DON'T FORGET TO REMEMBER: MOTIVATION AND ENVIRONMENTAL CUES AFFECT PROSPECTIVE MEMORY PERFORMANCE

By

Jessica Y. Hacker

Jill Shelton
Assistant Professor of Psychology
(Chair)

David Ross
Professor of Psychology
(Committee Member)

Peter Rendell
Professor of Psychology
(Committee Member)

DON’T FORGET TO REMEMBER: MOTIVATION AND ENVIRONMENTAL CUES

AFFECT PROSPECTIVE MEMORY PERFORMANCE

By

Jessica Y. Hacker

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

May 2018

ABSTRACT

Prospective memory (PM) refers to remembering to fulfill previously formed intentions. While some intentions are self-interested, others are prosocial, and both are influenced by motivational forces. This study examined these relationships using a monetary incentive to moderate motivation, and explored how metacognition was affected. College students (*N* = 75) were randomly assigned to one of three conditions (i.e., prosocial, self-interested, or standard). Eye-tracking technology collected gaze data using a visual search task that incorporated a PM intention. Motivational orientation did not differentially influence PM performance. Metacognitive analyses indicated that while participants in the prosocial and standard conditions were underconfident, those in the self-interested condition accurately predicted their performance. Participants in the self-interested and standard conditions exhibited poor metacognitive awareness while those in the prosocial condition were accurate in gauging how well they actually did. These findings suggest that motivational states and incentives moderate metacognitive accuracy for PM intentions.

DEDICATION

This thesis is dedicated to my wonderful partner, Erin Brock. I cannot imagine having made this journey without your unwavering encouragement and support. To the rest of my family, especially Megan and Jake, thank you for your never-ending patience and love.

ACKNOWLEDGEMENTS

First and foremost, I want to thank my mentor and thesis chair, Jill Shelton, for her guidance and support over the last couple of years. She saw potential in me, even when I did not see it in myself, and for that I am forever grateful. Special thanks to my committee members, David Ross and Peter Rendell, who provided invaluable feedback on this project. It was truly an honor to have had the opportunity to work with them both. Additionally, I want to thank my lab mate and friend, Tommy Vorwerk, who never failed to provide help when I needed it most. Thanks to my research assistants, Amelia Edwards and Daniel Ellis, for their dedication to this project. Finally, I would like to recognize all the amazing faculty and staff of the UTC Psychology department.

TABLE OF CONTENTS

ABSTRACT.......... iii

DEDICATION.......... iv

ACKNOWLEDGEMENTS..........v

LIST OF TABLES.......... viii

LIST OF FIGURES ix

CHAPTER

I. INTRODUCTION 1

II. LITERATURE REVIEW 2

III. METHODOLOGY 13

Participants and Design..........13
Apparatus 13
Materials 14
Visual Search Task 14
Prospective Memory Task 15
Monitoring 16
Condition Specific Script..........17
Condition-Specific Video 18
Global Motivation Scale 18
Procedure 18

IV. RESULTS 21

Prospective Memory Performance..........21
Overt Monitoring 22
Metacognition 24
Ongoing Task..........29
Task Importance..........30

V. DISCUSSION 32

Prospective Memory Performance 32
Overt Monitoring 34
Metacognitive Awareness 35
Conclusions and Implications 37

REFERENCES 38

APPENDIX 42

A. IRB APPROVAL LETTER 42

B. DEMOGRAPHIC QUESTIONNAIRE 44

C. GLOBAL MOTIVATION SCALE (GMS-28) 46

VITA 49

LIST OF TABLES

4.1 Comparison of Predictions and Postdictions Across Conditions................................25

LIST OF FIGURES

3.1 Example of visual search/PM task trial 16

4.1 Self-reported motivation and PM performance by condition 22

4.2 Overt monitoring between the control and experimental blocks by condition 23

4.3 Metacognitive awareness of PM performance..27

4.4 Ongoing task performance by condition..30

4.5 Importance ratings between the ongoing and prospective memory tasks....................31

CHAPTER I

INTRODUCTION

Prospective memory (PM) refers to remembering to fulfill previously formed intentions. A classic example of this phenomenon is remembering to pick up a loaf of bread from the grocery store on the way home from work (Einstein & McDaniel, 1990). This particular example helps to illustrate the fact that PM intentions are a routine part of life, although some intentions are certainly more important than others. For example, remembering to keep an appointment for a job interview is more important than remembering to order concert tickets to see your favorite band. Additionally, while some PM intentions primarily benefit the individual fulfilling the intention, others are more prosocial in nature (Brandimonte, Ferrante, Bianco, & Villani, 2010). For instance, a person that remembered to pick up a loaf of bread may have had a sandwich for lunch the next day. Alternatively, perhaps the person intended to donate the bread to the university food bank to help provide for someone in need. Penningroth, Scott, and Freuen (2011) found that college students deemed prosocial PM tasks as more important in their daily lives than PM tasks that benefitted the self. Despite the practical importance of successful PM performance, especially as it relates to prosocial contexts, research into the motivational mechanisms that underlie PM performance is relatively scarce (Brandimonte et al., 2010). The purpose of the present study was to examine the motivational influences that support prospective remembering, while exploring metacognitive awareness of PM abilities. Furthermore, this study tested the hypothesis that environmental cues can support PM in a laboratory task.

CHAPTER II

LITERATURE REVIEW

Prosocial behavior is a broad concept loosely defined as behavior carried out with the intention of benefitting others. Furthermore, prosocial behavior is understood to be initiated by motivational forces, including altruism and egoism. Altruism and egoism can be viewed as opposite sides of the same coin in that they are goal-directed motivations (Batson & Powell, 2003). At the same time, there is a clear distinction between the two as egoism is focused on improving the well-being of the individual, while the focus of altruism is on benefitting others (Batson, 1987). For purposes of the present study, prosocial motivation is akin to altruism (benefitting another) while self-interested motivation is analogous to egoism (benefitting the self).

Research into the social underpinnings of PM has suggested that future intentions that benefitted others were more likely to be executed than those with no social benefit (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010; Penningroth et al., 2011). In a similar vein, task importance has also been identified as a mechanism that can improve PM performance, meaning that intentions of greater importance are more likely to be remembered and performed (Kliegel, Martin, McDaniel, & Einstein, 2004; Kliegel, Martin, McDaniel, & Einstein, 2001) Interestingly, the prosocial advantage in PM seems to offer greater benefits than the importance advantage. Penningroth et al. (2011) reported that prosocial, but less important tasks were paramount and therefore were more likely to be performed than self-interested tasks rated as higher in importance.

Motivational incentives have been used as a method to manipulate task importance in PM research (Walter & Meier, 2014). For example, Brandimonte et al. (2010) used social relevance and material rewards to examine the effects of incentives on PM task performance in a sample of college students. They compared the effects of a low material reward for the student (1 course credit) versus a social benefit for another person (helping a student collect data for her thesis), and included a condition which combined these self-interested and social benefits. In a typical laboratory PM paradigm, participants engage in an ongoing activity, (e.g., making decisions on whether or not a string of letters on the screen forms a real word) in which the PM target is embedded (Einstein & McDaniel, 1990). Brandimonte et al. (2010) and Brandimonte and Ferrante (2015) used a verb identification task as their ongoing activity with a PM task that required participants to sign a form at the end of each experimental block. The prosocial incentive benefitted PM performance without creating additional burdens for the cognitive system (termed strategic monitoring), as evidenced by relatively faster reaction times in the experimental block of the ongoing task in comparison to the control block. However, participants in the combined prosocial/self-interested incentive condition exhibited lower PM performance, equivalent to those in the standard PM condition. In other words, while memory for prosocial intentions may be better than self-interested intentions, the potential to earn a small incentive for oneself dampened this effect (Brandimonte et al., 2010).

Brandimonte and Ferrante (2015) extended this line of research to further explore the effects of motivational incentives on prosocial PM task completion in a different sample of college students. The social relevance of the PM task was established by informing participants that remembering to sign a form at the end of each experimental block would aid the researcher in collecting thesis data. The researchers compared a low monetary incentive (1 euro) to a higher monetary incentive (20 euros) and found that larger incentives resulted in better PM performance (experiment 1). A non-monetary incentive (i.e., public recognition of the participant's altruistic behavior) resulted in poorer performance and slower reaction times in the ongoing task (experiment 2). The researchers proposed the motivation crowding theory (Bénabou & Tirole, 2006), which refers to the notion that monetary incentives undermine intrinsic motivation and therefore impair prosocial behavior, as a possible explanation for poorer PM performance in prosocial situations when a small material reward was offered (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010). However, the combination of self-interested incentives and a prosocial motive in this study makes it difficult to tease apart which type of motivation exerts a stronger influence.

Even so, there is evidence that a purely self-interested incentive increases motivation to complete PM tasks, at least among college students. The so-called age prospective memory paradox posits that while older adults typically perform more poorly in lab PM tasks, those deficits are eliminated in naturalistic PM tasks wherein older adults outperform younger adults (Rendell & Craik, 2000). Aberle, Rendell, Rose, McDaniel, and Kliegel (2010) examined the efficacy of a monetary incentive between older and younger adults in a naturalistic PM task. The naturalistic task required participants to send a text message to the researcher at two predesignated times, twice a day for a period of 5 days. Participants in the incentive condition were told that on-time responses would earn them three lottery tickets, while late responses would earn them one lottery ticket. Furthermore, it was explained that the lottery tickets would be entered into a drawing for 100 Swiss francs (~100 USD), and that 20 participants would be awarded the incentive. In the no incentive condition, older adults outperformed younger adults, while in the incentive condition, younger adults performed equivalently to older adults. These findings suggest that monetary (i.e., extrinsic) incentives may be an effective way to improve PM performance in young adults in everyday settings. It is worth mentioning that older adults were compensated 20 Swiss francs (~20 USD) for simply participating in this study, which could have served as a motivator to perform well.

The effects of prosocial and self-interested motivation on PM performance in college students was examined in a recent series of experiments (Bianchi et al., 2017; Shelton, Hulse, Comotto, Hacker, & Carroll, 2016). In the first experiment, researchers used the potential to earn a monetary incentive to manipulate motivation. More specifically, participants were advised that performing well in two prospective memory tasks would increase their chances of winning a monetary incentive valued at $25. The PM tasks included a laboratory paradigm that was designed to create ambiguity regarding the context in which the PM target will appear, thereby discouraging the engagement of strategic monitoring processes (Scullin & McDaniel, 2010). In addition, participants were asked to complete a naturalistic texting task modeled after Aberle et al. (2010), which required participants to send two text messages a day for a period of five consecutive days. These text messages were to be sent at predesignated times and participants were instructed to include a letter that corresponded to the reason they remembered to send each text message. Participants in the prosocial condition had the opportunity to win the incentive for a friend of their choosing, while participants in the self-interested condition had the opportunity to win the incentive for themselves. A standard condition was also included that served as the control wherein participants were not made aware of the potential to earn an incentive, and simply performed the PM tasks. PM performance was significantly higher for those in the self-interested condition, suggesting that the potential to earn a moderate monetary incentive for oneself can improve memory for future intentions. In contrast, the potential to earn a monetary reward for a friend did not lead to benefits in PM performance. Additionally, ongoing task cost was not observed across conditions, suggesting that participants were not engaging effortful monitoring processes to support retrieval of the PM intention. This finding, coupled with subjective reports, is suggestive of a spontaneous retrieval of the intention regardless of motivational orientation.

In the second experiment, motivation was manipulated using context priming rather than a monetary incentive because the lack of a prosocial advantage in the first experiment was presumed to stem from the opportunity to earn a monetary incentive (Bianchi et al., 2017). Participants watched a condition-specific video (i.e., prosocial, self-interested, or standard), which was followed by the researcher reading a condition-specific script. The prosocial condition included a video on the benefits of veterans with traumatic brain injury being involved in research. The video for the self-interested condition was about a student who overcame poor study habits, and the video for the standard condition was on different hat styles. After the video and script were completed, participants were equipped with a GoPro camera and walked around campus identifying instances of the condition-specific behavior. Some examples of condition-specific behavior included seeing someone holding the door open for another person (prosocial), or seeing someone studying for an exam (self-interested). Participants in the standard condition simply identified individuals wearing hats. Results from this experiment indicated an advantage in PM performance for those in the prosocial condition suggesting that individuals are more altruistically motivated when there is no potential for a monetary incentive. Additionally, participants in the self-interested condition exhibited slower reaction times across the control and

PM blocks of the ongoing tasks used in the lab PM paradigm, suggesting that the self-interested group was dedicating more cognitive resources to their ongoing activities.

The findings from this series of studies mesh with those of Brandimonte et al. (2010) and Brandimonte and Ferrante (2015), suggesting that when individuals have the potential to earn an incentive for themselves, cognitive control mechanisms are activated and more attention is allocated to the PM task. The fact that those in the prosocial condition exhibited faster reaction times (Bianchi et al., 2017) than those in the self-interested condition, and had better PM performance could suggest that prosocial intentions are driven by more automatic processes, which has been suggested by Bargh, Chen, and Burrows (1996). There are several theories of prospective memory that align with these notions. The preparatory attentional and memory processes (PAM) theory posits that individuals must use attentional resources to maintain an intention, suggesting that successful retrieval of an intention depends upon an individual monitoring for the opportunity to execute the PM intention. This use of attentional resources is thought to create a cost to ongoing task performance (Smith, 2003).

McDaniel and Einstein (2000) offered an alternative model in the Multiprocess Framework (MPV), which postulates that two distinct mechanisms are responsible for remembering to perform an intention. The first process, strategic monitoring, is in line with PAM theory (Smith, 2003), in that individuals consciously maintain the intention while waiting for the opportunity to execute it. The second process, termed spontaneous retrieval, is thought to operate more automatically. One route to spontaneous retrieval is through environmental cues, which can trigger memory for the intention. Importantly, these processes are understood to operate differently based upon the nature of the PM task, the contextual cue, as well as individual differences (McDaniel & Einstein, 2000).

The MPV was recently revised to accommodate the theoretical dynamic process that occurs between spontaneous retrieval and strategic monitoring during intention retrieval. Scullin, McDaniel, and Shelton (2013) proposed and tested the Dynamic Multiprocess Framework (DMPV) using a laboratory paradigm in which participants were uncertain as to the context in which the PM targets were expected to occur. They found that participants did not engage in strategic monitoring until they were exposed to a salient environmental cue (i.e., the PM target), which elicited spontaneous retrieval of the intention and prompted participants to begin monitoring for additional opportunities to execute the intention. This dynamic relationship can be framed in terms of top-down and bottom-up processing. Specifically, top-down processing refers to the controlled process of monitoring, while bottom-up processing refers to the unconscious spontaneous retrieval of an intention. The DMPV suggests that retrieval of an intention is not restricted to one of these processes over the other, but rather these processes operate in a fluid manner through the use of environmental cues (Shelton & Scullin, 2017). Citing past studies in the motivation literature, Brandimonte and Ferrante (2008) pointed out that unconscious (i.e., bottom-up) processes are important in supporting conscious (i.e., top-down) processes for retrieval of an intention, especially when attention is divided, lending credence to the DMPV.

A novel eye-tracking paradigm was recently developed to evaluate the dynamic interaction between environmental cues and the cognitive processes supporting the retrieval of future intentions (Shelton & Christopher, 2016). The signature feature of this new paradigm is the fact that the PM target region is separate from the ongoing task region allowing the researchers to isolate the strategic monitoring process. Furthermore, this paradigm provided the ability to assess how environmental cues interacted with the cognitive processes supporting PM retrieval. Having a physiological measurement of strategic monitoring provides another avenue for capturing ongoing task cost above and beyond using reaction times as is typically done in laboratory PM tasks. Results suggested that strategic monitoring was prompted after participants fixated on a subtle, related cue. That is, participants fixated on a cue that was semantically related to the PM target, and then immediately shifted their focus to the PM target region, which the authors termed "cue-driven monitoring." This provides support for the interaction between environmental context and both top-down and bottom-up processes in successfully retrieving an intention.

Whereas prosocial behaviors are thought to operate more automatically (Bargh et al., 1996), incentivized behaviors have been linked to top-down processing (Small et al., 2005). The influence of monetary incentives on behavior is rather complicated because the existence of an incentive sends mixed-messages that serve to undermine the intrinsic motivation to complete a task. Furthermore, the amount of the incentive can lead to different outcomes. For example, while low monetary incentives lead to crowding out, high incentives create undue pressure to perform well, which can negatively affect behavior. On the other hand, moderate incentives can improve performance, at least in the short term (Gneezy, Meier, & Rey-Biel, 2011). It is important to note that monetary and non-monetary incentives are viewed differently when related to prosocial tasks. For example, Lacetera and Macis (2010) found that adding a monetary incentive to the prosocial task of donating blood decreased the likelihood that participants would be willing to donate; however, a non-monetary incentive did not have this negative effect. It has been theorized that extrinsic incentives might lead to concerns over an individual's reputation when linked to prosocial behavior because social norms dictate acceptability of being incentivized for prosocial behavior (Bénabou & Tirole, 2006).

It is not surprising then that individuals are often unaware of the effect that incentives have on prosocial behavior. Brandimonte et al. (2010) and Brandimonte and Ferrante (2015) had independent raters rate the likelihood they would perform PM tasks with prosocial and self-interested benefits. They found that situations with a combined social and personal benefit were rated as being more important and more likely to be performed. Despite this prediction, however, actual PM performance was better in purely prosocial situations (Brandimonte et al., 2010) and worsened when a low monetary incentive was offered (Brandimonte & Ferrante, 2015). Predictions of participants' own PM performance were obtained in Shelton et al. (2016) and Bianchi et al. (2017), with the purpose of gauging participants' awareness of their PM abilities, and to shed light on the conscious nature of self-interested/prosocial plans (i.e., the differences in overt performance predictions between groups). Across both experiments, participants were significantly overconfident in their predicted performance in the naturalistic task for all conditions. However, different patterns of metacognition emerged for the lab task. In the first experiment, participants were overconfident in the prosocial and standard conditions; however, those in the self-interested condition were accurate in their predictions (Shelton et al., 2016). In the second experiment, participants were overconfident in the standard condition; however, those in the prosocial and self-interested conditions were accurate in their predictions (Bianchi et al., 2017). This suggests that motivation and incentives influence metacognitive awareness of PM intentions. More specifically, the potential to earn a monetary incentive for oneself improved accuracy of predictions, while a context priming approach (i.e., non-monetary incentive) led to more accurate predictions in both the prosocial and self-interested conditions.

Research on metacognition (i.e., awareness of one's mental processes) as it relates to PM is an underexplored area of research. Based on the few studies that have been conducted, individuals are typically unable to accurately predict their PM performance (Meeks, Hicks, & Marsh, 2007; Schnitzspahn, Zeintl, Jäger, & Kliegel, 2011). Devolder, Brigham, and Pressley (1990) explored predictions and postdictions on memory performance and found that participants were more accurate in their postdictions than in their predictions. Meeks et al. (2007) found a similar result using a PM task that encouraged strategic monitoring. More specifically, participants were underconfident in both their predictions and postdictions when they were compared to actual performance, although postdictions were highly correlated with performance. Predictions, on the other hand, were only correlated with performance when a specific target cue was used as opposed to a categorical target cue.

Interestingly, there are inconsistent findings when it comes to predictions of anticipated performance. For example, one study included a sample of children who exhibited high confidence and accuracy in their predictions (Kvavilashvili & Ford, 2014), while another study that contained a sample of individuals with traumatic brain injury showed high confidence but poor performance (Devolder et al., 1990). These studies have provided important insights into the cognitive processing involved in metacognition and PM. Perhaps most importantly, several of the studies have demonstrated that simply having to make predictions can positively influence PM performance, at least in some situations (Meier, von Wartburg, Matter, Rothen, & Reber, 2011; Rummel, Kuhlmann, & Touron, 2013).

To the best of my knowledge, this study is the first of its kind to compare metacognitive predictions and postdictions to actual performance in a PM study using motivational incentives and eye-tracking technology. This approach is especially relevant due to the fact that metacognitive and motivational factors not only impact PM performance, but also the strategic allocation of attention (Meier et al., 2011; Rummel et al., 2013). In fact, automatic and controlled processes seem to account for previous findings in the PM literature on motivation and task importance. For example, while socially motivated intentions lead to decreased reaction times in ongoing tasks, which is reflective of more automatic (i.e., bottom-up) processing, self-interested tasks that include a moderate monetary incentive lead to increased reaction times, which is indicative of more effortful top-down processing. On the other hand, task importance and purely prosocial motives can improve PM performance without taxing the cognitive system (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010; Penningroth et al., 2011).

I predicted that PM performance (i.e., the percentage of times participants correctly identified the PM target) would be significantly higher in both the prosocial and self-interested conditions in comparison to the standard condition. Additionally, I predicted that overall monitoring for the PM target would be greater in the PM block than in the control block. Furthermore, I hypothesized that fixating on pictures that were semantically related to the PM target, would prompt spontaneous retrieval of the intention, as evidenced by higher rates of gaze transitions from semantically related cues directly to the PM target region (i.e., cue-driven monitoring) in comparison to transitions from unrelated cues to the PM target region. I did not predict differences in cue-driven monitoring based upon the motivational orientation of participants. Finally, I hypothesized that participant's metacognitive predictions would be at odds with their actual PM performance and that they would be unaware of this conflict. More specifically, I expected no correlation between predicted and actual performance in the PM task, and a negative relationship between predicted performance and estimates of actual performance.

CHAPTER III

METHODOLOGY

Participants and Design

Participants were students at the University of Tennessee at Chattanooga ($N = 80$), randomly assigned to one of three conditions: prosocial ($n = 24$), self-interested ($n = 25$), or standard ($n = 26$). Five participants were excluded from the analyses because of experimenter or participant error; therefore, the final sample consisted of 75 students ($M_{age} = 21.27$) with the majority being female (93.3%) and White (78.7%). Most participants were right hand dominant (92.0%) and all had normal or corrected-to-normal vision. All participants volunteered to participate through the University's research participation system (i.e., SONA) and received course credit. Those in the prosocial and self-interested conditions were eligible to earn an additional incentive beyond course credit.

This study employed a 2 (Cue type: semantically related/unrelated) × 2 (Block: control/PM) × 3 (Condition: prosocial/self-interested/standard) mixed-factor design with condition serving as the between-participants factor and cue type and block serving as the within-participants factors.

Apparatus

Data were collected in the laboratory with a Dell Latitude E6530 17" laptop computer using a Sensomotoric Instruments (SMI) Red-250 mobile eye-tracker with EyeWorks eye tracking software. The SMI Red-250 mobile eye-tracker has a gaze position accuracy of 0.4˚, with a spatial resolution of 0.03˚. Eye movements were recorded at a sampling rate of 60Hz, with a screen resolution of 1600 × 900 pixels. The eye-tracker captured fixation points, quantified at a dispersion rate of 30 pixels and threshold of .150s. Additionally, the eye-tracker measured gaze patterns to capture monitoring activity for the PM target and to examine patterns of cue-driven monitoring.

Materials

Visual Search Task. In the visual search task participants counted the number of living objects depicted in an array of pictures, which served as the ongoing task. Each array contained between 10 and 16 black and white images (M = 13), with an approximately equal but varying number of living and nonliving objects (see Figure 3.1). Pictures were obtained from several websites including openclipart.org, pixabay.com, and clker.com. The images were either photographs or graphic images, selected to illustrate simple and easily identifiable (i.e., common) living and nonliving objects. Each array constituted one trial with both experimental blocks (i.e., control and PM) containing 44 trials. The area of each array was the same size and rectangular shape, taking up approximately 63% of the screen. The pictures within each trial varied in both shape and size, depending on the number of images. The primary objective was to maximize the real estate of the array while providing variability in the ongoing task. Each trial remained visible on the computer screen for 12 seconds before automatically advancing to the next trial. Participants verbally reported the number of living objects to the experimenter as soon as they had finished counting them.

Prospective Memory Task. The PM task was embedded within the ongoing task, and required participants to click the left mouse button when the PM target appeared. The items used as the PM targets were counterbalanced with participants being randomly assigned to receive one of two targets (horse or chair). The PM target region resided in the top right corner of the display, just outside the main picture array, and covered approximately 2% of the screen (see Figure 3.1). The images in the target region changed more frequently (every four seconds) than the main array. Therefore, each target region picture represented one subtrial, with three subtrials (e.g., a, b, and c) per trial. The PM target appeared on four separate occasions. More specifically, the chair appeared in the target region during Trials 7a, 14b, 28c, and 39c. The horse appeared in the target region on Trials 7b, 14c, 28a, and 39b. Importantly, participants were instructed not to include the images from the PM target region in their living object count, which effectively required participants to engage in strategic monitoring in the PM block.

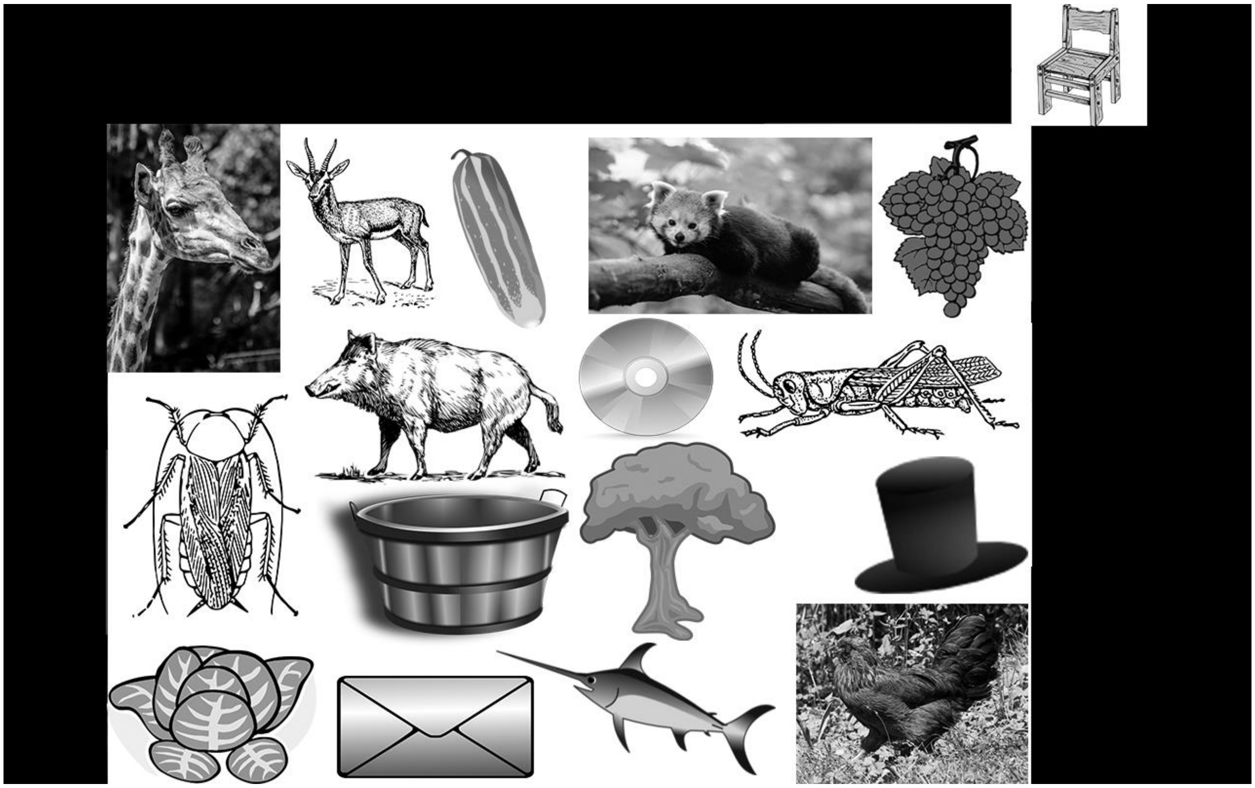

Figure 3.1

Example of visual search/PM task trial

Monitoring. In addition to serving as the ongoing task, the visual search task provided a means of examining cue-driven monitoring. Pictures of items semantically related to the PM targets were embedded within the visual search task. For the chair target, the semantically related items were table, desk, stool, and sofa. For the horse target, the semantically related items were cowboy, saddle, carriage, and hay. These pictures stemmed from semantically related cue words, obtained from Appendix B of the University of South Florida Free Association Norms (Nelson, McEvoy, & Schreiber, 2004). The associations between the semantic cues and the PM targets ranged from 13-87% (*M* = 20.6%), representing relatively strong associations between the cues and targets.

Each semantically related cue appeared twice, although different images were used for each cue so that identical images were not repeated. For the chair target, a table appeared in Trials 4 and 36, a desk in Trials 24 and 31, a stool in Trials 19 and 22, and a sofa in Trials 10 and 42. For the horse target, a cowboy appeared in Trials 3 and 32, a saddle in Trials 11 and 25, a carriage in Trials 21 and 43, and hay in Trials 18 and 35. For analysis purposes, semantically related cues were directly compared to unrelated cues. Furthermore, the unrelated cues occurred in the trial immediately before the semantic cues and resided in the same area of the main picture array as the semantic cues.

Condition-Specific Script. A condition-specific script was the primary method for manipulating motivation. These scripts introduced the additional incentive for those in the prosocial and self-interested conditions. The standard condition did not include a motivation manipulation. The self-interested script was as follows:

> You will be competing with other participants to win a $ 25 Amazon gift card. Each time that you remember to click the left mouse button when an image of a chair (horse) appears in the top right corner of the screen, you will earn a lottery ticket. At the end of the study, we will draw lottery tickets and 25% of participants will earn a $ 25 Amazon gift card. For example, if 100 people complete the study, we will draw lottery tickets for 25 winners. Thus, the more times you remember to perform this memory task, the more lottery tickets you will earn and the better your chance will be of winning this incentive.

The prosocial script was similar, although the potential incentive was a donation to charity rather than a gift card for the individual:

> You will be competing with other participants to win a $ 25 donation to a non-profit charity. Each time that you remember to click the left mouse button when an image of a chair (horse) appears in the top right corner of the screen, you will earn a lottery ticket. At the end of the study, we will draw lottery tickets and 25% of participants will earn a $ 25 donation to a non-profit charity. For example, if 100 people complete the study. We will draw lottery tickets for 25 winners. Thus, the more times you remember to perform this memory task, the more lottery tickets you will earn and the better your change will be of winning this incentive.

Condition specific video. A condition-specific video served a dual purpose. Specifically, the video was part of the delay interval; however, it was also used to strengthen the motivational orientation of participants. In Bianchi et al. (2017), a condition specific video was used and proved helpful in encouraging prosocial motivation. The prosocial video in this study featured a non-profit charity and highlighted the importance of individual donations. The self-interested video suggested various ways that college students could earn extra money. The video for the standard condition provided basic facts about the human brain, and was therefore unrelated to prosocial or self-interested motivations or incentives.

Global Motivation Scale. The Global Motivation Scale (GMS-28;Guay, Mageau, & Vallerand, 2003) was used to obtain a general measure of motivation (see Appendix A). The GMS-28 is a 28-item Likert-type scale with ratings ranging from one (“does not correspond accordingly”) to seven (“corresponds completely”). The scale contains seven constructs each measuring three distinct types of intrinsic motivation, three distinct types of extrinsic motivation, as well as amotivation. An example item is “In general, I do things…in order to feel pleasant emotions.”

Procedure

After being seated in front of the eye-tracking computer, participants completed the informed consent and then the GMS-28 (Guay et al., 2003). Immediately after this, the eye-tracker was calibrated and the experimenter verbalized the ongoing task (i.e., living object count) instructions. Then, participants completed two practice trials before the control block commenced.

At the conclusion of the control block, all participants received the PM task instructions with those in the prosocial and self-interested conditions also receiving the motivation manipulation (i.e., the condition-specific script). Next, participants completed an encoding check wherein they explained how the additional memory task worked and, when applicable, how the incentive competition worked. After this, a manipulation check was conducted by having participants provided a rating of how motivated they were to remember to respond to the image of the chair (horse) on a scale from 0 (not motivated at all) to 100 (extremely motivated). Then, participants predicted how well they would perform in the upcoming memory task on a scale from 0 (not very well at all) to 100 (extremely well), before moving to the desktop computer to watch the condition-specific video. No reminders of the PM task were given after this point in the experiment. At the conclusion of the video, participants completed a brief demographic questionnaire.

After completing the demographic questionnaire, participants moved back to the eye tracking laptop. From there, the eye tracker was recalibrated and participants completed the PM block. At the beginning of the PM block, the computer screen displayed the ongoing task instructions as a reminder to count the number of living objects. At the conclusion of the PM block, the computer screen displayed a series of questions, presented one at a time, with each question requiring a response from the participant in order to move forward with the experiment.

The first two questions served as a retrospective memory check to ensure that any failure to perform the PM task was not due to forgetting the PM task instructions. The first retrospective memory check allowed an open-ended response wherein participants explained the PM task in their own words. The second question was fill-in-the blank for the PM target and PM response, with four possible answer combinations. Importantly, there were no retrospective memory failures in this study. Next, participants rated the importance of counting the number of living objects as well as the importance of responding to the image of the chair (horse), on a scale from zero (not important at all) to 100 (extremely important). Next, participants rated how well they thought they did in the PM task on a scale from zero (not well at all) to 100 (extremely well). After this, participants explained the strategy they had used to remember to click the left mouse button when an image of a chair (horse) appeared. Finally, participants reported how many times they had remembered to click the left mouse button in response to an image of a chair (horse). At the conclusion of the eye-tracking task, the experimenter verbally debriefed and thanked participants for their participation.

CHAPTER IV

RESULTS

Prospective Memory Performance

PM performance was operationalized as the percentage of correct responses out of four possible targets, and analyzed using a 2 (Block: control/PM) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) ANCOVA with PM performance as the dependent variable and both condition and target as fixed factors. Additionally, each of the seven GMS-28 sub-scales was included as covariates[1]. There was not a main effect of condition, $F(2,61) = .37$, $p = .69$, $\eta^2 = .012$, or target, $F(1,61) = .13$, $p = .72$, $\eta^2 = .002$, and no interaction, $F(2,61) = .89$, $p = .42$, $\eta^2 = .028$. Mean performance in the PM task was equally high across conditions: prosocial *M* = 90.5%, *SE* = 6.04, 95% CI [78.4, 102.6], self-interested *M* = 84.5%, *SE* = 5.70, 95% CI [73.1, 95.9], and standard *M* = 90.9%, *SE* = 5.3, 95% CI [80.4, 101.4].

In relation to PM performance, participants provided a self-report rating of how motivated they were to perform the PM task. Differences in self-reported motivation were analyzed in a two-way ANOVA with motivation as the dependent variable, and both condition and target as fixed factors. There was not a main effect of condition $F(2,69) = 1.94$, $p = .15$, $\eta^2 = .053$, or target, $F(1,69) = .64$, $p = .43$, $\eta^2 = .009$, and no interaction, $F(2,69) = .48$, $p = .62$, $\eta^2 = .014$, suggesting that participants were motivated to perform equally well (see Figure 4.1).

[1] There were no significant effects of global motivation; therefore, the results of covariates are not reported.

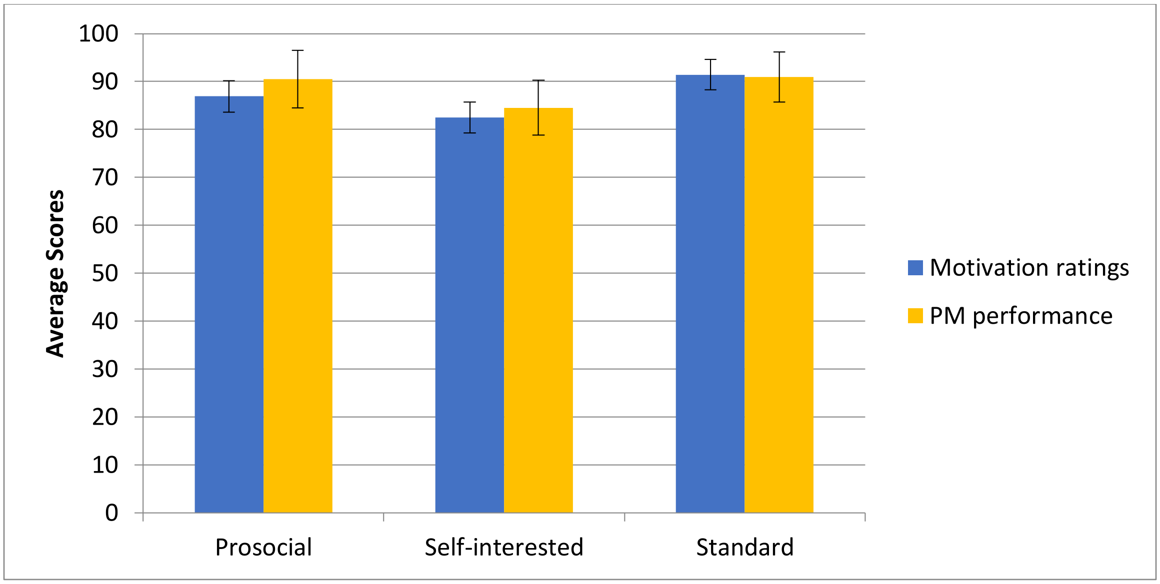

Figure 4.1

Self-reported motivation and PM performance by condition

Overt Monitoring

Overt monitoring refers to two distinct types of monitoring that includes total and cue-driven. Total monitoring was operationalized as the sum of fixations in the PM target region across all trials within each task block, and represented how often participants monitored for the PM target. Cue-driven monitoring was operationalized as the sum of immediate transitions from pictures of items semantically related to the PM target to the actual target region. Semantically related items served as the cues, which have been shown to initiate strategic monitoring processes (Shelton & Christopher, 2016).

Total monitoring was compared across blocks in a 2 (Block: control/PM) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) mixed-factor ANOVA. Block was the within-participants factor, while target and condition were the between-participants factors. Overt monitoring was observed in that there were significantly higher fixations in the PM block

(M = 126.34, SD = 60.23) relative to the control block (M = 14.69, SD = 11.60), $F(1,58)$ = 250.15, $p < .001$, $\eta^2 = .812$. There was not an effect of condition, $F(2,58) = 2.10$. $p = .13$, η^2 = .067, or target, $F(1,58) = .37$. $p = .55$, $\eta^2 = .006$, and there were no significant interactions (all F's < 2.27), indicating that the condition and target did not uniquely influence monitoring over and above receiving the PM intention (see Figure 4.2).

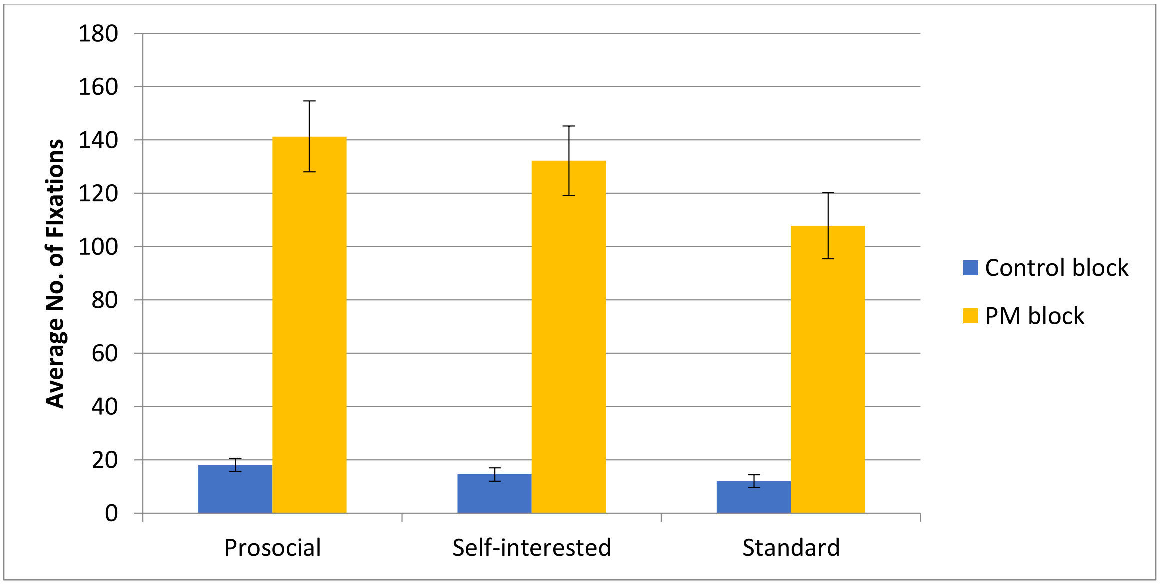

Figure 4.2

Overt monitoring between the control and experimental blocks by condition

For cue-driven monitoring, semantically related cues were compared to unrelated cues in a 2 (Cues: related/unrelated) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) mixed-factor ANOVA. There was not an effect of cue type, $F(1,60) = .16$, $p = .69$, $\eta^2 = .003$, with similar monitoring patterns between unrelated cues (M = 0.70, SD = 0.82) and semantically related cues (M = 0.68, SD = 0.88). Furthermore, there was not an effect of condition, $F(2,60) = 1.49$, $p = .23$, $\eta^2 = .047$ or target, $F(1,60) = 2.29$, $p = .14$, $\eta^2 = .037$ and no interactions. Thus, these data provided no evidence for cue-driven monitoring.

Metacognition

Metacognition was examined using multiple approaches. First, global levels of predicted performance, with mean predictions on a scale from zero - 100, were compared in a two-way ANOVA with prediction serving as the dependent variable and both condition and target as fixed factors. There was a trend toward a significant effect of predictions across conditions, $F(2,69) = 2.61$, $p = .08$, $\eta^2 = .070$. Nominally, the lowest predicted performance was in the self-interested condition, with highest predicted performance in the prosocial condition (see Table 4.1). There was no effect of target, $F(1,69) = 1.90$, $p = .17$, $\eta^2 = .027$, and no interaction, $F(2,69) = .75$, $p = .48$, $\eta^2 = .021$.

The same analysis was conducted with postdictions as the dependent variable. There was a significant effect of postdictions across conditions, $F(2,69) = 4.23$, $p = .02$, $\eta^2 = .109$. Postdicted performance was significantly higher for those in the prosocial condition relative to the self-interested condition. Following the same pattern of differences as for the predictions, the lowest postdicted performance was in the self-interested condition, with highest postdicted performance in the prosocial condition (see Table 4.1). While there was no effect of target, $F(1,69) = .24$, $p = .63$, $\eta^2 = .003$, an interaction between condition and target, $F(2,69) = 3.12$, $p = .05$, $\eta^2 = .083$ was observed. This interaction stemmed from differences in postdictions for the horse target. More specifically, postdictions were higher for the horse target ($M = 91.10$) relative to the chair target ($M = 81.62$) in the prosocial condition, but lower for the horse target ($M = 65.00$) relative to the chair target ($M = 79.58$) in the self-interested condition.

Table 4.1

Comparison of Predictions and Postdictions Across Conditions

		Predictions		Postdictions	
Condition	*n*	*M (SE)*	95% CI	*M (SE)*	95% CI
Prosocial	24	78.20 (3.60)	[71.03, 85.37]	93.27 (5.26)	[82.78, 103.76]
Self-interested	25	67.99 (3.51)	[60.98, 75.00]	83.09 (5.14)	[72.84, 93.35]
Standard	26	77.43 (3.45)	[70.55, 84.32]	89.43 (5.05)	[79.36, 99.51]

Next, I examined the relationship between predicted and actual PM performance using a 2 (Score: predicted/actual) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) mixed-factor ANOVA. There was a main effect of scores, $F(1,69) = 14.76$, $p < .001$, $\eta^2 = .176$, whereby actual performance exceeded predicted performance. Furthermore, there was a marginal effect of condition, $F(2,69) = 3.01$, $P = .06$, $\eta^2 = .080$, but no effect of target, $F(1,69) = .15$, $p = .70$, $\eta^2 = .002$, and no interactions. I followed up this effect with a series of paired samples t-tests to isolate the influence of condition. In the prosocial condition, there was a significant difference between predicted and actual performance, t (23) = -3.08, p = .005. There was a marginal effect for the self-interested condition, t (24) = -1.90, p = .07, and the difference in the standard condition was also significant, t (25) = -2.23, p = .04. Taken together, this suggests that while participants were underconfident in their predicted performance overall, performance predictions for the self-interested condition were slightly more accurate. Although this could simply reflect that the analysis was underpowered, there seems to be a trend in all conditions for under confidence.

After this, I conducted a 2 (Awareness: postdiction/PM performance) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) mixed-factor ANOVA to explore metacognitive awareness of actual PM performance. In other words, how participants thought they did versus how they actually did. There was a significant difference in actual performance and postdicted performance, $F(1,69) = 9.70$, $p = .003$, $\eta^2 = .123$. Additionally, there was a marginal effect of condition, $F(2,69) = 2.97$, $p = .06$, $\eta^2 = .079$, but no effect of target, $F(1,69) = .01$, $p = .92$, $\eta^2 = .000$, and no interactions. As with the predictions, participants underestimated their actual performance. I followed this up with a series of paired samples t-tests to isolate the influence of condition. There was not a significant difference in means for the prosocial condition, t (23) = -1.30, $p = .21$, suggesting good metacognitive awareness of performance. In the self-interested condition, there was a significant difference between postdiction and performance, t (24) = -2.10, $p = .05$, indicating that participants did much better than they thought they did. There was a similar result for the standard condition, t (25) = -2.09, $p = .05$. Again, participants performed much better than they thought they did, but only in self-interested and standard conditions. See Figure 4.3 for a comparison between predictions, postdictions, and performance across conditions.

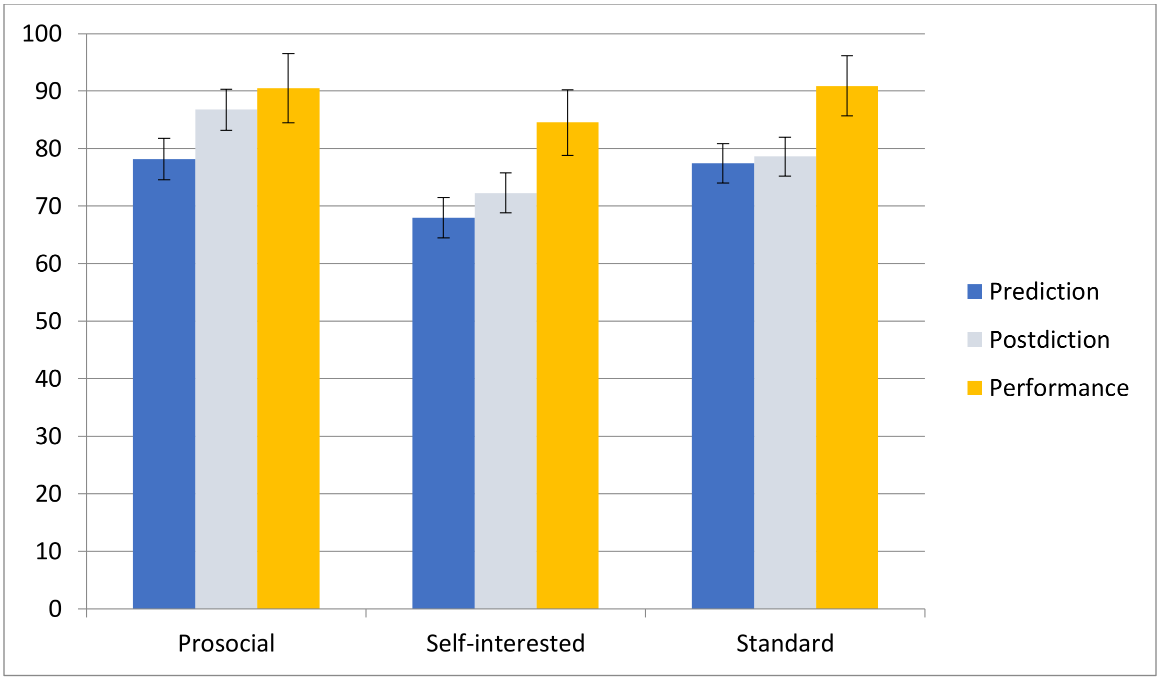

Figure 4.3

Metacognitive awareness of PM performance

Participants were queried at the completion of the experiment regarding how many times they remembered seeing the PM target and clicking the left mouse button. I compared estimated to actual performance in a 2 (Target awareness: estimated/actual) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) mixed-factor ANOVA, with target awareness as the within-participants factor and both target and condition as the between-participants factors. There was a main effect of target awareness, $F(1,68) = 5.56$, $p = .02$, $\eta^2 = .076$. Interestingly the mean of estimated target awareness was higher than actual PM responses ($M = 3.93$, $SD = 1.40$ and $M = 3.53$, $SD = 1.02$ respectively). There was no effect of target, $F(1,68) = .02$, $p = .88$, $\eta^2 = .000$, or condition, $F(2,68) = .70$, $p = .50$, $\eta^2 = .020$, and no interactions. This indicates a disconnect between the number of times participants remembered seeing the target in comparison to the number of times they remembered to make the appropriate response to the target.

Finally, I conducted a series of correlational analyses to examine the overall relationships between predictions, postdictions, and actual performance. There was no relationship between predicted and actual performance, $r = .02$, $p =.86$; however, there was a small strong positive relationship between postdicted performance and actual performance, $r = .37$, $p = .001$, as well as a medium positive relationship between predicted and postdicted performance, $r = .51$, $p < .001$. Moreover, there was a significant relationship between estimations of target count and PM performance, $r = .28$, $p = .02$. To further explore the effects of motivational orientation on these relationships, I obtained correlations for predictions, postdictions, and actual performance by condition. There were no significant relationships between predicted and actual performance (prosocial: $r = .14$, $p = .52$; self-interested: $r = -.08$, $p = .69$; standard: $r = -.003$, $p = .99$). The relationship between postdiction and actual performance was not significant in the prosocial ($r = .13$, $p = .54$) or standard ($r = .14$, $p = .49$) conditions; however, it was significant in the self-interested condition ($r = .54$, $p = .005$). Finally, the relationship between prediction and postdiction was significant for each condition (prosocial: $r = .48$, $p = .02$; self-interested: $r = .41$, $p = .04$; standard: $r = .60$, $p = .001$). As reported above, there was a general pattern of under confidence for both predictions and postdictions to actual performance. Interestingly, the pattern of these relationships varied according to condition. More specifically, these data suggest that while individuals lack metacognitive awareness for accurately predicting their performance in a future PM task, they do have some retrospective awareness. From this, it can be inferred that participants were unaware of the influence that motivation had on these relationships.

Ongoing Task

Performance in the ongoing task was not central to the theme of this study; therefore, I made no a priori predictions regarding ongoing task performance. Despite this, ongoing task performance has provided insight into the cognitive processes underlying retrieval of intentions in PM studies (Einstein & McDaniel, 2005). To this end, I conducted a 2 (Block: control, PM) x 2 (Target: chair/horse) x 3 (Condition: prosocial, self-interested, standard) mixed-factor ANOVA to explore the effects of condition on accuracy. Block served as the within participants factor with both target and condition as the between participants factors. Accuracy was operationalized as the proportion correct across 44 trials in each block of the ongoing task. There was a significant difference in accuracy between blocks, $F(1,69) = 7.05$, $p = .01$, $\eta^2 = .093$, with better performance in the PM block ($M = .40$, $SD = .28$) relative to the control block ($M = .36$, $SD = .26$). While there was not a significant difference between conditions, $F(2,69) = 1.18$, $p = .31$, $\eta^2 = .033$, a significant interaction between block and condition was observed, $F(2,69) = 3.84$, $p = .03$, $\eta^2 = .100$ (see Figure 4.4). This interaction stemmed from poorer performance in the PM block ($M = .35$, $SD = .25$) relative to the control block ($M = .36$, $SD = .25$) for participants in the self-interested condition. No other interactions were observed.

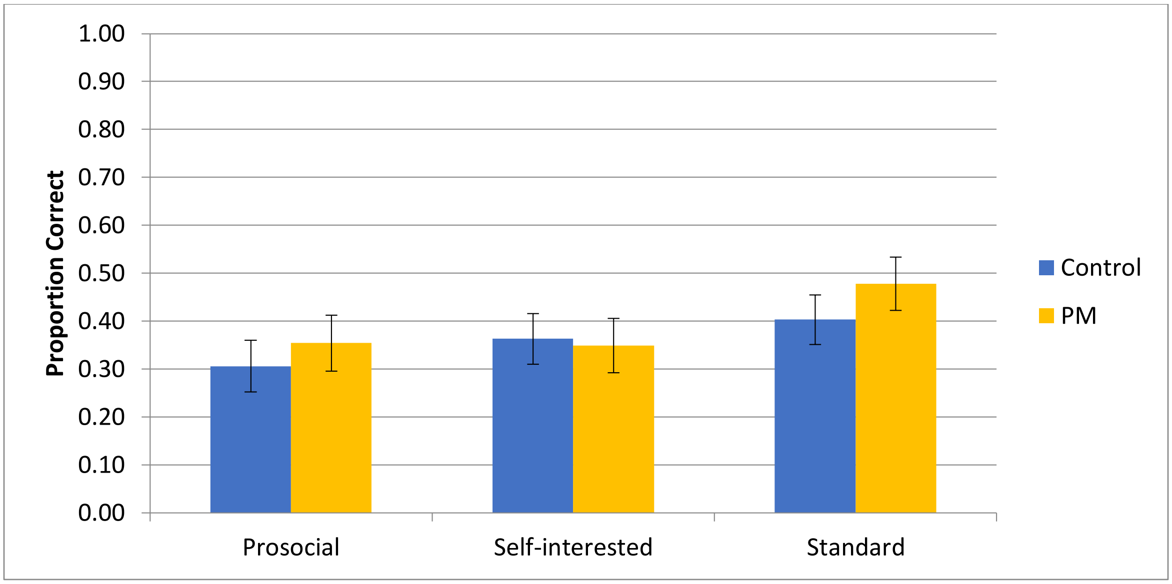

Figure 4.4

Ongoing task performance by condition

Task Importance

As with the ongoing task, I made no predictions about the effects of task importance; however, past research has demonstrated that importance can positively influence PM performance (Walter & Meier, 2014). Most importantly, by obtaining perceptions of task importance, I was able to verify that the motivation manipulation was effective. Participants provided self-report ratings of perceived task importance for both the OT and PM tasks. These data were analyzed in a 2 (Task: OT/PM) x 2 (Target: chair/horse) x 3 (Condition: prosocial/self-interested/standard) mixed-factor ANOVA, with task type as the within-participants factor and both condition and target as the between-participants factors. A main effect of task type emerged, $F(1,69) = 7.86$, $p = .01$, $\eta^2 = .102$ with the PM task being rated as more important than the ongoing task. Furthermore, there was a main effect of condition, $F(2,69) = 3.39$, $p = .04$, $\eta^2 = .089$, with those in the prosocial condition providing significantly higher ratings than those in the self-interested condition (see Figure 4.5). Mean ratings of participants in the standard condition fell between the prosocial and self-interested conditions. There was not an effect of target type, $F(1,69) = 1.82$, $p = .18$, $\eta^2 = .026$, and no interactions.

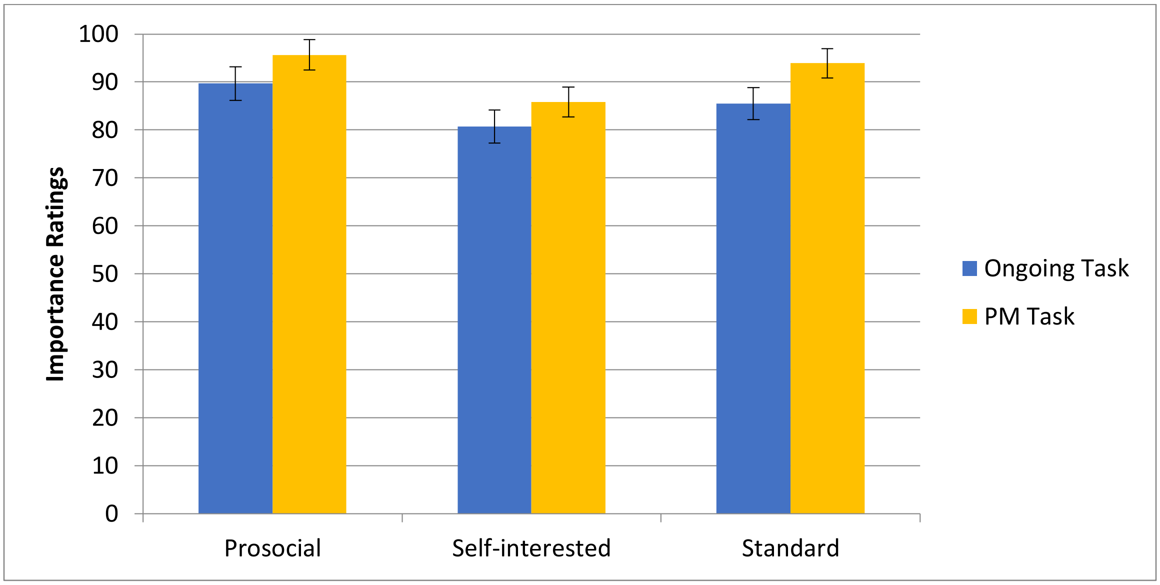

Figure 4.5

Importance ratings between the ongoing and prospective memory tasks

CHAPTER V

DISCUSSION

The research reported here is the first empirical study to investigate the effects of motivational incentives on PM using an eye-tracking paradigm. In addition, it is the first study in the PM literature to examine the influence and accuracy of metacognitive factors (e.g., predicted and postdicted performance) related to prosocial and self-interested motivational states. The results provided clear evidence that motivation positively influenced PM performance as evidenced by both high levels of self-reported motivation and PM performance across conditions. In general, participants were underconfident in predicting and estimating their actual performance, although the motivation manipulation appeared to moderate this effect. The following sections include a detailed analysis and discussion of the results.

Prospective Memory Performance

Previous research suggests that prosocial tasks are more important and more likely to be performed than self-interested tasks (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010). Furthermore, this effect transcends the benefit of task importance (Penningroth et al., 2011), which has also been demonstrated to improve performance (Kliegel et al., 2004; 2001). However, motivational incentives can moderate this relationship differentially based on factors such as the prosocial or self-interested nature of the task, as well as if monetary incentives are offered (Bianchi et al., 2017; Brandimonte & Ferrante, 2015; Brandimonte et al., 2010; Shelton et al., 2016). More specifically, PM performance is improved with a moderate monetary incentive (Aberle et al., 2010; Shelton et al., 2016), but only in situations that are not related to prosocial tasks (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010). There are benefits however, for purely prosocial motives as long as no monetary incentive is offered (Bianchi et al., 2017). The present study did not find an effect of motivation; however, there are several possible explanations for this unexpected finding. First, participants self-reported ratings of motivation indicated that they were equally and highly motivated to perform well in the PM task, suggesting the motivation manipulation used for the self-interested and prosocial groups did not induce higher levels of self-reported motivation relative to the standard group. Furthermore, self-reported ratings of perceived task importance showed that the PM task was deemed more important than the ongoing task across conditions. Moreover, simply predicting one's performance has the potential to improve PM performance (Meeks et al., 2007; Meier et al., 2011; Rummel et al., 2013).

Notably, there was a design feature present in this study that may have contributed to the high performance observed in the PM task. In a typical laboratory paradigm, the delay interval lasts 4-5 minutes, wherein participants are engaged in a distractor task to help ensure they are not rehearsing the intention (Einstein & McDaniel, 1990). In this study, participants watched a condition-specific video as part of the delay interval. The videos were not designed to serve as a reminder for the PM task but rather as a means to further prime participant's motivation, as was done in a previous study (Bianchi et al., 2017). Based on the results from that study, there was no reason to expect that these videos would lead to ceiling performance in the PM task. That being said, what happens in the delay interval may influence performance (Meier et al., 2011). More specifically, the number of tasks completing during the delay interval could moderate performance due to task breaks offering opportunity reminders (Martin, Brown, & Hicks, 2011). In the present study, the condition-specific video lasted approximately two minutes, and it is possible that participants were reminding themselves of (i.e., rehearsing) the PM intention.

Overt Monitoring

In a typical laboratory paradigm, the introduction of a PM intention can lead to costs in the ongoing task. These costs are typically measured through comparison of reaction times between the control and PM blocks. The inclusion of a motivational component can influence costs differentially, much like the effects on PM performance discussed above. For example, purely prosocial intentions can lead to faster reaction times; however, with the inclusion of a self-interested monetary incentive, this prosocial advantage is diminished resulting in slower performance in the ongoing task (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010). Taken together, this suggests that prosocial intentions may operate more automatically (Bargh et al., 1996) and therefore may benefit from the process of spontaneous retrieval (McDaniel & Einstein, 2000; Scullin et al., 2013), while self-interested intentions require overt monitoring (Smith, 2003). The paradigm employed in this study allows these predictions to be tested objectively through eye movements and fixations. This is important because traditional measures of reaction time rely upon inference as to the cognitive processes underlying retrieval of the intention, which could be influenced by a variety of other factors (Rummel et al., 2013; Shelton & Christopher, 2016). Although there were no significant effects of condition observed here, the fact that participants fixated on the target region significantly more in the PM block relative to the control block indicates that monitoring for the PM target occurred. In general, there were relatively high levels of monitoring observed across conditions, which is consistent with the high levels of self-reported motivation and PM performance across conditions.

Another important feature of this paradigm is that it allows for the isolation of cue-driven monitoring. Shelton and Christopher (2016) found that cues semantically related to the PM target led to increased rates of monitoring when compared to cues that were unrelated. Although I found no evidence for cue-driven monitoring here, there are several potential reasons for this finding. The non-focal nature of the task required monitoring, and the near ceiling PM performance suggests that there were high rates of monitoring overall. In fact, most participants reported visual monitoring as the strategy used to complete the PM task. In other words, the overall high levels of monitoring for the target may have eliminated any potential effects of cue-driven monitoring. Finally, while I did not predict differences in monitoring between the different motivational orientations (and none were observed) future studies might consider using cues semantically related to the specific condition (i.e., the incentive) to examine potential differences in cue-driven monitoring.

Metacognitive Awareness

The metacognitive component of this study was particularly interesting because there have been relatively few studies that have examined metacognition in PM. Most importantly, none have obtained predictions and postdictions relating to the potential to earn a monetary incentive. Brandimonte et al. (2010) and Brandimonte and Ferrante (2015) had independent samples of participants rate the likelihood of performing self-interested and prosocial PM tasks, and found that predicted performance was better in prosocial rather than self-interested situations. Furthermore, these participants also predicted better performance when a prosocial intention was combined with a self-interested incentive. The researchers suggested that the fact that actual performance in the PM task was impaired in this situation was indicative of a disconnect in how an individual thinks they will do compared to how they actually perform due to the conflict that monetary incentives introduce to motivation. Moreover, they suggested that participants were unaware of this conflict. In line with Brandimonte et al. (2010) and Brandimonte and Ferrante (2015), participants in the prosocial condition had the highest predicted performance, while those in the self-interested condition predicted the lowest performance.

Other studies have suggested a lack of metacognitive awareness related to PM performance in general. More specifically, participants are better able to evaluate how they actually performed in PM tasks rather than predicting how well they would do prospectively (Devolder et al., 1990; Meeks et al., 2007). As further evidence of a poor metacognitive awareness, individuals are typically overconfident or underconfident in their predictions and ratings of actual performance, although the findings in this regard are mixed. When comparing predictions to actual performance there was a general pattern of under confidence, and a lack of a correlation between predicted and actual performance. However, the difference between prediction and postdiction in the self-interested group was only marginally significant. The same pattern of under confidence was observed when comparing postdictions to actual performance, but this time it was the prosocial group who were more accurate. The logical implications are that the potential to earn an incentive for oneself leads to more realistic predictions, while prosocial intentions are more salient in retrospective memory. As this was the first study of its kind to investigate predictions and postdictions using a motivational incentive in PM, these suggested implications would need to be investigated in future studies

Additionally, I investigated accuracy in identifying PM targets and found no differences between groups. Interestingly, participants reported responding to more targets than they actually did. While this could be attributed to participant's providing a liberal estimate of the number of targets, it is further evidence that individuals lack metacognitive awareness of their performance in a PM task.

Conclusions and Implications

This study investigated the influence of different motivational orientations on PM performance using a monetary incentive to moderate motivation. Furthermore, it examined the concept of cue-driven monitoring in a novel eye-tracking paradigm, which allowed for direct measurement of overt monitoring. Finally, it explored metacognitive awareness in a PM task that included a motivational component. Observed PM performance was near ceiling, possibly due to participants' high self-reported motivation and deference to the PM task over the ongoing task. While there was strong evidence for overt monitoring, the lack of cue-driven monitoring could also be attributed to the overall high motivation of participants across conditions. The disconnect in metacognitive awareness was perhaps most interesting because it suggests that environmental factors can influence our ability to execute future intentions. Future research could examine other factors outside of motivation and incentives, as well as the effects of individual differences in metacognitive awareness. Furthermore, the eye-tracking paradigm used may help to isolate the disconnect, while also serving as an alternative to traditional PM paradigms to measure strategic monitoring.

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.

Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology, 71*(2), 230-244.

Batson, C. D. (1987). Prosocial motivation: Is it ever truly altruistic? In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 20, pp. 65-122): San Diego, CA: Academic Press.

Batson, C. D., & Powell, A. A. (2003). Altruism and prosocial behavior. In T. Millon, M.J. Lerner, & I. B. Weiner (Eds.) *Handbook of Psychology* (Vol. 5, pp. 463-484). Hoboken, NJ: John Wiley & Sons, Inc.

Bénabou, R., & Tirole, J. (2006). Incentives and prosocial behavior. *American Economic Review, 96*(5), 1652-1678.

Bianchi, C., Hacker, J. Y., Kaylor, M., Boring, E., May, L., & Shelton, J. T. (2017). Motivational influences on prospective memory in the laboratory and the real world. Poster presented at the Annual Convention of the Southeastern Psychological Association, Atlanta, GA.

Brandimonte, M. A., & Ferrante, D. (2008). The social side of prospective memory. In M. Kliegel, G. O. Einstein, & M. A. McDaniel (Eds.) *Prospective Memory: Cognitive, Neuroscience, Developmental, and Applied Perspectives* (pp. 347-365), New York, NY: Taylor & Francis Group.

Brandimonte, M. A., & Ferrante, D. (2015). Effects of material and non-material rewards on remembering to do things for others. *Frontiers in Human Neuroscience, 9*, 1-8.

Brandimonte, M. A., Ferrante, D., Bianco, C., & Villani, M. G. (2010). Memory for prosocial intentions: When competing motives collide. *Cognition, 114*(3), 436-441.

Devolder, P. A., Brigham, M. C., & Pressley, M. (1990). Memory performance awareness in younger and older adults. *Psychology and Aging, 5*(2), 291-303.

Einstein, G. O., & McDaniel, M. A. (1990). Normal aging and prospective memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16*(4), 717-726.

Einstein, G. O., & McDaniel, M. A. (2005). Prospective memory: Multiple retrieval processes. *Current Directions in Psychological Science, 14*(6), 286-290.

Gneezy, U., Meier, S., & Rey-Biel, P. (2011). When and why incentives (don't) work to modify behavior. *Journal of Economic Perspectives, 25*(4), 191-210.

Guay, F., Mageau, G. A., & Vallerand, R. J. (2003). On the hierarchical structure of self-determined motivation: A test of top-down, bottom-up, reciprocal, and horizontal effects. *Personality and Social Psychology Bulletin, 29*(8), 992-1004.

Kliegel, M., Martin, M., McDaniel, M., & Einstein, G. (2004). Importance effects on performance in event-based prospective memory tasks. *Memory, 12*(5), 553-561.

Kliegel, M., Martin, M., McDaniel, M. A., & Einstein, G. O. (2001). Varying the importance of a prospective memory task: Differential effects across time-and event-based prospective memory. *Memory, 9*(1), 1-11.

Kvavilashvili, L., & Ford, R. M. (2014). Metamemory prediction accuracy for simple prospective and retrospective memory tasks in 5-year-old children. *Journal of Experimental Child Psychology, 127*, 65-81.

Lacetera, N., & Macis, M. (2010). Do all material incentives for prosocial activities backfire? The response to cash and non-cash incentives for blood donations. *Journal of Economic Psychology, 31*(4), 738-748.

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 Expérimentale, 65*(1), 48-56.

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.

Meeks, J. T., Hicks, J. L., & Marsh, R. L. (2007). Metacognitive awareness of event-based prospective memory. *Consciousness and Cognition, 16*(4), 997-1004.

Meier, B., von Wartburg, P., Matter, S., Rothen, N., & Reber, R. (2011). Performance predictions improve prospective memory and influence retrieval experience. *Canadian Journal of Experimental Psychology/Revue Canadienne de Psychologie Expérimentale, 65*(1), 12-18.

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (2004). The University of South Florida free association, rhyme, and word fragment norms. *Behavior Research Methods, Instruments, & Computers, 36*(3), 402-407.

Penningroth, S. L., Scott, W. D., & Freuen, M. (2011). Social motivation in prospective memory: Higher importance ratings and reported performance rates for social tasks. *Canadian Journal of Experimental Psychology/Revue Canadienne de Psychologie Expérimentale, 65*(1), 3-11.

Rendell, P. G., & Craik, F. I. (2000). Virtual week and actual week: Age-related differences in prospective memory. *Applied Cognitive Psychology, 14*(7), S43-S62.

Rummel, J., Kuhlmann, B. G., & Touron, D. R. (2013). Performance predictions affect attentional processes of event-based prospective memory. *Consciousness and Cognition, 22*(3), 729-741.

Schnitzspahn, K. M., 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*(1), 19-26.

Scullin, M. K., & McDaniel, M. A. (2010). Remembering to execute a goal: Sleep on it! *Psychological Science, 21*(7), 1028-1035.

Scullin, M. K., McDaniel, M. A., & Shelton, J. T. (2013). The Dynamic Multiprocess Framework: Evidence from prospective memory with contextual variability. *Cognitive psychology, 67*(1-2), 55-71.

Shelton, J. T., & Christopher, E. A. (2016). A fresh pair of eyes on prospective memory monitoring. *Memory & cognition, 44*(6), 837-845.

Shelton, J. T., Hulse, S., Comotto, N., Hacker, J. Y., & Carroll, M. (2016). *Are you motivated to remember? The impact of prosocial and self-interested motivation on prospective memory*. Poster presented at the International Conference on Memory, Budapest, Hungary.

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.

Small, D. M., Gitelman, D., Simmons, K., Bloise, S. M., Parrish, T., & Mesulam, M.-M. (2005). Monetary incentives enhance processing in brain regions mediating top-down control of attention. *Cerebral Cortex, 15*(12), 1855-1865.

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.

Walter, S., & Meier, B. (2014). How important is importance for prospective memory? A review. *Frontiers in Psychology*, *5*, 1-9.

APPENDIX A

IRB APPROVAL LETTER

THE UNIVERSITY of TENNESSEE UT CHATTANOOGA

Institutional Review Board
Dept. 4915
615 McCallie Avenue
Chattanooga, TN 37403-2598
Phone: (423) 425-5867
Fax: (423) 425-4052
instrb@utc.edu
http://www.utc.edu/irb

MEMORANDUM

TO:	Jessica Hacker Dr. Jill Shelton	**IRB # 17-103**
FROM:	Lindsay Pardue, Director of Research Integrity Dr. Amy Doolittle, IRB Committee Chair	
DATE:	6/30/2017	
SUBJECT:	IRB #17-103: Don't Forget to Remember: Motivation and Environmental Cues Affect Prospective Memory Performance	

The IRB Committee Chair has reviewed and approved your application and assigned you the IRB number listed above. You must include the following approval statement on research materials seen by participants and used in research reports:

***The Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149) has approved this research project #* 17-103.**

Annual Renewal. All approved research is subject to UTC IRB review, at least once a year. Please visit our website (http://www.utc.edu/research-integrity/institutional-review-board/forms.php) for the Form B (continuation / change / completion form) that you will need to complete and submit if your project remains active and UTC IRB approval needs to be renewed for another year. Unless your research moves in a new direction or participants have experienced adverse reactions, then renewal is not a major hurdle. You as Principal Investigator are responsible for turning in the Form B on time (2 weeks before one year from now), and for determining whether any changes will affect the current status of the project. When you complete your research, the same change/completion form should be completed indicating project termination. This will allow UTC's Office of Research Integrity to close your project file.

Please remember to contact the IRB immediately and submit a new project proposal for review if significant changes occur in your research design or in any instruments used in conducting the study. You should also contact the IRB immediately if you encounter any adverse effects during your project that pose a risk to your subjects.

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

Best wishes for a successful research project.

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

General Demographic Questionnaire: Participant ID: ____________________

Age: ________________________
Sex: ________________________
Race: ________________________
Years of Education: ____________________________
Current / Past Occupation: ___________________________________

Hand Dominance (circle): Right Left
Do you wear glasses? Yes No

Medical History:
Please list any medications that you currently take:

________________________________ ________________________________
________________________________ ________________________________
________________________________ ________________________________
________________________________ ________________________________
________________________________ ________________________________

Do you currently use:
__ Tobacco: If so, how often: ____________________
How much: ____________________
__ Alcohol: If so, how often: ____________________
How much: ____________________

Have you experienced any of the following medical conditions in the past? If so, please indicate.
__ Head injury or concussion If yes, please indicate when this injury occurred: _______________
__ Seizure
__ Stroke
__ Multiple Sclerosis
__ Hypoxic event
__ Toxin overexposure / poisoning
__ Meningitis
__ Attention Deficit Hyperactivity Disorder
__ Substance dependence If yes, please indicate type of dependence: ____________________
__ Family history of dementia or "memory problems"
__ Depression / Anxiety

Do you currently experience any of the following medical conditions?
__ Acute illness/infection:
__ Recent surgery with general anesthesia
__ Thyroid disease:
__ Recent UTI:
__ Sleep Apnea
__ Insomnia

APPENDIX C

GLOBAL MOTIVATION SCALE (GMS-28)

GLOBAL MOTIVATION SCALE (GMS-28)

Frédéric Guay, Geneviève A. Mageau et Robert J. Vallerand
Society for Personality and Social Psychology, 29:8, 2003

Scale Description

This scale assesses people's global motivation toward behaving in general in their life as a whole. There are 7 constructs: intrinsic motivation toward knowledge, accomplishment and stimulation, as well as external, introjected and identified regulations and amotivation. There are 28 items (4 items for each of the 7 subscales) assessed on a 7-point scale.

References

Guay, F., Mageau, G., & Vallerand, R.J.. On the hierarchical structure of self-determined motivation : A test of top-down and bottom-up effects. Personality and Social Psychology Bulletin, 29, 992-1004.

GENERAL ATTITUDES

Indicate to what extent each of the following statements corresponds generally to the reasons why you do different things.

Does not correspond accordingly			Corresponds moderately			Corresponds completely
1	2	3	4	5	6	7

IN GENERAL, I DO THINGS . . .

1. ... in order to feel pleasant emotions.	1	2	3	4	5	6	7
2. ... because I do not want to disappoint certain people.	1	2	3	4	5	6	7
3. ... in order to help myself become the person I aim to be.	1	2	3	4	5	6	7
4. ... because I like making interesting discoveries.	1	2	3	4	5	6	7
5. ... because I would beat myself up for not doing them.	1	2	3	4	5	6	7
6. ... because of the pleasure I feel as I become more and more skilled.	1	2	3	4	5	6	7
7. ... although I do not see the benefit in what I am doing.	1	2	3	4	5	6	7
8. ... because of the sense of well-being I feel while I am doing them.	1	2	3	4	5	6	7
9. ... because I want to be viewed more positively by certain people.	1	2	3	4	5	6	7

10.	... because I chose them as means to attain my objectives.	1	2	3	4	5	6	7
11.	... for the pleasure of acquiring new knowledge.	1	2	3	4	5	6	7
12.	... because otherwise I would feel guilty for not doing them.	1	2	3	4	5	6	7
13.	... for the pleasure I feel mastering what I am doing.	1	2	3	4	5	6	7
14.	... although it does not make a difference whether I do them or not.	1	2	3	4	5	6	7
15.	... for the pleasant sensations I feel while I am doing them.	1	2	3	4	5	6	7
16.	... in order to show others what I am capable of.	1	2	3	4	5	6	7
17.	... because I chose them in order to attain what I desire.	1	2	3	4	5	6	7
18.	... for the pleasure of learning new, interesting things.	1	2	3	4	5	6	7
19.	... because I force myself to do them.	1	2	3	4	5	6	7
20.	... because of the satisfaction I feel in trying to excel in what I do.	1	2	3	4	5	6	7
21.	... even though I do not have a good reason for doing them.	1	2	3	4	5	6	7
22.	... for the enjoyable feelings I experience.	1	2	3	4	5	6	7
23.	... in order to attain prestige.	1	2	3	4	5	6	7
24	... because I choose to invest myself in what is important to me.	1	2	3	4	5	6	7
25.	... for the pleasure of learning different interesting facts.	1	2	3	4	5	6	7
26.	... because I would feel bad if I do not do them.	1	2	3	4	5	6	7
27.	... because of the pleasure I feel outdoing myself.	1	2	3	4	5	6	7
28.	... even though I believe they are not worth the trouble.	1	2	3	4	5	6	7

VITA

Jessica Hacker was born in Fort Oglethorpe, Georgia to Marcella Keith and Robert Hacker. She began her college education at Chattanooga State Community College, earning her Associate of Science before transferring to the University of Tennessee at Chattanooga, where she graduated summa cum laude with a Bachelor of Science in Psychology. She remained at UTC and earned her Masters of Science in Psychology in May 2018. Jessica is continuing her education by pursuing a Ph.D. in Experimental Psychology at Louisiana State University beginning in the fall of 2018.