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The effects of motivational states on metacognition and prospective memory

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The Effects of Motivational States on Metacognition and Prospective Memory

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Abstract

Prospective memory is the ability to remember and act upon future intentions. In the context of daily life, prospective memory intentions can be either self-interested or pro-socially motivated (such as remembering to pay a credit card bill or buy a gift for a friend, respectively). Research suggests that individuals place greater importance on their performance of prosocial intentions rather than self-interested intentions, and a pro-social advantage has been observed in prospective memory. I investigated the role of motivation in prospective memory and a person's belief about their cognitive abilities (i.e., metacognition) in regard to prospective memory. The present study used an eye-tracking paradigm in which participants were engaged in an ongoing visual search task, with a prospective memory task embedded into the trail. Participants' motivational state was manipulated through a monetary incentive, and they also made predictions and postdictions about their performance on the prospective memory and ongoing tasks as a proxy for metacognition. I found a trend for a prosocial advantage to prospective memory performance and metacognitive awareness, and a tendency of neutral motivational states in reducing cognitive effort in prospective memory target monitoring. Such trends were not observed in the self-interested motivational state.

The Effects of Motivational States on Metacognition and Prospective Memory

Prospective memory, as defined by Einstein & McDaniel (1990), is the ability to remember and act upon future intentions. In the context of daily life, prospective memory intentions can be either self-interested or altruistically motivated (Brandimonte, Ferrante, Bianco, & Villani 2010). An example of a self-interested prospective memory task is remembering to order dessert for yourself the next time the waitress stops by your table, while an example of an altruistic, or 'prosocial' prospective memory task is remembering to complete your part of a group project before midnight. Previous research suggests a prosocial advantage in remembering to execute previously-formed intentions when compared to self-interested incentives or no incentives (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010). In addition, Penningroth, Scott, & Freuen (2011) found that individuals consider their performance of prosocial prospective memory intentions to be much more important than their performance of self-interested prospective memory intentions. In these ways, researchers have used motivational states to manipulate the perceived importance of prospective memory tasks, in hopes of altering prospective memory performance in laboratory settings.

Effects of motivation on prospective memory performance can also be seen through ongoing task costs – or how much cognitive effort is averted to a simultaneous continuing task. These costs are traditionally measured by comparing reaction times to complete an ongoing task between a control block (comprising of only the ongoing task) and an experimental block (comprising of both an ongoing task and a prospective memory intention). By comparing reaction times across motivational states in a prospective memory task, researchers can determine if different incentives influence the allocation of cognitive effort on the ongoing task. In previous research, reaction time has been quicker in groups with purely prosocial incentives;

however, the reaction time of groups with an additional self-interested monetary incentive slowed (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010). This suggests that self-interested intentions require cognitively demanding overt monitoring of the prospective memory target, thus causing slow-downs in the ongoing task performance (Smith, 2003). Meanwhile, the cognitive processes behind prosocial intentions seem to function more automatically (Bargh et al., 1996), possibly as a result of spontaneous retrieval, the sudden retrieval of a previously-formed intention (McDaniel & Einstein, 2000; Scullin et al., 2013).

In addition to motivation, metacognition – which is the way in which people think about their own mental processes – can also alter prospective memory performance. Schnitzspahn, Zeintl, Jäger, & Kliegel (2011) observed that prospective memory performance predictions were correlated with their actual performance, suggesting that metacognition for prospective memory tasks is moderately accurate. Furthermore, the use of performance predictions and metacognition has been shown to improve prospective memory task performance (Meier, von Wartburg, Matter, Rothen, & Reber 2011). In contrast, Bianchi et al. (2017) studied participant's prediction of prospective memory performance and found participants to be overconfident in their predicted performance in a naturalistic setting, regardless of motivational states. These inconsistencies reveal how the study of influences of metacognition on prospective memory has the potential to be investigated further – particularly the investigation of how motivational states influence people's metacognition in service of prospective remembering.

Hacker et al. (2018) explored the effects of different motivational states on prospective memory task performance along with metacognition and was the first in this line of research to use an eye-tracker. In comparison to measures of reaction time, the novel eye-tracking approach used by Hacker et al. (2018) enabled a more direct assessment of the ongoing task cost by allowing researchers to observe overt monitoring for the prospective memory target. The study used monetary incentive to promote prosocial ($25 to charity), self-interested ($25 to self), or neutral (no monetary incentive) motivational states. Participants engaged in an ongoing visual search task in which they counted the number of living objects within an array of images. Participants were given the prospective memory task of responding to a particular image that appeared in a separate region of the screen. Participants first completed a control block of the visual search task without a prospective memory demand. Following the control block, participants engaged in a video viewing task that consisted of condition-specific videos. For example, in the pro-social condition, participants watched a video about the benefits of giving to charity. After, participants completed the experimental block of the visual search task, which included the prospective memory intention to respond to a particular image that appeared in a separate region of the screen. Each block consisted of 44 trials, each lasting 12 seconds. Additionally, the prospective memory image, located outside of the main visual array in the upper right-hand corner of the screen changed every 4-second, making three subtrials per trial.

Results from Hacker et al. (2018) found that prospective memory performance was not affected by motivational states – however, participants were underconfident in their performance. Furthermore, those in the self-interested condition more accurately predicted their performance, while those in the prosocial condition more accurately postdicted their performance. These results suggest that metacognitive awareness of prospective memory performance can be influenced by motivational states in the form of monetary incentives, however, the researchers observed ceiling effects. Participant accuracy in the prospective memory task was consistently high.

It is possible that the items in the delay interval (a demographic questionnaire and a context-priming video) did not capture focused or sustained attention, allowing participants to internally rehearse the prospective memory instructions, thus improving their accuracy (Martin, Brown, & Hicks 2011). It is also possible that both the ongoing and prospective memory tasks were too slow and simple, promoting constant monitoring of the prospective memory target region. To account for these potential confounds, I used the same eye-tracking paradigm to explore this important research question while implementing a task with a higher cognitive load during the delay interval (e.g. a verbal fluency test) to prevent intention rehearsal. In addition, I increased the speed of the ongoing task to allocate attention away from the prospective memory target region.

There is relatively little literature on the effects of motivation and metacognition on successful prospective memory performance. Filling in these gaps may have important theoretical implications, such as further advancing prospective memory research in regard to the use of an eye-tracker as a proxy for prospective memory target monitoring. My study hypothesized that prospective memory performance would be highest in the prosocial condition and that changes to the experiment would reduce previously observed ceiling effects.

Methodology

Participants and Design

Participants were undergraduate students from the University of Tennessee at Chattanooga (n=37), and they were recruited through the UTC SONA system. The study implemented a 2 X 2 X 3 mixed-factor design, with counterbalancing target images (horse/chair) as a 2-level between-participants factor, incentive type (control/self-interested/prosocial) as the 3-leveled between-participants factor, and block (control/prospective memory) as a two-level within-participants factor.

Materials

Apparatus: Data were collected using a Sensomotoric Instruments (SMI) Red-250 mobile eye-tracker with a gaze position accuracy of 0.4˚ and a spatial resolution of 0.03˚. Fixation points were defined as lingering for .150s I a 30-pixel diameter and were used to measure gaze patterns and target region monitoring. This device obtained data involving eye movements and the participants' monitoring of the prospective memory target region of the screen. The EyeWorks eye 14 tracking software allowed for programming and data collection of the task.

Condition-Specific Script: Between the control and experimental block, participants were told of the prospective memory task, target image, and monetary incentive with a condition-specific script (see Appendix A). Participants in the prosocial condition were incentivized with a chance to win $25 for a charity of their choice, while participants in the self-interested condition were incentivized with a chance to win a $25 gift card for themselves. Those in the standard condition were not given a monetary incentive.

Ongoing Task: Participants were shown an array of images lasting for 9 seconds before automatically changing to the next trial. The images were either photographs or graphic images of easily identifiable living and nonliving objects. They were obtained from several open-source websites including openclipart.org, pixabay.com, and clker.com (see *Figure 1*).

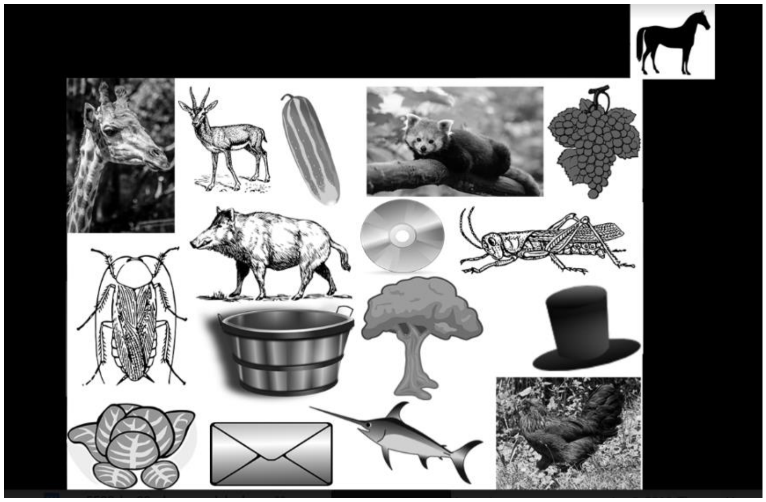

Figure 1. Example of ongoing task/prospective memory target region array.

Prospective Memory Task: The prospective memory target region appeared in the upper right-hand corner of the screen, which participants needed to monitor for a prospective memory target image. As a counterbalancing measure, this image was either a chair or a horse. The image in the top right corner changed more rapidly, with 3 sub-trials lasting 3 seconds per trial.

Delay Task: Participants completed a delay task that consisted of 3 verbal fluency trials lasting one minute each, using the letters F, A, and S. The purpose of this delay task was to create temporal distance between the prospective memory task instruction and the completion of the prospective memory task.

Metacognition Survey: Embedded throughout the experiment were opportunities for participants to report their awareness of their own mental processes. Before the delay task, participants were given an encoding check to ensure that they understood the task instruction as well as the incentive that they were told about in their condition-specific scripts. At this time, they were also asked predictive questions (On a scale from 1-100, how well do you think you will do in this memory task? On a scale from 1-100, how well do you think you will do in the living object count task?) as well as questions signifying how important they thought each of these tasks were. At the end of the experiment, participants were asked postdictive questions (On a scale from 1-100, how well do you think you did in this memory task? On a scale from 1-100, how well do you think you did in the living object count task?) as well as qualitative questions regarding their monitoring strategies (What strategies did you use to remember to click the left mouse button when an image of the [chair/horse] appeared?).

Procedure

Participation in this study consisted of a single session in the Cognitive Aging, Learning, and Memory (CALM) lab, which lasted for approximately 1 hour. The study required the participants to sit at a computer, and a mounted eye-tracker recorded gaze data. The participants were randomly assigned to one of six groups, differing on the prospective memory target (chair/horse) and incentive type (control/self-interested/prosocial). Upon arrival, participants signed an informed consent that explained their condition-specific incentives for this experiment – for example, the incentive for the prosocial condition was in the form of a $25 donation to a charity, the incentive in the self-interested condition was in the form of a $25 gift card, and there was no incentive for the control group. Participants then completed a demographic questionnaire.

With the eye-tracker apparatus, participants began a control block, which consisted of 44 trials, each with an array of images that changed every 9 seconds. The participants were told to count and report the number of living objects in each 9-second trial. The control block included the mechanism for the prospective memory task, 3-second-long sub-trials of a separate target region in a corner of the screen, but the participants were not made aware of its significance.

After the control block, participants were given instructions for the prospective memory task – to click the left mouse button when an image of a chair or horse appeared in the top right-hand corner of the screen – and were reminded of their incentives through a condition-specific script. This was followed by an encoding check to ensure their understanding of the task, as well as a metacognition questionnaire to allow the participants to predict their accuracy in the prospective memory performance. Next, as a delay task, participants completed 3 trials of a verbal fluency task, where they had 60 seconds to list words that begin with a specific letter. The purpose of this high-cognitive-load task was to distract the participants from the prospective memory instructions.

Once the verbal fluency task was complete, participants began the experimental block. They were not reminded of the prospective memory task instructions at this time. The experimental block consisted of another 44 trials. Consistent with the control block, each trial lasted 9 seconds with 3-second subtrials of the prospective memory target region. Participants completed the same ongoing task of counting and reporting the number of living objects, with the additional prospective memory task of clicking the right mouse button when the target image appeared in the target region of the screen.

Next, the participants answered more metacognition questions to postdict their prospective memory task accuracy. The participants also completed a retrospective memory task, to ensure that they retained an understanding of the prospective memory instructions. Finally, participants were verbally debriefed and dismissed.

Results

Due to an eye-tracker malfunction, testing had to be stopped before attaining the required sample. For this reason, I will focus on descriptive statistics rather than inferential statistics.

Prospective Memory

I operationalized prospective memory performance as the percentage of correct responses out of four possible targets. Prospective memory task performance averages were equally high across conditions: standard *M* = 75.0%, SE = 4.65, 95% CI [56.1, 93.9], prosocial *M* = 81.3%, SE = 5.7, 95% CI [58.2, 104.3], and self-interested *M* = 76.6%, SE = 4.0, 95% CI [56.1, 93.9] (see Figure 2).

Metacognition

I operationalized prospective memory performance prediction using a self-reported response on a scale from 1-100. Prospective memory task performance prediction averages were equally high across conditions: standard *M* = 72.0%, SE = 5.4, 95% CI [61.0, 83.0], prosocial *M* = 76.8%, SE = 6.6, 95% CI [63.2, 90.2], and self-interested *M* = 70.9%, SE = 4.7, 95%, CI [61.3, 80.5] (see Figure 2). I operationalized prospective memory performance postdiction using a self-reported response on a scale from 1-100. Prospective memory task performance postdiction averages differ across conditions: standard *M* = 68.30%, SE = 4.6, 95% CI [58.9, 77.8], prosocial *M* = 79.1%, SE = 5.7, 95% CI [67.6, 10.7], and self-interested *M* = 84.2%, SE = 4.0, 95% CI [76.2, 92.6] (see *Figure 2*).

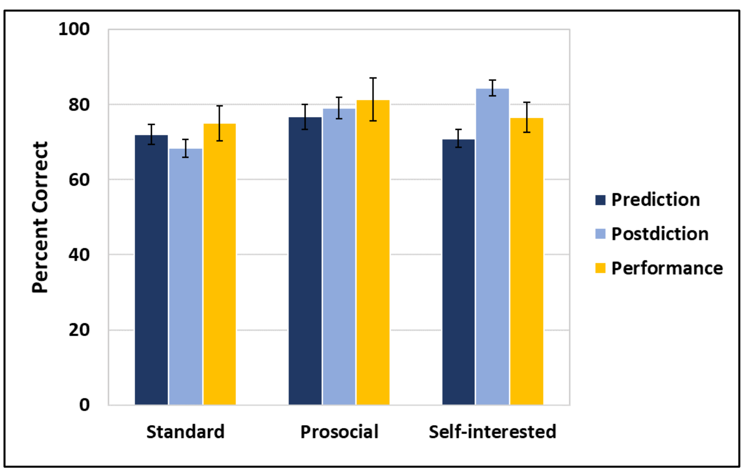

Figure 2. Metacognitive awareness and prospective memory performance side-by-side.

Monitoring

I operationalized monitoring as total gaze fixations in the prospective memory target region across all trials within each task block, which represented how often participants monitored for the prospective memory target. Monitoring was observed in the experimental block where there were significantly higher fixations; standard *M* = 54.25, SE = 12.65, 95% CI [28.51, 80.00], prosocial *M* = 100.50, SE = 15.50, 95% CI [68.97, 103.03], and self-interested *M* = 87.25, SE = 10.96, 95%, CI [64.96, 109.54]. Comparatively, the control block experienced very few fixations; standard *M* = 11.8, SE = 4.60, 95% CI [2.48, 21.19], prosocial *M* = 4.12, SE = 5.63, 95% CI [-7.33, 15.58], and self-interested *M* = 3.98, SE = .017, 95% CI [-2.35, 13.85] (see *Figure 3*).

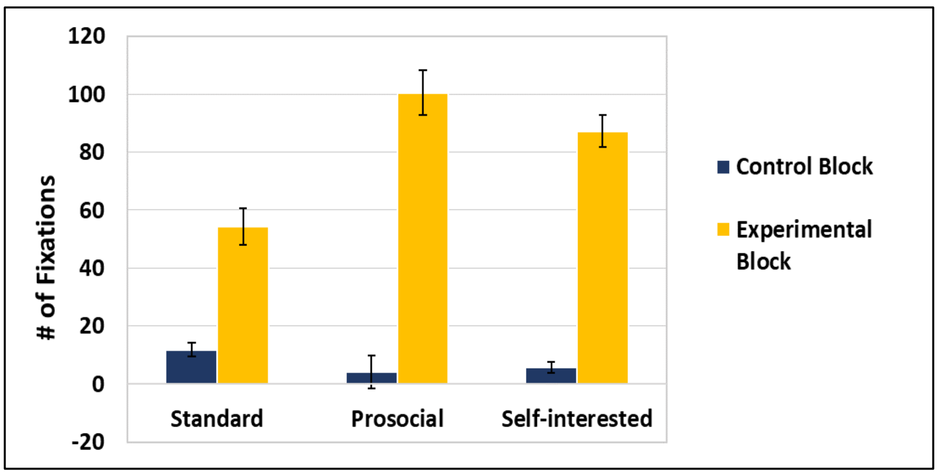

Figure 3. Prospective memory target monitoring by condition between the task blocks.

Ongoing Task

I operationalized ongoing task accuracy as the degree to which a participant's response was correct, calculated by how many digits a response differed from the correct number of living objects across 44 trials in each block, inverted and shown as a percent. In the control block, standard *M* = 88.1%, SE = .02, 95% CI [83.7, 92.4], prosocial *M* = 94.7%, SE = .026, 95% CI [89.3, 100.1], and self-interested *M* = 89.4%, SE = .017, 95% CI [85.6, 93.2]. In the experimental block, standard *M* = 86.9%, SE = .029, 95% CI [80.9, 92.8], prosocial *M* = 92.1%, SE = .036, 95% CI [84.8, 99.4], and self-interested *M* = 88.1%, SE = .025, 95%, CI [82.9, 93.2] (see *Figure 4*).

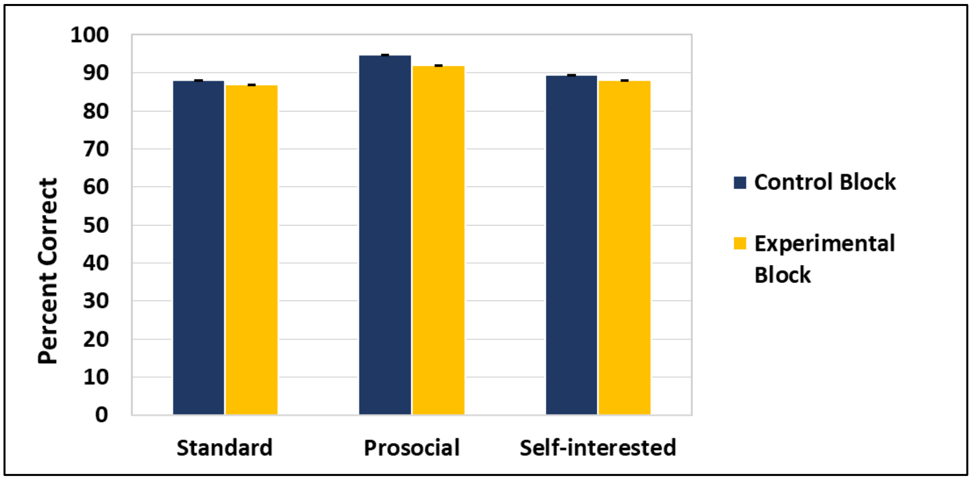

Figure 4. Ongoing task performance by condition.

Comparison of Hacker at al. (2018) and present study

I measured the effects of the altered methodology on the ceiling effects observed in Hacker et al. (2018) by comparing the means of prospective memory performance across conditions in both studies. The performance in Hacker et al. was higher in every condition: standard *M* = 89.4%, SE = 5.6, 95% CI [78.5, 100.30], prosocial *M* = 89.0%, SE = 5.5, 95% CI [77.9, 100.10], and self-interested *M* = 83.0%, SE = 5.6, 95% CI [71.9, 94.1]. In every condition, I observed lower prospective memory performance accuracy: standard *M* = 75.0%, SE = 4.65, 95% CI [56.1, 93.9], prosocial *M* = 81.3%, SE = 5.7, 95% CI [58.2, 104.3], and self-interested *M* = 76.6%, SE = 4.0, 95% CI [56.1, 93.9].

I calculated inferential statistics using a univariate general linear model, with the within-participants factor being performance and the between-participants factors being the condition and the experiment. There was no main effect of experiment, $F(1,110) = 1.782$, $p = 0.185$ (see *Figure 5*).

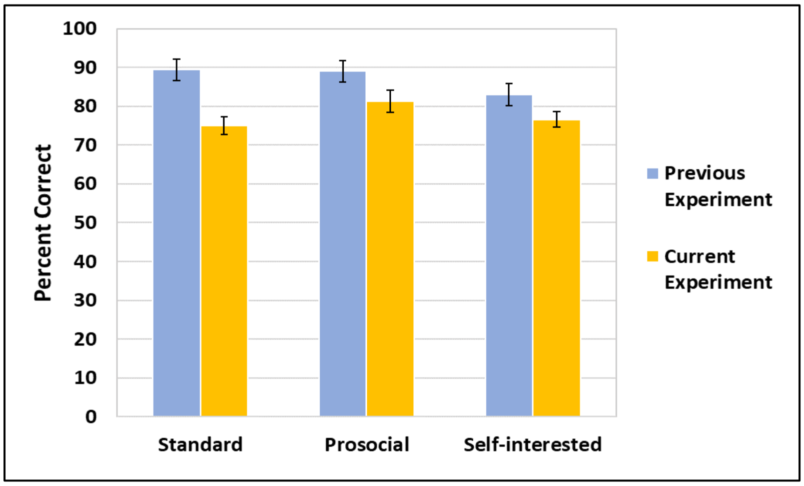

Figure 5. Prospective memory performance accuracy by condition between experiments.

Discussion

Consistent with previous studies (Brandimonte & Ferrante, 2015; Brandimonte et al., 2010; Penningroth, Scott, & Freuen 2011), participants who were given a prosocial incentive had higher prospective memory performance. This trend supports the suggestion made by Bargh, Chen, & Burrows (1996) that prosocial intentions function more automatically in prospective memory tasks. These results offer more evidence in favor of the process of spontaneous retrieval in prospective memory.

While prospective memory performance was relatively high in all three conditions, I was successful in reducing the high prospective memory performance found in Hacker et al. (2018). When compared to Hacker et al. 2018, the present study saw a decrease in prospective memory performance, suggesting that the decrease in trial time and the use of a verbal fluency test as a delay task successfully reduced ceiling effects. It is suggested that the decrease in trial time increased the difficulty of the task and the delay task required a higher cognitive load to complete.

Regardless of condition, participants were relatively accurate in predicting and postdicting their performance in the prospective memory task, although there was a slight trend for higher metacognitive accuracy in the prosocial condition than the self-interested or standard conditions. More research must be done to investigate the nature of this relationship, as well as to examine the mechanisms that underly it.

The present study observed high monitoring of the prospective memory target region in the incentivized conditions (prosocial and self-interested), with lower monitoring observed in the standard unincentivized condition. This trend suggests that a neutral motivational state leads to a lower allocation of attention in the prospective memory target region, which has been attributed to lower motivation to complete the prospective memory task successfully, due to a lack of incentive. This outcome appears to be inconsistent with the theory of spontaneous retrieval, as it suggests that prosocial motivation does rely on monitoring rather than a more automatic retrieval process. I propose that prosocial motivation could use a more automatic retrieval process, such as spontaneous retrieval, in using covert monitoring rather than overt monitoring. This requires future investigation. Furthermore, these results could also be a result of the study's small sample size, and the methods should be replicated in future studies with a larger sample.

Future studies could attempt to reduce the limitations of my research, such as low participant numbers. In addition, future studies could use this paradigm to further examine this apparent advantage of prosocial motivation on prospective memory performance without experiencing ceiling effects found in previous research. They could also use this eye-tracking paradigm to research other factors, such as emotional states, in relation to prospective memory.

In summary, my study extends previous research involving the effects of motivational states on prospective memory and metacognition, as well as the use of an eye-tracking paradigm as a more direct assessment of prospective memory task monitoring. Consistent with previous research, the present study suggests a prosocial advantage in prospective memory that has been attributed to a more automatic system of remembering, such as spontaneous retrieval. The present study also informs prospective memory literature by demonstrating the use of a verbal fluency test as an effective delay task between prospective memory task instruction and completion. The information in the present study and subsequent lines of research might assist individuals, both in the general population and those with cognitive impairments (e.g. Alzheimer's disease) in developing more efficient prospective memory strategies in their daily lives.

References

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.

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. doi:10.1016/j.cognition.2009.10.011

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.

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

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.

Hacker, J. Y., Edwards, A., Ellis, D., Boring, E., Bianchi, C., & Shelton, J. T., (2018, March). *Don't forget to be altruistic! Motivational influences on prospective memory.* Paper to be presented at 64th annual conference for the Southeastern Psychological Association, Charleston, SC.

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.

http://dx.doi.org/10.1037/a0022872

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. http://dx.doi.org/10.1037/a0022784

McDaniel, M. A., & Einstein, G. O. (2000). Strategic and automatic processes in prospective memory retrieval: A multiprocess framework. *Applied Cognitive Psychology, 14*, 127-144. doi:10.1002/acp.775

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. doi:10.1037/a0022841

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.

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. doi: 10.1016/j.cogpsych.2013.07.001

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. doi:10.3758/s13421-016- 0601-3

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.

Appendix A

Condition-Specific Scripts

Standard script: "In the next phase of the experiment, in addition to counting the number of living objects, we are particularly interested in how well you remember to respond to particular items you will encounter in this task. A new image will appear every four seconds in the top right corner of the screen during each trial. Whenever you see a [chair/horse] appear in the top right corner, you should click the left mouse button. The [chair/horse] will rarely appear but it will appear more than once over the course of the experiment. Remember, you do not need to include images in the top right corner in your living object count; however, you should click the left mouse button whenever you see a [chair/horse] in the top right corner."

Pro-social script: "In the next phase of the experiment, in addition to counting the number of living objects, we are particularly interested in how well you remember to respond to particular items you will encounter in this task. A new image will appear every four seconds in the top right corner of the screen during each trial. Whenever you see a [chair/horse] appear in the top right corner, you should click the left mouse button. The [chair/horse] will rarely appear but it will appear more than once over the course of the experiment. Remember, you do not need to include images in the top right corner in your living object count; however, you should click the left mouse button whenever you see a [chair/horse] in the top right corner.

"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 chance will be of winning this incentive."

Self-interested script: "In the next phase of the experiment, in addition to counting the number of living objects, we are particularly interested in how well you remember to respond to particular items you will encounter in this task. A new image will appear every four seconds in the top right corner of the screen during each trial. Whenever you see a [chair/horse] appear in the top right corner, you should click the left mouse button. The [chair/horse] will rarely appear but it will appear more than once over the course of the experiment. Remember, you do not need to include images in the top right corner in your living object count; however, you should click the left mouse button whenever you see a [chair/horse] in the top right corner.

"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."

Appendix B

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 C

IRB Renewal Letter

THE UNIVERSITY OF TENNESSEE
CHATTANOOGA

Institutional Review Board
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TO: Amelia Edwards
Jessica Hacker, Dr. Jill Shelton

IRB # 17-103

FROM: Lindsay Pardue, Director of Research Integrity
Dr. Amy Doolittle, IRB Committee Chair

DATE: 6/13/2018

SUBJECT: IRB #:**17-103**: The Effects of Motivation and Metacognition on Prospective Memory Performance

The Institutional Review Board has reviewed and approved the following changes for the IRB project listed below:

- Change of title to the title listed above.
- Jessica Hacker has been removed from the project
- Connecting data from this project to the Psychology department SONA pre-screen data as outlined in the revised Form A submitted on 6/5/2018
- Project end date has been extended to 8/1/2021

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 D

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 E

SSPP Poster Presentation

Cognitive Aging, Learning, & Memory

CALM Lab

The Effects of Motivation on Metacognition and Prospective Memory

Amelia Edwards, Claudia Craig, Ashley May, Jessica Hacker, Jill Shelton, Ph.D.
The University of Tennessee at Chattanooga.

Purpose

Prospective Memory: Remembering to fulfill previously formed intentions.

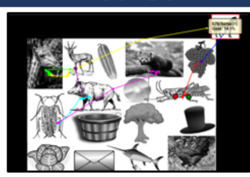
Prosocial Motivation: Motivation to promote the well-being of others.

Self-interest Motivation: Motivation to promote the well-being of oneself.

Metacognition: Awareness of one's own mental processes.

The purpose of this study was to investigate the different effects of prosocial and self-interested motivation on prospective memory performance, using monetary incentives to encourage motivational states. Additionally, this study explored the influence of these motivational states on metacognition.

Method



Ongoing Task: Count the number of living objects.

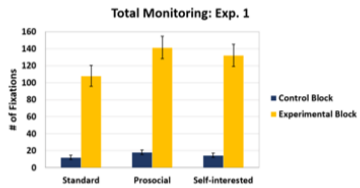
Prospective Memory Task: Click the left mouse button when a horse appears in the top right corner.

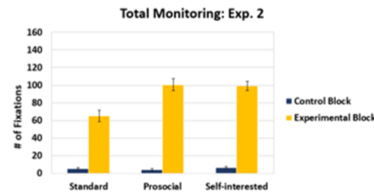
Standard Condition: No monetary incentive.

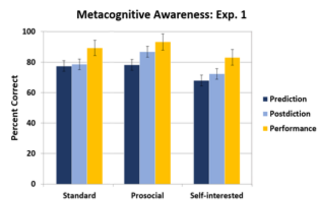
Prosocial Condition: Chance to earn $25 for charity.

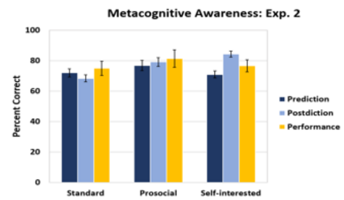
Self-interested Condition: Chance to earn $25 for oneself.

Differences Between Experiments: To reduce ceiling effects in prospective memory performance, Experiment 2 used a more cognitively engaging delay task between the encoding and retrieval stage of the prospective memory task. Experiment 2 also increased the difficulty of the ongoing task by reducing the time of each trial from 12 seconds to 9 seconds.









Results

Experiment 1

- Monitoring was not affected by condition.
- Participants in the prosocial and standard conditions were underconfident, while those in the self-interested condition more accurately predicted their performance.
- Participants in the prosocial condition had most accurate postdiction of performance.

Experiment 2

- Prospective memory target monitoring was higher in the self-interested and prosocial conditions.
- Participants were relatively accurate in predicting and postdicting their performance in the prospective memory task regardless of condition.
- Participants in the prosocial condition had higher performance, higher levels of monitoring, and higher metacognitive accuracy.

Conclusions

- The novel eye-tracking approach used in the present study enabled a more direct assessment of monitoring for the prospective memory target.
- Performance is relatively high in both experiments. However, the adjustments made in Experiment 2 were successful in reducing ceiling effects.
- This study extends previous research by revealing the relationship between metacognitive accuracy and motivational states in prospective memory.
- Consistent with previous research, the present study suggests a prosocial advantage in prospective memory.

References

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.

Grant, A. M., & Berg, J. M. (2011). Prosocial motivation at work: When, why, and how making a difference makes a difference. *Oxford Handbook of Positive Organizational Scholarship*, 28-44.

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.