, G. O. (2010). Varying the importance of a prospective memory task: Differential effects across time - and event-based prospective memory. *Memory*, *9*(1), 1–11. https://doi.org/10.1080/09658210042000003

Kuhlmann, B. G. (2019). Metacognition of prospective memory: Will I remember to remember? In *Prospective Memory*. Routledge.

Kvavilashvili, L., & Ellis, J. (2004). Ecological validity and twenty years of real-life/laboratory controversy in memory research: A critical (and historical) review. *History and Philosophy of Psychology*.

Kvavilashvili, L., & Fisher, L. (2007). Is time-based prospective remembering mediated by self-initiated rehearsals? Role of incidental cues, ongoing activity, age, and motivation. *Journal of Experimental Psychology: General*, *136*(1), 112–132. https://doi.org/10.1037/0096-3445.136.1.112

Loft, S., Dismukes, K., & Grundgeiger, T. (2019). Prospective memory in safety-critical work contexts. In Editors (Eds.), Prospective Memory (pp. 170 - 186). Routledge.

Martin, B. A., Brown, N. L., & Hicks, J. L. (2011). Ongoing task delays affect prospective memory more powerfully than filler task delays. *Canadian Journal of Experimental Psychology = Revue Canadienne De Psychologie Experimentale*, *65*(1), 48–56. https://doi.org/10.1037/a0022872

Meeks, J., Hicks, J. L., & Marsh, R. L. (2007). Metacognitive awareness of event-based prospective memory. *Consciousness and Cognition*, *16*(4), 997–1004. https://doi.org/10.1016/j.concog.2006.09.005

McDaniel, M. A., & Einstein, G. O. (2000). Strategic and automatic processes in prospective memory retrieval: A multiprocess framework. *Applied Cognitive Psychology*, *14*(7), S127–S144. https://doi.org/10.1002/acp.775

McNerney, M., & West, R. (2007). An imperfect relationship between prospective memory and the prospective interference effect. *Memory & Cognition*, *35*(2), 275–282. https://doi.org/10.3758/BF03193448

Neisser, U. (1985). The role of theory in the ecological study of memory: Comment on Bruce. *Journal of Experimental Psychology: General*, *114*, 272–276. https://doi.org/10.1037/0096-3445.114.2.272

Nuño, C. (2022). Being present for the future: Exploring mindfulness and prospective memory. *Masters Theses and Doctoral Dissertations*. https://scholar.utc.edu/theses/749

Psychology Software Tools, Inc. [E-Prime 3.0]. (2016). Retrieved from https://support.pstnet.com/.

Phillips, L. H., Henry, J. D., & Martin, M. (2008). Adult aging and prospective memory: The importance of ecological validity. In *Prospective memory: Cognitive, neuroscience, developmental, and applied perspectives* (pp. 161–185). Taylor & Francis Group/Lawrence Erlbaum Associates.

Rendell, P. G., & Craik, F. I. M. (2000). Virtual week and actual week: Age-related differences in prospective memory. *Applied Cognitive Psychology*, *14*(7), S43–S62. https://doi.org/10.1002/acp.770

Rendell, P. G., & Thomson, D. M. (1999). Aging and prospective memory: Differences between naturalistic and laboratory tasks. *The Journals of Gerontology: Series B*, *54B*(4), P256–P269. https://doi.org/10.1093/geronb/54B.4.P256

Rose, N. S., 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*(3), 595–605. https://doi.org/10.1037/a0019771

Rummel, J., & McDaniel, M. A. (2019). *Prospective Memory*. Routledge.

Rummel, J., & Meiser, T. (2013). The role of metacognition in prospective memory: Anticipated task demands influence attention allocation strategies. *Consciousness and Cognition*, *22*(3), 931–943. https://doi.org/10.1016/j.concog.2013.06.006

Rummel, J., Snijder, J.-P., & Kvavilashvili, L. (2023). Prospective memories in the wild: Predicting memory for intentions in natural environments. *Memory & Cognition*, *51*(5), 1061–1075. https://doi.org/10.3758/s13421-022-01379-y

Schmuckler, M. (2001). What is ecological validity? A dimensional analysis. *Infancy*, *2*. https://doi.org/10.1207/S15327078IN0204_02

Schnitzspahn, K. M., Kvavilashvili, L., & Altgassen, M. (2020). Redefining the pattern of age-prospective memory-paradox: New insights on age effects in lab-based, naturalistic, and self-assigned tasks. *Psychological Research*, *84*(5), 1370–1386. https://doi.org/10.1007/s00426-018-1140-2

Schnitzspahn, K., Zeintl, M., Jäger, T., & Kliegel, M. (2011). Metacognition in prospective memory: Are performance predictions accurate? *Canadian Journal of Experimental Psychology = Revue Canadienne de Psychologie Expérimentale*, *65*, 19–26. https://doi.org/10.1037/a0022842

Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive accuracy. *Contemporary Educational Psychology*, *19*(4), 460-475.

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. https://doi.org/10.1037/a0017732

Scullin, M. K., McDaniel, M. A., & Shelton, J. T. (2013). The Dynamic Multiprocess Framework: Evidence from prospective memory with contextual variability. *Cognitive Psychology*, *67*(1), 55–71. https://doi.org/10.1016/j.cogpsych.2013.07.001

Shelton, J. T., & Christopher, E. A. (2016). A fresh pair of eyes on prospective memory monitoring. *Memory & Cognition*, *44*(6), 837–845. https://doi.org/10.3758/s13421-016-0601-3

Shelton, J. T., & Scullin, M. K. (2017). The dynamic interplay between bottom-up and top-down processes supporting prospective remembering. *Current Directions in Psychological Science, 26*(4), 352–358. https://doi.org/10.1177/0963721417700504

Shelton, J. T., Scullin, M. K., J. Y., Hacker. (2019). The multiprocess framework: Historical context and the “dynamic” extension. In *Prospective Memory*. Routledge.

Smilek, D., Carriere, J. S. A., & Cheyne, J. A. (2010). Failures of sustained attention in life, lab, and brain: Ecological validity of the SART. Neuropsychologia, 48(9), 2564-2570. https://doi.org/https://doi.org/10.1016/j.neuropsychologia.2010.05.002

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*(3), 347–361. https://doi.org/10.1037/0278-7393.29.3.347

Smith, R. E., & Bayen, U. J. (2004). A multinomial model of event-based prospective memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *30*(4), 756–777. https://doi.org/10.1037/0278-7393.30.4.756

Smith, R., Hunt, R., Mcvay, J., & McConnell, M. (2007). The cost of event-based prospective memory: Salient target events. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *33*, 734–746. https://doi.org/10.1037/0278-7393.33.4.734

SR Research Experiment Builder 2.3.1 [Computer software]. (2020). Mississauga, Ontario, Canada: SR Research Ltd.

Unsworth, N., Brewer, G. A., & Spillers, G. J. (2012). Variation in cognitive failures: An individual differences investigation of everyday attention and memory failures. *Journal of Memory and Language*, *67*(1), 1–16. https://doi.org/10.1016/j.jml.2011.12.005

Vorwerk, T. M., Shelton, J. T., Splean, A., Wash, A., Craig, C. A., Hacker, J. Y., & Scullin, M. K. (March, 2019). *The Efficacy of Auditory and Visual Cues in an Nonfocal* 9 *Prospective Memory Task.* Paper presented at the annual conference for the Southern Society for Philosophy and Psychology. Cincinnati, OH.

Walter, S., & Meier, B. (2014). How important is importance for prospective memory? A review. *Frontiers in Psychology*, *5*. https://www.frontiersin.org/articles/10.3389/fpsyg.2014.00657

Walter, S., & Meier, B. (2017). Social importance enhances prospective memory: Evidence from an event-based task. *Memory*, *25*(6), 777–783. https://doi.org/10.1080/09658211.2016.1221973

Wells, G. (1993). What do we know about eyewitness identification? *The American Psychologist*, *48*, 553–571; discussion 572. https://doi.org/10.1037/0003-066X.48.5.553

Wells, S. (2022). When the goal is to be less stressed: A naturalistic investigation of academic and self-care goal completion. *Masters Theses and Doctoral Dissertations*. https://scholar.utc.edu/theses/760

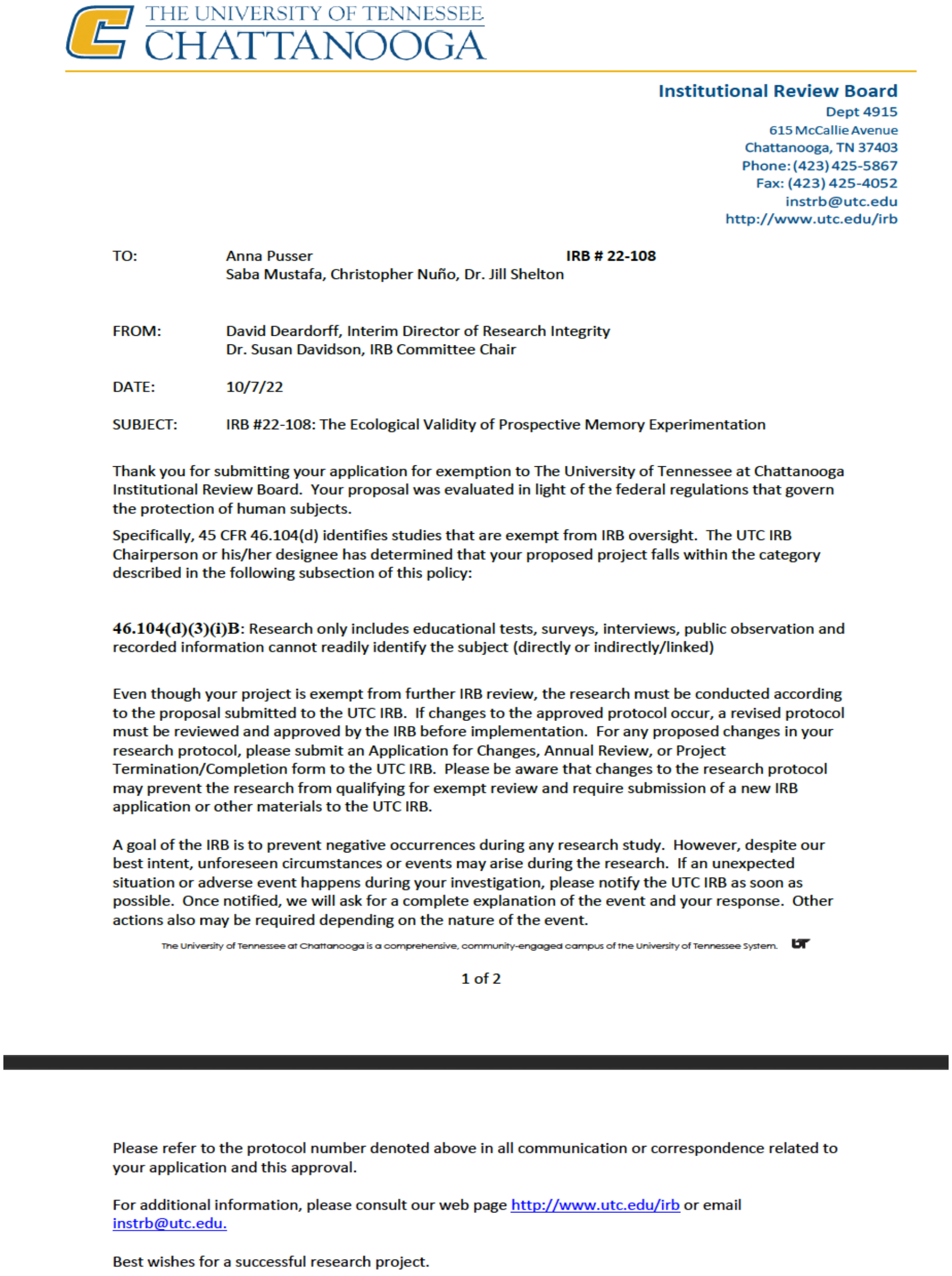
Wang, L., Altgassen, M., Liu, W., Xiong, W., Akgün, C., & Kliegel, M. (2011). Prospective memory across adolescence: The effects of age and cue focality. *Developmental Psychology, 47*, 226–232. https://doi.org/10.1037/a0021306

Zuber, S., Kliegel, M., & Ihle, A. (2016). An individual difference perspective on focal versus nonfocal prospective memory. *Memory & Cognition*, *44*(8), 1192–1203. https://doi.org/10.3758/s13421-016-0628-5

Yörük, A., & Cangöz-Tavat, B. (2022). Aging effect in prospective memory monitoring: An eye tracking study. *Turkish Journal of Geriatrics*, *25*(4). https://doi.org/10.31086/tjgeri.2022.323

APPENDIX A

IRB APPROVAL LETTER



THE UNIVERSITY OF TENNESSEE
CHATTANOOGA

Institutional Review Board
Dept 4915
615 McCallie Avenue
Chattanooga, TN 37403
Phone: (423) 425-5867
Fax: (423) 425-4052
instrb@utc.edu
http://www.utc.edu/irb

TO: Anna Pusser **IRB # 22-108**
Saba Mustafa, Christopher Nuño, Dr. Jill Shelton

FROM: David Deardorff, Interim Director of Research Integrity
Dr. Susan Davidson, IRB Committee Chair

DATE: 10/7/22

SUBJECT: IRB #22-108: The Ecological Validity of Prospective Memory Experimentation

Thank you for submitting your application for exemption to The University of Tennessee at Chattanooga Institutional Review Board. Your proposal was evaluated in light of the federal regulations that govern the protection of human subjects.

Specifically, 45 CFR 46.104(d) identifies studies that are exempt from IRB oversight. The UTC IRB Chairperson or his/her designee has determined that your proposed project falls within the category described in the following subsection of this policy:

46.104(d)(3)(i)B: Research only includes educational tests, surveys, interviews, public observation and recorded information cannot readily identify the subject (directly or indirectly/linked)

Even though your project is exempt from further IRB review, the research must be conducted according to the proposal submitted to the UTC IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an Application for Changes, Annual Review, or Project Termination/Completion form to the UTC IRB. Please be aware that changes to the research protocol may prevent the research from qualifying for exempt review and require submission of a new IRB application or other materials to the UTC IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the UTC IRB as soon as possible. Once notified, we will ask for a complete explanation of the event and your response. Other actions also may be required depending on the nature of the event.

The University of Tennessee at Chattanooga is a comprehensive, community-engaged campus of the University of Tennessee System.

1 of 2

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval.

For additional information, please consult our web page http://www.utc.edu/irb or email instrb@utc.edu.

Best wishes for a successful research project.

VITA

Anna Pusser was born in Jackson, Tennessee to her parent Christie Pusser. She is an older sister to, Malia Pusser. She attended and graduated from Jackson Central Merry Early College High School in Jackson, Tennessee and went on to pursue her undergraduate degree in psychology at the University of Memphis. During her time at the University of Memphis, Anna developed a strong interest in pursuing research and teaching. In her senior year she joined the Health, Education and Promotion laboratory in the psychology department. After graduating with her bachelors in 2021, Anna went on to pursue a Master's degree in Psychological Science at the University of Tennessee at Chattanooga. While attending the University of Tennessee at Chattanooga, Anna served as a psychology department graduate assistant. She also served as an instructor for a Research Methods Laboratory, Statistic Laboratory, and an Introductory Psychology course. She also served as manager for the Cognitive Aging, Learning, and Memory Laboratory as well as the Graduate Coordinator for the Research Methods Laboratory. Anna's research primarily focuses on prospective memory and applying cognition to educational practices. In her free time, she enjoys spending time with her cat Tater tot.