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Improving Self-Regulated Learning of Undergraduates through a Prospective Memory Intervention: A Pilot Study

By

Jeff McCarthy

A Thesis
Submitted to the Faculty of Graduate Studies
through the Department of Psychology
in Partial Fulfillment of the Requirements for
the Degree of Master of Arts at the
University of Windsor

Windsor, Ontario, Canada
2016

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Improving Self-Regulated Learning of Undergraduates through a Prospective Memory Intervention: A Pilot Study

by

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September 20, 2016

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ABSTRACT

Undergraduates may struggle to finish degree requirements due to factors such as poor academic self-efficacy and goal management. The cognitive rehabilitation literature has found that prospective memory (PM) skill training has improved goal attainment in older adult and brain-injured populations. Due to the ongoing brain development supporting PM in emerging adults, cognitive rehabilitation approaches also may help improve function and academic self-efficacy. Thirty-nine undergraduate students (25 female) were randomly assigned to one of two conditions: PM skills training (n = 21) or relaxation training (n = 18). PM was assessed immediately before and 2 to 14 days after intervention using self-report and performance PM measures and mood and academic self-efficacy questionnaires. PM training emphasized implementation intention, cue monitoring, and use of external aids. Larger post-intervention gains were expected in the PM condition. PM performance and academic self-efficacy measures showed significant main effects for time ($p < .01$). Effect sizes ($\omega^2_{partial}$) were .12 for an updated version of the Royal Prince Albert (RPA) PM test, .21 for Self-Efficacy for Learning form, .25 for a time-based PM measure embedded in a working memory test, .37 for an event-based PM task incorporated into a semantic memory test, and .08 for a self-report measure of stress. Only the RPA showed a significant interaction between time and condition; however, this interaction reflected a decline after relaxation and stability after PM training. The interaction for the time-based PM measure approached significance (p = .07) and was in the expected direction. Self-reported PM did not show significant change. A single-session PM intervention shows promise for improving PM performance and academic self-efficacy. Self-reported PM showed no consistent effect from this intervention in the current form. Further exploration of this intervention in a long-term context is warranted.

TABLE OF CONTENTS

DECLARATION OF ORIGINALITY iii

ABSTRACT iv

CHAPTER 1 INTRODUCTION 1

Prospective Memory 1

Neuroanatomical Correlates of Prospective Memory 5

Prospective Memory Interventions 6

Intention Formation Interventions 6

Cue Monitoring Interventions 8

Use of External Aids 9

Role Of Motivation in Intervention 10

Brain Development of Typical University-Age Students 12

University Student Difficulties 13

Focus of Present Research 19

Research Questions for the Present Study 20

CHAPTER 2 METHOD 22

Participants 22

Measures 23

Prospective And Retrospective Memory Questionnaire 23

Multifactorial Metamemory Questionnaire 24

Royal Prince Alfred Prospective Memory Test 25

Self-Efficacy For Learning Form 27

Multidimensional Scale Of Perceived Self-Efficacy 27

Depression Anxiety Stress Scale 29

Embedded Event-Based Prospective Memory Test and Famous Faces Test 30

Embedded Time-Based Prospective Memory Test and Modified Letter N-Back Task 31

Procedure 33

Experimental (Prospective Memory) Group 34

Comparison (Relaxation) Group 36

Statistical Analyses 37

RESULTS 42
Demographic Characteristics 42
Research Question 1 44
Research Question 2 46
Research Question 3 49
Research Question 4 53
Research Question 5 54
Research Question 6 57
Research Question 7 58
DISCUSSION 60
REFERENCES 71
APPENDICES 71
Appendix A: Participant Pool Advertisement 83
Appendix B: Consent Forms 84
Appendix C: Famous Faces Task 92
Appendix D: Modified Letter N-Back Task 95
Appendix E: Script fsor Intervention Condition 96
Appendix F: Script for Comparison Condition 99
Appendix G: Descriptive Statistics by Group for Dependent Measures 103
VITA AUCTORIS 105

CHAPTER 1

Introduction

Cognitive training is an intervention approach used to address difficulties with various aspects of cognitive functioning such as memory (Bahar-Fuchs, Clare, & Woods, 2013). It is similar in scope to cognitive rehabilitation, though rehabilitation tends to center on restoring abilities after neural insults such as traumatic brain injury (TBI) or stroke (Cicerone et al., 2005) or neurodegenerative disorders such as dementia (Bahar-Fuchs et al., 2013). Whereas cognitive rehabilitation is restorative in nature (that is, emphasizing the return to baseline levels of ability), training interventions focus on improving skills from baseline (Papp, Walsh, & Snyder, 2009). The efficacy of cognitive rehabilitation across a wide range of domains and pathologies has led researchers and clinicians to adapt these approaches to healthy populations for the purposes of mitigating cognitive decline related to normal aging and improving areas of difficulty in daily life related to later adulthood (Bahar-Fuchs et al., 2013; Mckitrick, Camp, & Black, 1992; Papp et al., 2009). As function does not need to be rehabilitated per se in these cases, these interventions are considered "cognitive training" for the domains with which the participants have difficulty. The aim of this project is to adapt cognitive training techniques relating to prospective memory to assist undergraduates in coping with the demands of academic life.

Prospective Memory

Prospective memory is our ability to remember intentions for future action (McDaniel & Einstein, 2007; van den Berg, Kant, & Postma, 2012). Prospective memory tasks may include activities such as remembering to deliver a message to a friend,

remembering to pay household bills, or remembering to take one's medications (Zogg, Woods, Sauceda, Wiebe, & Simoni, 2012). Prospective memory requires both a prospective component, remembering the intention for action for an appropriate moment, and a retrospective component, recalling the action itself once the opportunity for action arises (McDaniel & Einstein, 2007). For example, consider the scenario of buying milk at the grocery store on one's way home; There is a prospective component, stopping into the grocery store as you pass it, as well as a retrospective component, remembering that what you wanted to pick up was milk. There are thought to be two major forms of prospective memory: event-based and time-based (Brandimonte, Einstein, & McDaniel, 1996; McDaniel & Einstein, 2007). Event-based prospective memory tasks are those carried out in response to the presence or absence of an external stimulus, for example buying stamps when passing by the post office. Time-based prospective memory tasks, in contrast, are those to be carried out at a particular time (for example, going to a meeting at 10:30 am), and whose cues are internally reliant.

Models of prospective memory proposed over the years suggest that, for a given prospective memory task, a series of stages is required for successful completion (Brandimonte et al., 1996; McFarland & Glisky, 2012; van den Berg et al., 2012; Zogg et al., 2012). First, the intention or goal itself, i.e., what one wishes to do, must be decided – a stage termed "intention formation" (McDaniel & Einstein, 2007). After the formation of the intention or goal, there is a delay period, during which the intention must be retained or remembered. In prospective memory tasks, these intentions have a cue associated with them (such as this afternoon or the grocery store), which acts as a signal to carry out the intended action. The presence of this cue is monitored during the delay period. If the cue

is successfully detected, the original intention must then be remembered. Should the intention be successfully recalled, the intended task can potentially be executed and the prospective memory task thereby completed.

Prospective memory is complex, requiring several cognitive functions to work in symphony. Prospective memory tasks, unlike most retrospective memory tasks, rely on internal mechanisms (that is, they are largely without external prompts or cues). Retrospective memory tasks tend to involve external prompts to retrieve the memories, especially in research settings, where participants are explicitly asked to recall information (McDaniel & Einstein, 2007; van den Berg et al., 2012). This reliance on internal mechanisms without the support of prompts may explain, in part, why difficulties with prospective memory tasks are among the first memory symptoms reported by older adults to physicians (van den Berg et al., 2012). Many people with complaints of a "bad memory" are often concerned with their lapses in prospective memory, rather than difficulties in learning lists or recalling information (West, 1995). Difficulties with prospective memory can be particularly troubling in cases of older adults with comorbid health problems, due to the role of prospective memory in medication adherence and attending appointments (DiMatteo, Giordani, Lepper, & Croghan, 2002; Zogg et al., 2012). While the retrieval processes needed for retrospective memory are similarly essential for prospective memory, attentional and executive processes are also required. These processes allow one to notice the execution opportunity and carry out the targeted action. Further, these processes aid in managing potential distractors that would interfere with the completion of the goal (Gollwitzer & Sheeran, 2006; Levine et al., 2000).

Prospective memory performance can be measured in a variety of ways, both in and out of laboratory settings (van den Berg et al., 2012). Laboratory prospective memory tasks can include monitoring tasks, in which the participant is to respond to a series of stimuli except in cases of cue stimuli, in which case they respond differently (e.g., hitting the "F" key instead of "J"). Time-based laboratory tasks require the participant to perform a particular action after an allotted time period, such as 10 minutes. Laboratory tasks tend to show increased effect sizes relative to naturalistic tasks, though there is concern that performance on these tasks may not generalize to real-world function (Kazdin, 2003; van den Berg et al., 2012). Simulation tasks, such as "Virtual Week" protocols, in which participants are to perform four tasks per day over two days of simulated time, are able to use both event-based and time-based tasks in realistic settings under laboratory conditions, though these experiments require significant time commitments (van den Berg et al., 2012). Questionnaires in either self-report or informant report format can give insight into prospective memory problems in everyday life, and deepen understanding of participants' perceived difficulties. These questionnaires are one of the few ways of explicitly evaluating internal processes relating to prospective memory. However, these can be subject to a host of biases (for example, forgetting instances of memory failure) and may not accurately reflect true prospective memory performance unless corroborated by other measures (Kazdin, 2003). Naturalistic lab-based tasks, such as having the participant leave an item (e.g., a piece of identification) with the examiner and ask for it to be returned at the end of the testing session, provide realistic prospective memory tasks in a structured format (van den Berg et al., 2012). Other real-world prospective memory tasks, such as remembering to make a

phone call, can be adapted and operationalized for study of prospective memory. Participants can be tasked with calling the examiner at a set time after the testing session, or can be given a post-card to deliver to a mailbox (Radford, Lah, Say, & Miller, 2011; van den Berg et al., 2012). Interventions targeting real-world prospective memory tasks tend to have smaller effect sizes compared to lab tasks, though these interventions are better suited to how participants perform in everyday life (Kazdin, 2003; Papp et al., 2009; van den Berg et al., 2012). A combination of lab and naturalistic prospective memory tasks may help optimize the strengths of each approach, allowing one to detect stronger effects and permitting increased generalizability of findings.

Neuroanatomical Correlates of Prospective Memory

Prospective memory relies on many brain regions associated with memory, namely the medial temporal lobe and hippocampus, and attention regions, such as inferior parietal, anterior cingulate and frontal cortical regions (Burgess, Quayle, & Frith, 2001; Okuda et al., 2007; van den Berg et al., 2012; Zogg et al., 2012). In particular, there is a significant involvement of prefrontal areas in prospective memory tasks (Burgess et al., 2001; Okuda et al., 2007; Simons, Scholvinck, Gilbert, Frith, & Burgess, 2006; Zogg et al., 2012). The involvement of prefrontal areas in prospective memory is indicative of the role executive function plays in prospective memory (Zogg et al., 2012). Of particular relevance for prospective memory is the rostral prefrontal cortex (Brodmann area 10; Burgess et al., 2001; Okuda et al., 2007; Simons et al., 2006). Functional imaging studies have found this area is activated in both time- and event-based prospective memory tasks (Burgess et al., 2001; Okuda et al., 2007). The rostral prefrontal cortex is thought to be associated with the maintenance and realization of delayed intentions (Burgess et al., 2001; Okuda et al., 2007). This area shows activation during both cue identification and

intention retrieval, suggesting that while behaviourally distinct, these functions have a common neurological basis (Simons et al., 2006). This reliance on prefrontal and temporal systems, which are often among the first regions impaired in many neurodegenerative disorders, may suggest why prospective memory difficulties are so prevalent in populations with these disorders (van den Berg et al., 2012).

Prospective Memory Interventions

Interventions focusing on prospective memory are often geared towards specific stages in prospective memory: intention formation, intention retention, cue monitoring and detection, and intention recall (McDaniel & Einstein, 2007; van den Berg et al., 2012; Waldum, Dufault, & McDaniel, 2014). Although not fully distinct insofar as the underlying cognitive processes and neuroanatomy are concerned, these stages provide a pragmatic heuristic framework for interventions (Papp et al., 2009; van den Berg et al., 2012; Zogg et al., 2012). The action component of prospective memory tasks, wherein the intention is carried out, is often not addressed in prospective memory interventions, though it can be targeted as part of interventions concerned with managing goal achievement (Gollwitzer & Sheeran, 2006; Levine et al., 2000). Instead, prospective memory interventions focus on two broad aspects: intention formation and cue monitoring.

Intention Formation Interventions. Many interventions designed to improve intention formation make use of techniques that improve encoding of the intention (van den Berg et al., 2012). By improving the encoding of an intention, a stronger, better link between the intention and cue is made, allowing for improved ease of recall once the cue is detected (Zogg et al., 2012). The techniques typically used for prospective memory

interventions include errorless learning, spaced-retrieval techniques, and implementation intentions, with implementation intentions being the most researched for prospective memory (Fish, Manly, Kopelman, & Morris, 2014; van den Berg et al., 2012; West, 1995; Zogg et al., 2012).

Errorless learning is a technique that prevents people from making mistakes while they are learning a new skill or information (Fish et al., 2014; Svoboda, Richards, Leach, & Mertens, 2012; West, 1995). This approach has been leveraged in cases of memory impairment (for example, Baddeley and Wilson, 1995), allowing for increased learning compared to "errorful learning" conditions (that is, where the participants make errors during learning; Svoboda et al., 2012; West, 1995). While there is strong evidence supporting the use of errorless learning in those with memory impairment, there is some evidence that trial-and-error learning may benefit neurologically healthy persons (Cyr & Anderson, 2015). By making mistakes while learning information, younger adults in a study by Cyr and Anderson could use their errors as "stepping stones" to help them recall information.

Spaced-retrieval is a process based on reviewing material over increasing lengths of time. By reviewing material as it is on the cusp of being forgotten, the encoding of the information becomes stronger (Kinsella, Ong, Storey, Wallace, & Hester, 2007). By asking the participant what they are supposed to do that day over a period of intervals of increasing length, prospective memory performance can be improved (Kinsella et al., 2007).

Implementation intention involves specifying a plan of action (that is, the when, where, and how of the future behaviour) as part of the intention formation (Gollwitzer &

Brandstätter, 1997). This allows for a clear link between specific cues and specific responses to be made, reducing the effort required for recall of the original intention (Zogg et al., 2012). A meta-analysis of implementation intentions found a positive effect of medium-to-large magnitude (d = .65) on goal attainment, suggesting that this technique may be beneficial in facilitating the completion of prospective tasks (Gollwitzer & Sheeran, 2006). While various approaches to implementation intention require the user to imagine the scenario in which they will act, statements of intent themselves, without an imagination component, provide a comparable improvement in prospective memory tasks (McFarland & Glisky, 2012). Implementation intention may benefit performance on certain types of prospective memory tasks more than others. On tasks which have subtle cues for action, such as writing down the day of the week on each piece of paper received during a study, use of implementation intentions improved task performance (Gollwitzer & Sheeran, 2006). However, on tasks that involve salient cues (for example, responding to an alarm), implementation intention may have a lesser effect (Chasteen, Park, & Schwarz, 2001), suggesting that the formation of implementation intention primarily benefits tasks that require self-initiation.

Cue Monitoring Interventions. Interventions that focus on monitoring during the delay period of prospective memory tasks tend to be divided into event-based and time-based techniques (van den Berg et al., 2012). In the case of event-based prospective memory tasks, interventions focus on increasing the quality of the cue, making detection and intention recall easier (Burkard, Rochat, Juillerat Van der Linden, Gold, & Van der Linden, 2014; Gollwitzer & Sheeran, 2006; McDaniel & Einstein, 2007). There are several approaches to this, including reducing the gap between detection and action (for

example, using a pill bottle for to remind yourself to take medication); making the cue distinct (for example, putting the reminder for action in an unusual place where it will stand out); and making the cue "centrally located" (that is, putting the cue in a place that is relevant to your activities during the event; Zogg et al., 2012). For time-based prospective memory tasks, clock-checking is one of the most widespread techniques (McDaniel & Einstein, 2007; van den Berg et al., 2012; Waldum et al., 2014). Clock-checking involves the periodic disengagement from the task at hand to evaluate the environment and make note of the time. This approach has been found to be effective in a variety of time-based prospective memory tasks (McDaniel & Einstein, 2007; Waldum et al., 2014). Participants, once taught the strategy, periodically monitor the time and as the target time approaches, increase their rate of monitoring, increasing the opportunity for them to complete the task appropriately (McDaniel & Einstein, 2007). Training of executive abilities, which can help redirect attention, reduce distraction, and minimize interruption, may also aid in the delay phase of prospective memory tasks by improving one's ability to focus and monitor (Levine et al., 2000; van den Berg et al., 2012).

Use of External Aids. In some cases, improvements in underlying prospective memory ability may not be possible, but gains in performance still may be achievable. In cases of more severe memory impairment, the use of external aids to compensate for prospective memory difficulties may prove more fruitful than standard intervention techniques (Svoboda et al., 2012; West, 1995). These aids can include reminders from others, alarms, timers, paper reminders, and calendars. In research on patients with severe memory impairment, those trained to use external aids were able to complete prospective memory tasks despite severe memory impairments (Svoboda et al., 2012). Active cues –

that is, cues which require no action on the part of the user (for example, phone alarms) – are considered more effective compared to passive cues, such as calendars, as these do not place cognitive demands on the person (West, 1995). Improvements in technology, particularly with smartphones, provide an increasing number of ways to assist in this regard. Beyond notifications based on time (for example, alarms, calendar appointments), smartphones are now able to provide reminders based on additional criteria, such as location. It is possible that these aids may become more widely implemented in future memory interventions given the increasing availability of technology.

Role of Motivation in Intervention

Reviews of cognitive training have suggested that many interventions have questionable efficacy and small-to-moderate effect sizes (Bahar-Fuchs et al., 2013; Gollwitzer & Sheeran, 2006). While these theory-based interventions and training programs are often developed on solid scientific foundations, there remains a gap between expected and actual effects (Gollwitzer & Sheeran, 2006). It is possible that the possible benefits of interventions are unintentionally undercut by the participants. Many skills learned in cognitive training interventions require substantial commitment from the participants, in terms of practice and homework exercises (Bahar-Fuchs et al., 2013; Gollwitzer & Sheeran, 2006; Levine et al., 2000). For example, in a popular cognitive rehabilitation program for persons with executive problems (Levine et al., 2000), participants are asked to attend 10 weekly with up to three follow-up sessions. At the end of each session, participants are given homework assignments to practice these skills. While this work serves to further develop the skills learned, increase automaticity of the techniques, and increase generalizability of skills (DiMatteo et al., 2002; Levine et al., 2000), these tasks also increase the demands placed upon the participants. In

interventions where the participant has an active role, the complexity of treatment tends to be a large factor in the program's success, with adherence and compliance diminishing as regimen complexity increases (DiMatteo et al., 2002; Fielding & Duff, 1999). Additional factors found to impact the adherence of participants include: the participant's level of psychological distress; conflicting goals between participant and researchers/clinicians; level of functional impairment; and participant's lack of knowledge or understanding of their difficulties (DiMatteo et al., 2002; Fielding & Duff, 1999).

As a client's level of psychological distress increases, two conflicting factors come into play. Firstly, motivation to participate in treatment to alleviate their symptoms increases regimen adherence (Fielding & Duff, 1999). Secondly and contrastingly, an increased level of distress impairs functioning, including their ability to manage what is required of them to adhere to the intervention regimen, reducing levels of adherence (Fielding & Duff, 1999). Similarly, higher levels of functional impairment decrease a client's ability to adhere to protocols, especially in cases where the interventions are complex (DiMatteo et al., 2002; Fielding & Duff, 1999).

Protocol noncompliance also may stem from differences in the goals of client and clinician. Generally, clients tend to focus on short-term goals centered on the removal of immediate stressors, whereas clinicians focus on long-term patient goals (for example, prevention of future difficulties related to their impairment; Fielding & Duff, 1999). Consequently, clinician-developed interventions do not always focus on what is important for the client, introducing barriers that prevent clients from fully committing to the protocol. To help correct for this discrepancy, collaborative goal-planning can be

used. By using a collaborative process, participants are allowed agency in addressing their problems, and a stronger relationship is forged between both the clinician and patient as well as a greater commitment of the patient to the protocol (Fielding & Duff, 1999). Education about the intervention and the problems it addresses additionally serves to increase protocol compliance and improve the client's sense of self-efficacy regarding their difficulties (Fielding & Duff, 1999). To effectively work towards goal achievement, one needs to be able to motivate oneself, which is heavily linked to one's sense of agency (Gollwitzer & Brandstätter, 1997; Gollwitzer & Sheeran, 2006).

Brain Development of Typical University-Age Students

While many of the systems within the central nervous system have fully matured in emerging adults, the brain is still maturing in several ways. The anterior regions of the brain, including frontal and temporal lobes, are among the last areas of the brain to complete maturation (Blakemore, 2012). Emerging adults show greater activation in areas of medial prefrontal cortex relative to adults, suggesting comparatively lower efficiency in tasks involving this area (Blakemore, 2012). Changes occurring in these cortical regions include an increase in white matter mass (due to myelination) and a decrease in grey matter (due to synaptic pruning), improving connections both within the frontal lobe itself and between external regions of cortex (Blakemore, 2012; Lenroot & Giedd, 2006). Compared to pre-adolescent children, emerging adults show a lesser degree of activity of frontal systems at rest, indicating a greater degree of efficiency. Some of the most marked changes from a neuroanatomical perspective occur in the prefrontal cortex (Blakemore, 2012; Bunge & Wright, 2007). Beyond changes in neuroanatomy, emerging adults manifest burgeoning understanding of their own mental functions; this understanding is referred to as metacognitive ability (Blakemore, 2012). Metacognitive

ability allows for increased efficiency in cognition, compensation for difficulties, and leveraging of skills. The ongoing maturation of frontal, especially prefrontal, and temporal areas and the link between activation of these areas and prospective memory suggest that the neural systems on which prospective memory relies are not fully developed in emerging adults. By incorporating metacognitive strategies and practice of the skills required for prospective memory tasks, future prospective memory performance may be enhanced in this group.

University Student Difficulties

While sufficient academic ability is a requirement for academic success, it is not sufficient. Indeed, emotion, self-regulated learning ability, and motivation are significant factors in determining academic success (Mega, Ronconi, & De Beni, 2014). A recent review article by Wolters & Hoops (2015) found that post-secondary education, in general, involves increased freedom, responsibility and independence, compared to secondary education. This idea of self-regulated learning emphasizes processes such as goal-setting, self-monitoring, strategy use, and self-evaluations (Zimmerman & Kitsantas, 2005). Further, the format and nature of instruction shift dramatically from what was previously required in prior education settings. Courses in this setting, compared to secondary school, involve less time in class, less direct oversight, and more long-term assignments and evaluations. This shift in educational paradigm, from the work required to the nature of the student's role, puts students in an unfamiliar environment for which they have few existing skills (Wolters & Hoops, 2015). There is increased recognition of student difficulties in recent years: the graduation rate for colleges and universities in Ontario, defined as the number of those who graduated from their university within seven

years of entering, has been largely stable and was 65.8% for 2013 (Higher Education Quality Council of Ontario, 2016). A study by Morisano, Hirsh, Peterson, Pihl, & Shore (2010) reported that approximately 25% of university students in a four year program never graduate and the majority of students who do graduate take longer than expected. In some cases, students become disengaged with their education, evidenced by skipping class, discontinuing courses, not completing assignments, or attaining low grades (Wolters & Hoops, 2015). While the causes behind this are multi-faceted, there likely are students who would be able to successfully complete their programs with effective intervention.

Interventions that enable students to better achieve success in post-secondary education provide value in two major ways. First, for many people pursuing higher education, completion of their degree is an important step on their pathway to well-being and success *(U.S. Department of Education, National Center for Education Statistics*, 2015; Wolters & Hoops, 2015). Secondly, non-completion of degrees may mean that institutional and financial resources are consumed that otherwise would support completion of a degree. In Canada, the mean for two semesters' tuition was $11,918 in 2014 (Statistics Canada). The costs for education are beyond these figures, however, as they do not include course materials (for example, textbooks) or living expenses for students. Grants, scholarships, and bursaries are established by governments, institutions, and community members to help students manage these costs. Consistent year-to-year increases in post-secondary enrollment mean ever-growing demands for funds; approximately 50% of students graduate from their programs with student debt, with close to 75% of these students utilizing government loan services such as OSAP

(Statistics Canada, 2015). In the 2013-2014 school year, approximately $2.7 billion dollars were provided to full-time students in loans, with a further $715 million provided in grants with no repayment requirement. Of student borrowers, 59% were enrolled in university (Employment and Social Development Canada, 2014). Consequently, enabling students to complete their degrees would mean a substantial gain in the benefit from funds allocated for university student support (Wolters & Hoops, 2015).

Self-efficacy and self-regulated learning ability have been found to be large factors in predicting academic success (Lotkowski, Robbins, & Noeth, 2003; Richardson, Abraham, & Bond, 2012), and consequently may be a worthwhile focus for intervention. To improve students' ability at, and self-efficacy regarding, self-regulated learning, the construct itself must be explored. Self-regulated learning involves three major stages or components: forethought, performance, and self-reflection (Kitsantas, Dabbagh, Hiller, & Mandell, 2015). Forethought involves the planning and goal-setting aspects of self-regulated learning. It is affected by a student's motivation, perceived efficacy, and expectancies. The goals set in this stage can either be process- or outcome-oriented (for example, understanding a process or getting the answer, respectively). Performance involves the actual completion of tasks at hand and includes self-control (for example, attention focusing and use of task strategies) and self-observation (for example, monitoring of performance and record-keeping). Self-reflection consists of both a self-reaction (that is, satisfaction with outcome) and a self-evaluation (that is, comparison of outcome with original goal) component.

For students having difficulty in self-regulated learning environments, a review article found that several interventions offered through their place of education may be of

help (Wolters & Hoops, 2015). These interventions involve tutoring, workshops, or coursework, each of which carries strengths and shortcomings. In tutoring, interventions are individualized to focus on students' shortcomings to help them reach their goals. Tutoring is considered most effective as a short-term intervention, utilizing a few sessions from 30 to 90 minutes in length (Wolters & Hoops, 2015). A downside to this approach is that tutoring tends not to be comprehensive, especially in cases where students require assistance in many areas. Further, due to the brief nature of these interventions, the theory behind the intervention is often neglected to focus more on skill training, which may limit compliance (Fielding & Duff, 1999; Wolters & Hoops, 2015). Workshops on self-regulated learning allow for interventions with small groups, focusing on one or two skills. Consequently, these interventions allow for students to explore topics in greater depth, with some degree of theoretical background. Workshops tend to have limited time for feedback or practice of skills and instead focus on the concepts behind the skills (Wolters & Hoops, 2015). Learning and, more importantly, adoption of non-intuitive skills, such as those required for self-regulated learning, are benefited by the practice of skills and application to real-life scenarios (van den Berg et al., 2012; Wolters & Hoops, 2015). Interventions also can be implemented as part of coursework, such as in "College 101" courses (Wolters & Hoops, 2015). These courses can cover a wide amount of content related to self-regulated learning and often include a rich theoretical background. These courses may incorporate cognitive, motivational, affective, behavioural, and contextual dimensions for self-regulated learning skills (Wolters & Hoops, 2015). Unfortunately, these require an additional course in students’ schedules or programs and may be viewed as unnecessary by students who may benefit from it.

Further, as these courses tend to be standardized, there is little opportunity for an individual's problems to be directly addressed. Depending on their structure, there may be opportunities to practice and receive feedback on the skills taught in the course, either in class itself or as homework (Wolters & Hoops, 2015). However, in those cases in which students develop a sense of competency or self-efficacy as a result of these courses, they subsequently are better able to persist in environments that are difficult for them (Wolters & Hoops, 2015).

For undergraduates, three approaches for prospective memory interventions are thought to be most appropriate: implementation intention, cue-monitoring, and external aids. Strategy training for time-based prospective memory tasks has shown effectiveness in lab settings (Waldum et al., 2014). In a university context, time-based prospective memory tasks would include dealing effectively with deadlines, or managing time effectively during examinations or assignments. For these tasks, cue-monitoring strategies such as clock-checking would likely be an effective technique for undergraduates to learn. Implementation intention, due to its role in both prospective memory and goal-directed behaviour (that is, behaviour that allows for the attainment or progress toward a desired end), may be best suited as a focus for intervention for academic success (Burkard, Rochat, Blum, et al., 2014). The use of external aids would provide a level of support for prospective tasks as deemed appropriate for the individual student. Dependent on their difficulties, students would be able to leverage specific supports, such as time- or event-based notifications. Additionally, as these aids require some level of organization and forethought about future tasks, these techniques may provide additional benefits related to self-regulated learning. For example, a date-based

notification regarding an upcoming assignment deadline requires the student to understand the deadline and the associated time commitment and input appropriate reminders accordingly.

While many forms of intervention have been used to address difficulties with university students, interventions focused on prospective memory have not been explored in this population. Indeed, the interventions used for this population tend to emphasize executive function broadly, stress reduction, or academic skills training (Carstens, 2011; Hindman, Glass, Arnkoff, & Maron, 2014; Van Gordon, Shonin, Sumich, Sundin, & Griffiths, 2013). These are largely manualized interventions usually delivered over several weeks. While there are briefer interventions (e.g, Carstens, 2011; Wolters & Hoops, 2015), these tend to be more focused and to have smaller effects.

The extant literature on prospective memory interventions for non-student populations suggests these treatments are efficacious (van den Berg et al., 2012). These studies tend to look at populations in which prospective memory is declining or impaired, namely, in older adult and in acquired brain injury populations, respectively (Bahar-Fuchs et al., 2013; van den Berg et al., 2012). Researchers constructing these studies have relied heavily upon theory, particularly models of the cognitive processes underlying prospective memory (McDaniel & Einstein, 2007; van den Berg et al., 2012; Waldum et al., 2014).Although these intervention studies have demonstrated moderate efficacy, generalization to everyday prospective memory tasks remains uncertain (van den Berg et al., 2012). The impact of these interventions in populations in which the neural system supporting prospective memory is maturing has not yet been explored directly.

Focus of Present Research

This study addressed the use of prospective memory skills training to improve undergraduates' function in self-regulated learning environments. Participants in the experimental condition were given individualized tutoring on prospective memory skills, including implementation intention, cue selection, clock checking, and the use of external aids. Prospective memory and related abilities were assessed before and after intervention. Performance changes in the experimental intervention group were compared to those in a comparison group given relaxation training not specific to prospective memory. The hypothesis was that learning techniques shown to aid in meeting goals and completing tasks would better equip students to manage the demands of a post-secondary education. This study was intended to be a pilot for a brief intervention focused on using prospective memory skills to improve academic self-efficacy.

As it stands, this approach for this population is yet unexplored, so it would be important to consider whether a prospective memory-focused intervention would be effective, or at least promising, in a more limited fashion before conducting in-depth studies. Due to the exploratory nature of this study and to increase the likelihood that busy undergraduates participate in the study, the intervention period was a single session and was substantially shorter than in typical prospective memory training (van den Berg et al., 2012; Waldum et al., 2014). However, there is good evidence that skills training done in a single focused session can be beneficial, with participants retaining the learned information (Carstens, 2011; Eaton et al., 2012; Feldman & Dreher, 2012; Troxel, Germain, & Buysse, 2012; Wolters & Hoops, 2015). The majority of these single-session interventions use theory-driven techniques to focus on key elements which are to be improved, with emphasis on engaging the individual in a one-on-one setting. Overall, this

suggests that there may be efficacy in a single-session psychoeducational intervention as proposed in this study, though it is probable that a more in-depth educational paradigm would provide greater gains and generalizability to day-to-day lives for those undergoing the intervention.

Research Questions for the Present Study:

1. Will the experimental group show significant improvement on subjective prospective memory measures after prospective memory training? Will greater improvement on subjective prospective memory performance be seen in the experimental group after brief prospective memory training than in the comparison group after relaxation training?
2. Will the experimental group show significant improvement on objective prospective memory measures after prospective memory training is completed? Will greater improvement on objective prospective memory performance be seen in the experimental group after completion of brief prospective memory training than in the comparison group after completion of the relaxation training?
3. Will there be greater gains in time- than in event-based prospective memory after the intervention for those in the prospective memory training group? Will post-intervention changes in time- compared to event-based memory be greater for those in the prospective memory training group than any changes observed for those in the relaxation training group? Traditionally, prospective memory has been dichotomized into time-based and event-based memory, which tend to be studied as two separate processes (McDaniel & Einstein, 2007). Recent research involving prospective memory interventions have found greater benefits of training on time- versus event-based tasks (Waldum et al., 2014).

4. Will participants who receive the prospective memory intervention subsequently demonstrate significant boosts in their perceived efficacy for self-regulated learning? Will these gains be bigger than any observed in the comparison condition after relaxation training?
5. After the prospective memory training intervention, will self-efficacy items related to learning (ratings on the SELF and on the Academic Self-Efficacy factor of the MSPSE) show greater positive gains than those observed in other domains (Social Self-efficacy and Self-Regulatory Efficacy on the MSPSE)? Will the contrast between post-intervention changes on learning self-efficacy domains versus the other Social Self-efficacy and Self-Regulatory Efficacy domains be greater for those in the prospective memory training group than in the relaxation training group?
6. Following intervention, will the prospective memory training group show a significant reduction in stress? Will this post-intervention reduction in stress be greater after prospective memory training than after relaxation training?
7. Will participants receiving prospective memory intervention show greater satisfaction with their memory after intervention than before? Will these gains be greater than any seen in the comparison group after relaxation training?

CHAPTER 2

Method

Participants

Participants in this study were recruited through the Psychology Participant Pool site at the University of Windsor. Students enrolled in psychology and business courses at the University of Windsor are eligible for participation in this Pool if the instructor of the course so elects. Participants were asked to participate in this study based on self-perceived difficulties with self-directed learning and prospective memory. Further, study postings on the Participant Pool website emphasized the core component of the study, namely the brief intervention focusing on remembering to do things. To maximize suitability for this intervention, screening questions for the Pool were used such that only those who endorsed difficulties with self-regulated learning, who wished to improve their abilities, and who had a data-enabled smartphone or tablet, were able to view and sign up for the study (screening questions and recruitment posting can be found in Appendix A).

Upon arrival for the study, students were reintroduced to the purpose of the study and asked to give informed consent for the first session. Participants also consented to the researcher obtaining their marks for the previous and the current semester (the former was obtained in-session by the participants; the latter was requested through the Office of the Registrar), although analysis of these data are not part of the thesis project. Participants received 2 bonus points for 120 minutes of participation towards the Psychology Participant Pool, if registered in the pool and enrolled in one or more eligible courses. The second session of the study was conducted between 2 to 14 days after the first session. At the beginning of this session, participants were again asked to give

informed consent for this component of the study. Participants were given 1 bonus point for 60 minutes of participation towards the Psychology Participant Pool. This study was conducted in accordance with the University of Windsor's Research Ethics Board (REB). Prior to the recruitment of participants, this study was reviewed and approved by both the REB and the Psychology Participant Pool Coordinator. Consent forms for the study can be found in Appendix B.

Measures

Participants completed a battery of tests on prospective memory and academic self-efficacy, including the Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie, & Maylor, 2000), Multifactorial Metamemory Questionnaire (MMQ; Troyer & Rich, 2002), Royal Prince Alfred Prospective Memory Test (RPA-ProMem; Radford, Lah, Say, & Miller, 2011), Self-Efficacy for Learning Form (SELF; Zimmerman & Kitsantas, 2005), Multidimensional Scale of Perceived Self-Efficacy (Zimmerman, Bandura, & Martinez-Pons, 1992), and Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995). As there are often issues of real-world generalizability from tests (Kazdin, 2003), emphasis was placed on selecting measures that focused on performance in daily life

Prospective and Retrospective Memory Questionnaire. The PRMQ is a common, brief self-report questionnaire designed to assess the frequency at which participants make various memory errors (Crawford, Smith, Maylor, Della Sala, & Logie, 2003). The questionnaire has 16 items, with a 5-point Likert-type scale (Very Often, Quite Often, Sometimes, Rarely, Never). The Prospective scale of the PRMQ has been found to predict prospective memory performance (Kliegel & Jager, 2006). To develop

norms, Crawford et al. administered the PRMQ to 551 people ages 17 to 94 in UK communities (Crawford et al., 2003). Since analysis showed no age or gender differences, T score conversions are based on relative standing within the whole sample of 551 (Crawford & Henry, 2003). This questionnaire examines both time- and event-based prospective and retrospective memory performance, for both long- and short-term retention periods (Crawford et al., 2003; Smith et al., 2000). The Prospective scale includes items such as "Do you forget to buy something you planned to buy, like a birthday card, even when you see the shop?" Internal consistency for the scales, as measured by Cronbach's alpha, is as follows: Total ($\alpha = .89$), Prospective ($\alpha = .84$), and Retrospective ($\alpha = .80$) (Crawford et al.). For the purposes of analyses, the four self-cued prospective items (e.g., "Do you decide to do something in a few minutes' time and then forget to do it?") were considered time-based and the four environmentally-cued prospective items ("Do you forget to buy something you planned to buy, like a birthday card, even when you see the shop?") were considered event-based (Smith et al., 2000). Time-based item ratings were summed to compute the PRMQ-Time score, and event-based item ratings were summed for the PRMQ-Event score. PRMQ-Time and PRMQ-Event scores were combined to produce the PRMQ prospective memory total (PRMQ-PM).

Multifactorial Metamemory Questionnaire. The MMQ is a self-report measure developed to provide information about subjective memory and metamemory (Troyer & Rich, 2002). While developed for older adults, many of the items relating to memory confidence are applicable to undergraduates with prospective memory difficulties (A. Troyer, personal communication, November 5, 2015). The MMQ assesses three

dimensions of memory: Memory Satisfaction (that is, affect regarding one's memory), Ability (that is, self-appraisal of one's memory capabilities), and Strategy Use (that is, reported frequency of memory strategy use; Troyer & Rich). The items address working memory and retrospective memory as well as prospective memory. Psychometric analysis of the MMQ has found good factor structure, with almost all items in each scale loading significantly (all but six of 60 items loaded highly on their respective scales). Internal consistency was found to be high, with Cronbach's alpha on the Contentment, Ability, and Strategy scales of .95, .93, and .83, respectively. Normative data for this measure is provided from the original 115 healthy older adults, with change on the MMQ measured as difference from baseline (Troyer & Rich, 2002). Item ratings receive from zero to four points based on the level of difficulty, with lower scores reflecting more difficulty, and are summed for each section of the questionnaire (that is, memory satisfaction, memory ability, and strategy use). Ratings on the MMQ items across the three dimensions were combined to produce a total MMQ score (MMQ Total), though the sum of ratings for memory satisfaction (MMQ Satisfaction Rating) also was used for separate analysis.

Royal Prince Alfred Prospective Memory Test. The RPA-ProMem is an objective and standardized clinical instrument used to assess prospective memory (Radford et al., 2011). To increase ecological validity, tasks on this measure simulate activities in daily life. Both time-based tasks and event-based tasks, over either short- or long-term retention intervals, are designed to highlight potential failures in prospective memory (Radford et al.). The RPA-ProMem shows acceptable reliability for alternate forms (Radford et al.). The RPA-ProMem was found to be negatively correlated with

several subjective measures of prospective memory difficulties (such as the Comprehensive Assessment of Prospective Memory), suggesting that higher performance on the RPA-ProMem is associated with fewer reported prospective memory problems (Radford et al.). In the present study, administration of the long-term prospective memory tasks in the RPA-ProMem before the intervention would have been unwieldy, given the limited time to see participants. To eliminate this confound, the pre-intervention administration of the RPA-ProMem only included short-term prospective memory tasks, with the long-term event- and time-based prospective memory tasks being administered at the end of the first session, post-intervention. The RPA-ProMem also was modified to allow participants to send e-mails in lieu of postcards for the long-term memory time-based prospective task on each test form; otherwise the tasks remained the same. While psychometrics such as norms are not available for modified versions of the RPA-ProMem, direct comparisons of scores on short-term prospective memory items still were possible. This modification of the RPA-ProMem was used as an objective measure of prospective memory ability, with time-based and event-based tasks loading on time- and event-based factors, respectively. Performance for each of the four items of the RPA-ProMem (Short-term Event-based, Short-term Time-based, Long-term Event-based, and Long-term Time-based) receives up to 3 points, with higher scores reflecting better performance. Event-based items produce an event-based prospective memory score (RPA-Event score), with time-based items loading similarly for a time-based score (RPA-Time score). These summary scores produce a total score (RPA-Total score), which estimates overall prospective memory ability.

Self-Efficacy for Learning Form. The SELF is a brief self-report rating scale of academic self-efficacy uses a 0-100 percentage scale, with the options presented in increments of 10. While responses can be given between these increments, participants are encouraged to use this decile format as it has been found to be more sensitive to changes (Zimmerman & Kitsantas, 2005, 2007). This scale examines students' perceived ability to carry out six different aspects of self-regulated learning, ranging from ability to concentrate on school subjects to remembering things from class, with higher scores reflecting more positive self-efficacy (Zimmerman & Kitsantas, 2005). Several factors within the SELF, such as reading, note taking, writing, test taking and general studying, were found to be correlated, loading an a single underlying factor of self-regulation (Zimmerman & Kitsantas, 2005). Normative data for the SELF is derived from a study assessing reliability and validity of the measure on 223 college students (Zimmerman & Kitsantas, 2007). The SELF shows good concurrent validity with other measures of self-regulated learning ability, such as teacher ratings and quality of homework (Zimmerman & Kitsantas, 2007). The SELF was used as a measure of academic self-efficacy, using the average rating across the domains it measures as a “global” self-efficacy score (SELF rating).

Multidimensional Scale of Perceived Self-Efficacy. This multidimensional scale of self-efficacy was originally developed for children in 1989 by Albert Bandura, and was adapted for use in emerging adults and adults by Zimmerman and colleagues in 1992. While most research examines the validity of this measure for middle school and high school students, research conducted with undergraduate students have shown the MSPSE to be valid for this population as well (Choi, Fuqua, & Griffin, 2001). The

MSPSE examines a wide range of self-efficacy behaviours, including enlisting social resources, academic achievement, self-regulated learning, leisure-time skill and extracurricular activities, self-regulatory efficacy to resist peer pressure, meeting others' expectations, social self-efficacy, self-assertive efficacy, and enlisting parental and community support. For this study, two subscales were given emphasis: self-regulated learning and academic achievement. The self-regulated learning scale includes 11 items measuring perceived capability to use skills required in self-regulated learning. The academic achievement scale consists of 9 items addressing perceived efficacy in different academic domains, including mathematics, biology, reading, and social studies (Zimmerman et al., 1992). The items use a seven-point scale ranging from 1 ("not well at all") to 7 ("very well"). The scales used in the MSPSE have been found to be valid, with items aligning exclusively with their theoretical scales (Choi et al., 2001). The internal consistency of the MSPSE scales varies by scale, with Cronbach's alphas ranging from 0.63 (enlisting social resources) to 0.86 (self-regulated learning; Choi et al., 2001). The MSPSE has some normative information from 102 high school students (Zimmerman et al., 1992) and 651 undergraduates (Choi et al., 2001). The MSPSE was used in analyses of self-efficacy, with three primary factors: academic self-efficacy (self-regulated learning efficacy, academic achievement self-efficacy, and self-efficacy to meet others' expectations), social self-efficacy (enlisting social resources efficacy, self-assertiveness efficacy, and leisure-time skill and extracurricular activities efficacy), and self-regulatory efficacy (self-regulatory efficacy to resist peer pressure; Choi et al., 2001). For the purposes of analysis, the academic self-efficacy (ASE) factor was contrasted with the other two factors (that is, social self-efficacy (SSE) and self-regulatory efficacy (SRE)).

Ratings on these variables were calculated using average ratings for items in sections found to load on the respective factors (ASE rating, SSE rating, and SRE rating).

Depression Anxiety Stress Scale. The DASS is a self-report measure consisting of three scales that assess depression, anxiety and stress (Lovibond & Lovibond, 1995). The DASS was developed to provide data about emotional states in a way that is relevant for both clinicians and researchers. The scales of the DASS contain 42 items, divided into three subscales of content. A four-point scale for frequency or severity is used to rate the extent to which the participant has experienced the symptom over the past week (Lovibond & Lovibond). In terms of internal consistency, Cronbach's alphas for the scales for the DASS were as follows: Depression ($\alpha = .97$), Anxiety ($\alpha = .92$), Stress ($\alpha = .95$), as reported by Antony, Bieling, Cox, Enns, & Swinson (1998). Factor structures for the Anxiety, Depression and Stress scales found that items loaded appropriately, with only three of the 42 items cross-loading or not loading on any scale (Antony et al.). The DASS has been shown to have high correlations with the Beck Anxiety Inventory ($r = 0.81$) and Beck Depression Inventory ($r = 0.74$) for the Anxiety and Depression scales, respectively (Lovibond & Lovibond, 1995) and provides insight into perceived levels of tension and stress. Normative data for this measure were developed using a non-clinical sample of adults in the UK, and the DASS has been found to be appropriate for students in university settings (Crawford & Henry, 2003; Lovibond & Lovibond, 1995). The total raw scores for each scale (Depression, Anxiety and Stress) were used for analyses. Ratings on the Stress scale (DASS-Stress rating) were used in analyses as a measure of stress.

Embedded Event-based Prospective Memory Test and Famous Faces Test. The researcher constructed the Famous Faces Test to serve as a vehicle for training on event-based prospective memory as well as a test in which the Embedded Event-based Prospective Memory Test was inserted. The Famous Faces Test was developed using PsychoPy, an open-source psychometric research program using Python, and was adapted from the Famous Faces task as described in Rendell, McDaniel, Forbes, and Einstein's 2007 study on the role of task complexity in age-related changes in prospective memory. Three forms of this test were developed for this study. For each form, participants were asked to recall names of 50 faces (25 males, 25 females) of famous people from movies, television, music, and politics. The first form of the task was administered during the pre-intervention assessment; the second form was administered during skills training; and the third form administered during the post-intervention assessment in the second session. Participants were told that their main goal during this task was to write down the name of each person presented on the screen. Performance for the semantic memory portion is scored based on the number of names correctly recalled: one point was awarded for the person's full name, with recall of a person's role or partial name receiving half a point. After twenty seconds, or after the space bar was pressed, the stimuli progressed to a feedback screen showing the correct name.

In keeping with past literature on famous faces tasks (e.g., Greene & Hodges, 1996), a selection of 150 prominent public figures (50 per administration) was made. Faces for this task were chosen from sites such as Time and Buzzfeed Celeb to be recognizable to undergraduates of typical undergraduate age in Ontario and included actors, musicians, and politicians. All photographs are used under Creative Commons

(CC) or public domain licenses. Full licensing and attribution details are listen in Appendix C. The photos used for this task were normalized according to the procedures outlined in Butler and colleagues (2010), ensuring that stimuli were as consistent as possible. The photos used were of a frontal view, resized to normalize the position of facial features within the photograph, converted to grayscale, and scaled to 500 by 500 pixels (Willenbockel et al., 2010). Scores on the Famous Faces task are reported for each form (that is, Famous Faces Form 1 score, Famous Faces Form 2 score, and Famous Faces Form 3 score).

The Embedded Event-based Prospective Test (EEPT) was inserted within the administration of the Famous Faces Test. During the Famous Faces Test, the participant was asked to hit the X key (instead of space) when a famous person wearing glasses appeared, in addition to writing down the name of the person in the picture. The paradigm of using an embedded measure in a famous faces task as an estimate of event based prospective memory ability was established in past research (Fish, Wilson, & Manly, 2010; Waldum et al., 2014). There were seven pictures of faces with glasses in each form of the Famous Faces Test. Performance for the prospective memory portion is scored as the number of correct responses to the prospective memory task (that is, hitting X when a face with glasses is displayed). The EEPT total correct, with a maximum of 7 points, was used for analyses as an objective measure of event-based prospective memory. As the EEPT and Famous Faces Test were tasks developed for this study, descriptive or normative data from other samples do not exist for this test.

Embedded Time-based Prospective Memory Test and Modified Letter N-back Task. An N-Back task was used as a vehicle for a time-based prospective memory

task and prospective memory training in addition to constituting a test of attention. The Letter N-back test was adapted from the procedure described in Gur and colleagues' work (2012). The embedded time-based prospective memory test incorporated elements from the clock-checking aspects from Waldum et al (2014). A sequence of uppercase letters was displayed for 500 ms, with an inter-stimulus interval (ISI) of 2,500 ms. Three conditions were used for this task: 0-back, 1-back, and 2-back. In the 0-back condition, participants were to respond to a target stimulus ("X") when it appeared by hitting the space bar (see Appendix D). In the 1-back task, participants were to hit the space bar when the letter on-screen was identical to the preceding letter. For the 2-back condition, participants were to respond when the letter on-screen was identical to what was presented two trials back. Scores on the N-Back task were measured as the number of hits (that is correct responses to targets) to a maximum of 10 points per section. For use in analyses, performance was reported as 0-Back scores, 1-Back scores, and 2-Back scores for the respective section of the task.

The Embedded Time-based Prospective Test (ETPT) was inserted within the administration of the N-Back Task. To assess time-based prospective memory, participants were asked to respond using the X key every minute (Waldum et al., 2014). Throughout the task, the participants could refer to an analog wall clock with a seconds' hand to view the time. The paradigm of using similar N-back tasks as a vehicle to assess prospective memory has been established as a way to objectively assess prospective memory in laboratory settings (Fish et al., 2010; van den Berg et al., 2012; Waldum et al., 2014). Performance was scored as a target response every 60 +/- 5 seconds (that is, hitting X within one trial of the target time). Target time was measured from their last

response or from the start of the trial if a response was not yet provided for that trial. Scores on the ETPM were measured as the number of hits (that is correct responses to targets) to a maximum of 6 points per administration (that is, for the entire N-Back task).

Procedure

Participants, after enrolling on the Psychology Participant Pool website, were randomly assigned to either the experimental (prospective memory training) or comparison (relaxation training) group. A comparison condition (relaxation training) was used instead of a no-intervention control to better match for fatigue, exposure to training tasks, and timing effects compared to the experimental group. Either the experimental or relaxation training intervention was delivered during a single session that included the assessments before the intervention and the administration of the long-term items of the RPA-ProMem. In entirety the first session, took approximately two hours. Participants returned for a second session one hour in duration which consisted solely of assessment, with no intervention. Upon arrival at the first session, participants were given and guided through consent forms, with an opportunity to have their questions asked and answered. After informed consent was obtained for the first session, participants completed a brief demographic questionnaire. Participants were then given pre-intervention measures (in order: RPA-ProMem Short-Term, DASS, SELF, MSPSE, PRMQ, MMQ, Famous Faces/EEPM Task, N-Back/ETPM Task). Participants were tested individually to help establish rapport and ensure a supportive environment for later intervention. Tests and measures were administered and scored according to standardized instructions by the researcher. Following this, participants were given an intervention according to their group assignment. Sessions were concluded with the administration of the RPA-ProMem

Long-Term tasks. In the second session, all tests and inventories were re-administered. Due to the exploratory nature of this intervention, feedback from participants about the intervention was gathered. Following the end of each session, participants were credited on the Participant Pool site. A flowchart illustrating the structure of the procedure can be found in Figure 1.

Experimental (Prospective Memory) Group. The prospective memory training consisted of strategy-focused discussion, skill teaching, and prospective memory practice tasks. Prospective memory tasks with which participants expressed difficulty were given additional emphasis in discussion. At face value, event-based prospective memory tasks are often what comes to mind when participants think of prospective memory (Brandimonte et al., 1996; van den Berg et al., 2012). As such, the first technique covered was implementation intention – the forming of an explicit plan of action for future action. The purpose of including implementation intention first is twofold. First, it creates a logical transition into prospective skill training for participants. Second, the adoption of implementation intent typically requires practice beyond that needed for clock-checking or external aids. To practice the use of this strategy, the EEPT and Famous Faces task was used, as described above, in van den Berg and colleagues (2012), and in Appendix C.

The second technique covered was clock-checking, as described in Waldum (2014). While not a difficult topic to grasp, the technique benefits from practice. The practice task for clock-checking used the N-back task and the ETPT, in which the participant is to provide an additional response every 60 seconds as described above and in Appendix D. To promote clock-checking, participants were provided with an analog wall-clock during the task (Waldum et al., 2014).

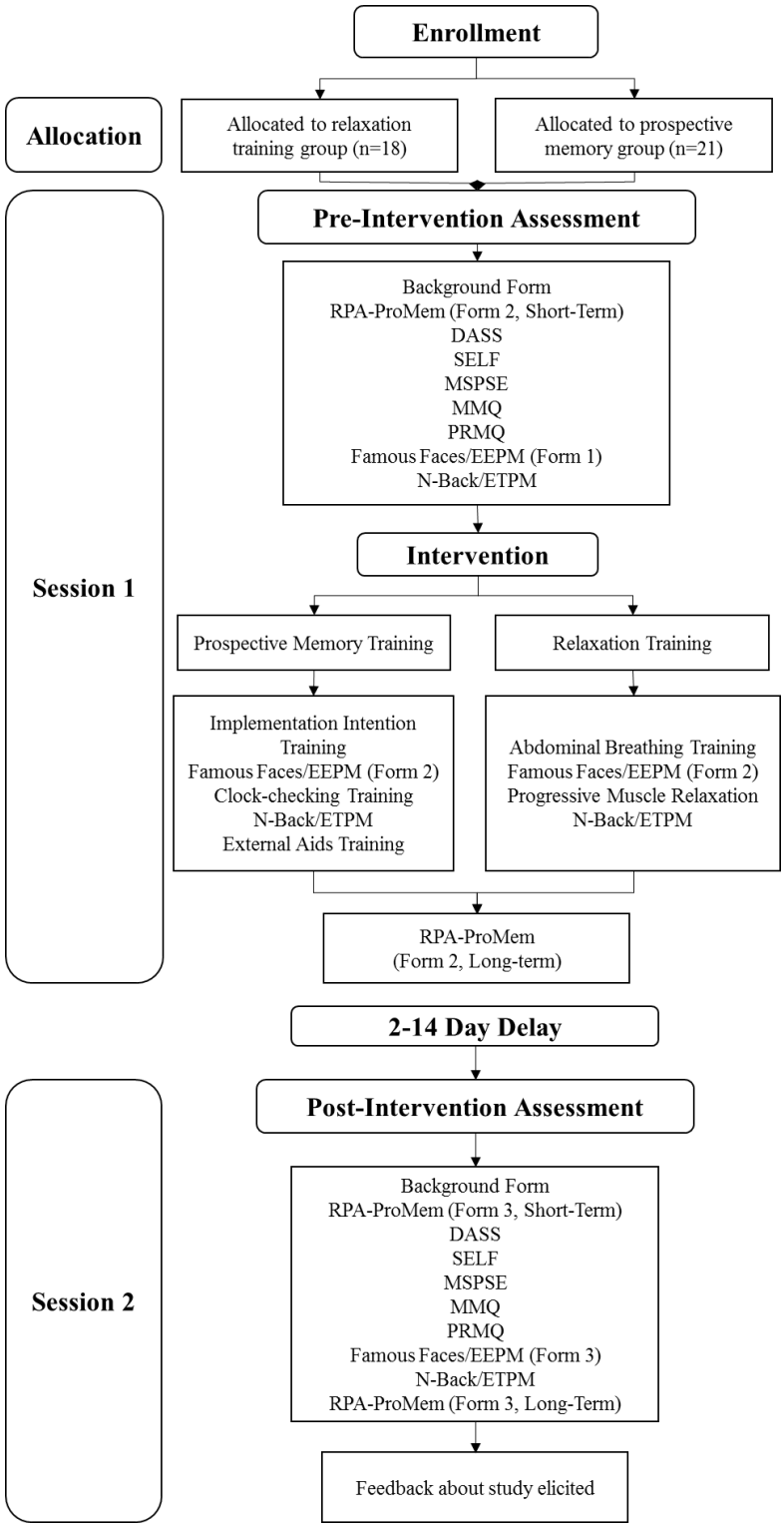

Figure 1. Flowchart depicting procedure for first session for both conditions. PRMQ, Prospective and Retrospective Memory Questionnaire, MMQ, Multifactorial Metamemory Questionnaire, RPA-ProMem, Royal Prince Alfred Prospective Memory task, MSPSE, Multidimensional Scale of Perceived Self-Efficacy questionnaire (MSPSE), DASS, Depression Anxiety Stress Scale

Finally, the use of external aids was explored, with emphasis given to smartphone and computer notifications associated with Google (Google Calendar, Google Keep, Google Now reminders), as all University of Windsor students possess a Google account as part of their student mail system. Further, many major computer and smartphone operating systems allow for similar degrees of control for Google-based notifications. Practice for these techniques involved the input of and response to a notification adapted from Svoboda and colleagues (2012), wherein participants are asked to use upcoming real-life tasks to populate the reminder system. This allowed the participant to role-play responding to events as they would in their everyday environment, increasing the generalization of the learned technique (Svoboda et al., 2012). A full script for the intervention can be found in Appendix E.

Comparison (Relaxation) Group. In the comparison group, participants were briefly educated on relaxation techniques such as deep breathing and progressive muscle relaxation and given an opportunity to practice these methods. Stress reduction techniques have been documented to assist with mood (Cairncross & Miller, 2016; Hindman et al., 2015; Van Gordon et al., 2013) and executive functions (Cicerone et al., 2005; Levine et al., 2000), but these techniques do not include some core elements of prospective memory training (for example, cue monitoring or intention formation). A script for the deep breathing and progressive muscle relaxation exercises can be found in Appendix F. Following these techniques, to match the intervention group, participants were given the Famous Faces/EEPM and letter N-back/ETPM tasks, after the abdominal breathing and progressive muscle relaxation techniques were practiced, respectively.

Statistical analyses

For these analyses, between-subjects repeated measures analysis of variance (ANOVA) was used. As part of these analyses, the assumptions for ANOVA were examined: namely, normality of data (skewness, kurtosis, and distribution of data), homogeneity of variance (using Levene's test), sphericity of data (using Mauchly's test) and independence of observations (Field, 2013). The approaches used for each research question are as follows:

1. Will the experimental group show significant improvement on subjective prospective memory measures after prospective memory training? Will greater improvement on subjective prospective memory performance be seen in the experimental group after brief prospective memory training than in the comparison group after relaxation training?

A mixed repeated-measures ANOVA was used to evaluate if there were significant effects of group assignment (between-subjects factor), time (i.e., pre- or post-intervention; within-subject factor), and the interaction of group by time. Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variables used in this analysis were the PRMQ-PM and MMQ Total scores.

2. Will the experimental group show significant improvement on objective prospective memory measures after prospective memory training? Will greater improvement on objective prospective memory performance be seen in the experimental group after brief prospective memory training than in the comparison group after the relaxation training?

A mixed repeated-measures ANOVA was used to evaluate if there were significant effects of group assignment (between-subjects factor), time (i.e., pre- or post-intervention; within-subject factor), and the interaction of group x time. Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variables used in this analysis were RPA-ProMem overall performance (RPA-Total), and performance on the prospective memory portion of the Famous Faces and Modified Letter N-Back tasks (EEPM and ETPM, respectively).

3. Will there be greater gains in time- than in event-based prospective memory after the intervention for those in the prospective memory training group? Will post-intervention changes in time- compared to event-based memory be greater for those in the prospective memory training group than any changes observed for those in the relaxation training group?

Two mixed repeated-measures ANOVA was used: one for time-based prospective memory performance, and one for event-based prospective memory components. For each of these ANOVAs, main effects (for both group and time) and interaction effect sizes were calculated. Effect sizes for these ANOVAs were compared using confidence intervals, as outlined in Garamszegi (2006). Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variables used for time-based prospective memory performance are time-based items from the PRMQ (PRMQ-Time), RPA-ProMem (RPA-Time), and performance on the time-based prospective component of the N-back task (ETPM). The variables used for event-based prospective memory performance are event-based items from the PRMQ (PRMQ-Event), RPA-ProMem (RPA-Event), and performance on the event-based prospective component of the famous

faces task (EEPM). To compare effect sizes, $\omega^2_{partial}$ was used, as it is considered a less biased estimator of effect size (Field, 2013).

4. Will participants who receive the prospective memory intervention subsequently demonstrate significant boosts in their perceived efficacy for self-regulated learning after the intervention? Will these gains be bigger than any observed in the comparison condition after relaxation training?

A mixed repeated-measures ANOVA was used to evaluate if there are significant effects of group assignment (between-subjects factor), time (i.e., pre- or post-intervention; within-subject factor), and the interaction of group x time. Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variables used in this analysis were overall ratings on the SELF (SELF scores) and ratings for the Academic Self-Efficacy factor of the MSPSE (MSPSE-ASE).

5. After the prospective memory training intervention, will components of self-efficacy related to learning (ratings on the SELF and on the Academic Self-Efficacy factor of the MSPSE) show greater positive gains than those observed in other domains (Social Self-efficacy and Self-Regulatory Efficacy on the MSPSE)? Will the contrast between post-intervention changes on learning self-efficacy domains versus the other Social Self-efficacy and Self-Regulatory Efficacy domains be greater for those in the prospective memory training group than in the relaxation training group?

Two mixed repeated-measures ANOVA was used: one for learning self-efficacy, and one for self-efficacy for other domains. For each of these ANOVAs, main effects (for both group and time) and interaction effect sizes were calculated. Effect sizes for these

ANOVAs were compared using confidence intervals, as outlined in Garamszegi (2006). Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variables used for learning self-efficacy are ratings on the SELF rating, and ratings on the Academic Self-Efficacy factor for the MSPSE (MSPSE-ASE) as defined by Choi and colleauges (2001). The variables used for the other self-efficacy component are the Social Self-efficacy (MSPSE-SSE) and Self-Regulatory Efficacy (MSPSE-SRE) factors on the MSPSE as defined by Choi and colleauges (2001). To compare effect sizes, $\omega^2_{partial}$ was used, as it is considered a less biased estimator of effect size (Field, 2013).

6. Following intervention, will the prospective memory training group show a significant reduction in stress? Will this post-intervention reduction in stress be greater after prospective memory training than after relaxation training?

A mixed repeated-measures ANOVA was used to evaluate if there are significant effects of group assignment (between-subjects factor), time (i.e., pre- or post-intervention; within-subject factor), and the interaction of group x time. Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variable used in this analysis was the raw score on the Stress scale of the DASS.

7. Will participants receiving prospective memory intervention show greater satisfaction with their memory after intervention than before? Will these gains be greater than any seen in the comparison group after relaxation training?

A mixed repeated-measures ANOVA was used to evaluate if there are significant effects of group assignment (between-subjects factor), time (i.e., pre- or post-

intervention; within-subject factor), and the interaction of group x time. Planned comparisons using one-tailed t-tests were conducted to evaluate the directional hypothesis. The variables used in this analysis were ratings on the Memory Satisfaction Scale of the MMQ (MMQ Satisfaction).

A power analysis conducted using GPower version 3.1 for Windows based on the effect size found in Waldum and colleagues (2014), suggests that an overall sample size of a 36 is suggested ($f = 0.18$, $\alpha = 0.05$, $\beta = 0.2$, $k = 2$, $\varepsilon = 1$, $r = 0.5$ for 6 measures). That is, 18 participants per condition should provide sufficient power to detect an intervention effect.

CHAPTER 3

Results

Demographic Characteristics

The total number of participants who completed both sessions of the study was 39, with 18 in the Comparison Condition, and 21 in the Prospective Memory Condition. Of these participants, 25 were female, and 14 were male. The average age was 23.3 (*SD* = 7.3, range 18 to 53), with an average education level of 14.3 years (SD = 1.7, range 12 to 20). 36 participants were right-handed, 2 were left-handed, and 1 was ambidextrous. T-tests revealed no group differences on gender, age, education, and the participants' previous semester's average. Full descriptives are available in Table 1. Performance for groups on dependent measures at pre- and post-intervention assessment can be found in Appendix G. Based on demographics of the enrolled students available by the Institutional Analysis group at University of Windsor, participants from this study were representative of University of Students in Psychology and Business students on gender ($\chi^2(2) = 1.51$, $p = .22$) and age ($\chi^2(6) = 11.53$, $p = .07$) distribution (University of Windsor, 2016).

Table 1. *Demographic Characteristics Overall and by Group*

		Group		
	Overall N = 39	Relaxation Condition n = 19	Prospective Memory Condition n = 21	*t*
Age	23.33 (7.29)	21.8 (3.5)	24.7 (9.3)	1.45
Education	14.31 (1.73)	14.2 (1.7)	14.4 (1.7)	-.47
Last Semester's Average	73.88 (12.30)	73.8 (12.6)	74.0 (12.3)	-.05
				χ^2
Gender				
Male	14 (36%)	7 (39%)	7 (33%)	.13
Female	25 (64%)	11 (61%)	14 (67%)	
Handedness				
Right	36 (92%)	16 (89%)	20 (95%)	3.20
Left	2 (5%)	2 (11%)	0 (0%)	
Ambidextrous	1 (3%)	0 (0%)	1 (5%)	

Note. *t* and χ^2 values above are not significant at an α of .05

Analysis of Variance Assumptions

A Shapiro-Wilk test of normality was performed for each dependent measure for each group. Six variables were significant, suggesting that the data for these measures did not follow a normal distribution: The Stress Scale score for the DASS at both pre- (W = .91, $p < 0.01$) and post-intervention (W =.90, $p < 0.01$), RPA-Total at post-intervention performance (W = .92, $p < 0.01$, ETPM scores at both pre- (W=.83, $p < 0.001$) and post-intervention (W=.64, $p < 0.001$), and EEPM scores at the post-intervention period (W = .85, $p < 0.001$) were significant. For all of these variables, skewness and kurtosis were within acceptable limits for normality (range of skewness = -1.87 to 0.86, and range of kurtosis = -0.35 to 2.54; Field, 2013) suggesting that the assumption of normality is

largely upheld. Outliers were assessed using boxplots and z-scores, and several cases of outliers were noted on MSPSE-SRE ratings, ETPM scores, RPA-Time scores, age and education. The ANOVAs below were run with and without outliers beyond z-scores of 3.00 for variables being analyzed (Field, 2013), as well as with and without outliers on demographic variables (one participant was an outlier for age and years of education). As there was no meaningful change in the results, the outliers were retained for the analyses. Homogeneity of variance was tested for each variable using Levene's test. Values for these tests were not significant with the exception of the MSPSE-SSE ratings ($p < 0.05$), and therefore the assumption of homogeneity of variance is largely considered to be met. ANOVAs are typically quite robust to small violations of assumptions such as the above (Field, 2013). While sphericity is a core assumption for repeated measures ANOVAs, this assumption cannot be violated in cases of only two groups and as such is not relevant to these analyses. To test for equality of covariance, Box's M Test was conducted and found to be non-significant for all measures, suggesting that covariance matrices for the dependent variables were equal across groups. Independence of observation was assumed, due to the procedure and structure of the study.

Research Question 1

The first research question sought to explore changes on subjective prospective memory performance, to see whether participants in the prospective memory group would show improvement relative to the comparison group, in which members received no prospective memory skills training. For this analysis, ratings for the Prospective Memory component of the PRMQ (PRMQ-PM rating) and MMQ Total score were used as variables.

A paired-samples t-test was conducted to examine change in the experimental group between sessions on these measures. No significant differences were found on the PRMQ-PM ($t(20) = -2.09$, $p = .41$) or MMQ Total score ($t(20) = -1.83$, $p = .43$).

A mixed design repeated measures ANOVA for PRMQ-PM ratings and MMQ total scores (see Tables 2 and 3) found no significant interaction term for either PRMQ-PM ratings (F (1, 37) = 0.31, p = 0.58, $\omega^2_{partial} = -.02$) or MMQ Total scores ($F$ (1, 37) = 0.39, p = 0.54, $\omega^2_{partial} = -.02$). This, coupled with the lack of significant main effects for condition or session for either measure, suggests that no significant changes were found on these self-report measures of prospective memory performance after the prospective memory training or the relaxation training.

Table 2. *PRMQ Prospective Memory Ratings ANOVA Source Table*

	df	*F* (1, 37)	$\omega^2_{partial}$	*p*
Condition	1	1.49	0.01	.23
Session	1	0.05	-0.02	.83
Condition x Session	1	0.31	-0.02	.58
Error	37			

Note. *df*, degrees of freedom, *PRMQ*, Prospective and Retrospective Memory Questionnaire

Table 3. *MMQ Total Ratings of Performance ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition	1	0.32	-0.02	.58
Session	1	0.11	-0.02	.75
Condition x Session	1	0.39	-0.02	.54
Error	37			

Note. *df*, degrees of freedom, *MMQ Total*, Multifactorial Metamemory Questionnaire

Research Question 2

In contrast with subjective prospective memory performance, the second research question sought to explore objective performance on prospective memory: namely, whether the prospective memory group would improve more on prospective memory task performance after completion of prospective memory training than the comparison group following completion of relaxation training. For these analyses, the RPA-Total score and the embedded prospective memory component scores of the N-Back and Famous Faces tasks (that is, ETPM and EEPM, respectively) were used as variables for analysis. It should be noted that the long-term prospective memory items for the RPA-ProMem were administered immediately after the intervention for each group was completed. Therefore, when these measures are discussed the terms intervention session and post-intervention session, or Session 1 and Session 2, are used rather than pre-intervention and post-intervention session.

One-tailed paired-sample t-tests were conducted to examine change in the experimental group between sessions on these measures; significant differences were found for the ETPM scores ($t(20) = -3.77$, $p < 0.001$) and EEPM scores ($t(20) = -3.23$, $p = .002$), though no significant differences were found on the RPA-ProMem scores ($t(20) = .40$, $p = .35$).

A mixed design ANOVA (see Table 3) found that there was a significant main effect for session on the RPA-Total scores (F (1, 37) = 6.23, $p < 0.05$, $\omega^2_{partial} = .12$), showing a decline in scores as well as a significant interaction effect (F (1, 37) = 4.21, $p < 0.05$, $\omega^2_{partial} = .08$). Interestingly, this interaction term demonstrated not an increase in performance on the RPA-Total, but a lack of decline in performance for the prospective

memory group from Session 1 to Session 2 (see Figure 2) in contrast to a drop in performance for the comparison group. For ETPM scores, there was a significant main effect for session (F (1, 37) = 13.973, $p < 0.01$, $\omega^2_{partial} = .25$), as well as a marginally significant interaction effect (F (1, 37) = 3.49, $p = 0.07$, $\omega^2_{partial} = .06$). It is possible that a ceiling effect (35.9% and 61.5% of participants across conditions received ceiling values for pre- and post-training, respectively) prevented the interaction term from reaching significant levels. For EEPM scores, there was a significant main effect for session (F (1, 37) = 23.46, $p < 0.001$, $\omega^2_{partial} = .37$), though there was no significant interaction effect (F (1, 37) = .40, $p = 0.53$, $\omega^2_{partial} = -.02$).

Table 3. *Objective Prospective Memory Performance ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition				
RPA-Total	1	1.19	.00	.28
ETPM	1	0.16	-.02	.70
EEPM	1	0.14	-.02	.71
Session				
RPA-Total	1	6.23	.12	.02
ETPM	1	13.97	.25	< .01
EEPM	1	23.46	.37	< .01
Condition x Session				
RPA-Total	1	4.21	.08	.04
ETPM	1	3.49	.06	.07
EEPM	1	0.40	-.02	.53
Error				
RPA-Total	37			
ETPM	37			
EEPM	37			

Note. *df*, degrees of freedom*; RPA-Total*, overall score for the Royal Prince Alfred Prospective Memory Test*; ETPM*, prospective memory component of the Modified N-Back Task*; EEPM*, prospective memory component of the Famous Faces Task

Post-hoc analyses sought to explore the effects found on the measures in which the prospective memory tasks were embedded, namely, the N-Back task and the Famous Faces task. While F-tests for 0-, 1-, and 2-Back task performance all showed significant effects due to session (p's < 0.05), none of these showed significant interaction terms to suggest these changes differed between groups. Performance on the 0-Back task showed a decline, with performance during the first session (mean = 9.03, *SD* = 1.29; mean = 9.23, *SD* = 1.80 for pre-intervention and training administrations, respectively) exceeding performance during the post-intervention administration (mean = 4.95, *SD* = 1.81). Performance on the 1- and 2-Back both showed an improvement over time, with mean scores for the 1-Back rising from 7.79 (*SD* = 2.35) to 8.92 (*SD* = 1.88), and mean scores for the 2-Back increasing from 5.77 (*SD* = 2.89) to 8.41 (*SD* = 1.43) between pre-intervention and post-intervention administrations. This improvement in scores suggests a training effect for the 1-Back and 2-Back portions of the N-Back, though the decline for the 0-Back suggests this training effect does not apply to the earlier, simpler component of the task. Mean performance on the Famous Faces task showed no significant group or interaction effects (p = .96 and .69, respectively), but a significant session effect was found ($F(2,74) = 33.21$, $p < 0.001$) with Form 1 scores (mean = 26.83, SD = 11.38) being higher than Form 2 scores (mean = 22.32, SD = 10.06) or Form 3 scores (mean = 21.39, SD = 11.23). This suggests that the multiple forms for the Famous Faces test were not fully equivalent in terms of difficulty, with Form 1 being easier for participants.

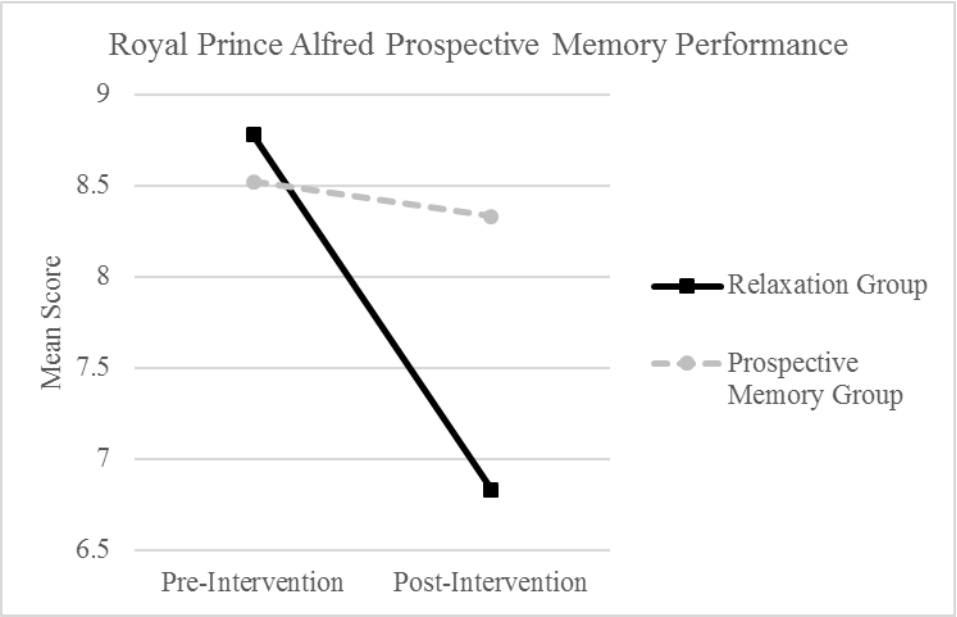

Figure 2. Performance on the Royal Prince Alfred Prospective Memory Test.

Research Question 3

The third research question explores the nature of the changes that may occur in prospective memory tasks following training, namely between time- and event-based prospective memory tasks. It was thought that time-based prospective memory tasks would show a stronger effect from prospective memory training than event-based tasks based on prior research (Waldum et al., 2014). Moreover, it was expected that the improvement the Prospective Memory group showed relative to the comparison group would be greater on time-based prospective memory tasks than for event-based prospective memory tasks. For these analyses, two mixed-model repeated measures ANOVAs were conducted: one for time-based prospective memory performance, and one for event-based prospective memory components. The variables used for the time-based prospective memory ANOVA were PRMQ-Time ratings, RPA-Time scores, and ETPM scores.

A one-tailed paired-samples t-test first was conducted to examine whether there was significant improvement for the experimental intervention group on these time-based prospective memory measures from Session 1 to Session 2. Significant improvement, as measured by an increase in scores, was found for the ETPM task scores ($t(20) = -3.77$, $p < 0.001$). No significant improvements were found for the PRMQ-Time ($t(20) = .185$, $p = .43$) or RPA-Time ($t(20) = .00$, $p = .50$) scores across sessions.

Table 4. *Time-Based Prospective Memory ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition				
PRMQ-Time	1	1.79	.02	.19
RPA- Time	1	1.58	.01	.22
ETPM	1	0.16	-.02	.70
Session				
PRMQ-Time	1	1.33	.01	.26
RPA- Time	1	7.17	.14	.01
ETPM	1	13.97	.25	< .01
Condition x Session				
PRMQ-Time	1	0.71	-.01	.40
RPA- Time	1	7.17	.14	.01
ETPM	1	3.49	.06	.07
Error				
PRMQ-Time	37			
RPA-Time	37			
ETPM	37			

Note. *df*, degrees of freedom*; PRMQ-Time*, Time-Based Prospective Memory score on the Prospective and Retrospective Memory Questionnaire, *RPA-ProMem Time*, time-based prospective memory tasks on the Royal Prince Alfred Prospective Memory Test*; ETPM*, prospective memory component of the Modified N-Back Task scores.

In a mixed design repeated measures ANOVA (see Table 4), significant main effects for session were noted for the RPA-Time scores indicating a decline in scores across groups (F (1, 37) = 7.17, p = 0.01, $\omega^2_{partial} = .14$) and the ETPM task scores indicating increased performance (F (1, 37) = 13.97, p = 0.001, $\omega^2_{partial} = .25$). Interaction effects were significant for the RPA-Time, which showed a decline in scores for the

relaxation group and stability in scores for the prospective memory group (F (1, 37) = 7.17, p = 0.01, $\omega^2_{partial}$ = .14), and there was a marginally significant interaction for the ETPM task scores (F (1, 37) = 3.49, p = 0.07, $\omega^2_{partial}$ = .06). The RPA-ProMem interaction effect shows the Prospective Memory group maintains similar scores across sessions, while the Comparison group shows deterioration in performance.

For the event-based prospective memory ANOVA, scores from event-based prospective memory items from the PRMQ (PRMQ-Event), RPA-Event scores and the EEPM task performance were used. Full results of this analysis are located in Table 5. A one-tailed paired-samples t-test was conducted to examine whether there was significant improvement for the experimental intervention group on these measures. Significant improvement, as measured by an increase in scores, was found for the EEPM score (t(20) = -3.23, p = .002). Neither PRMQ-Event or RPA-Event scores showed significant improvements for event-based prospective memory (PRMQ-Event scores t(20) = -.45, p = .33; RPA-Event scores t(20) = .37, p = .36).

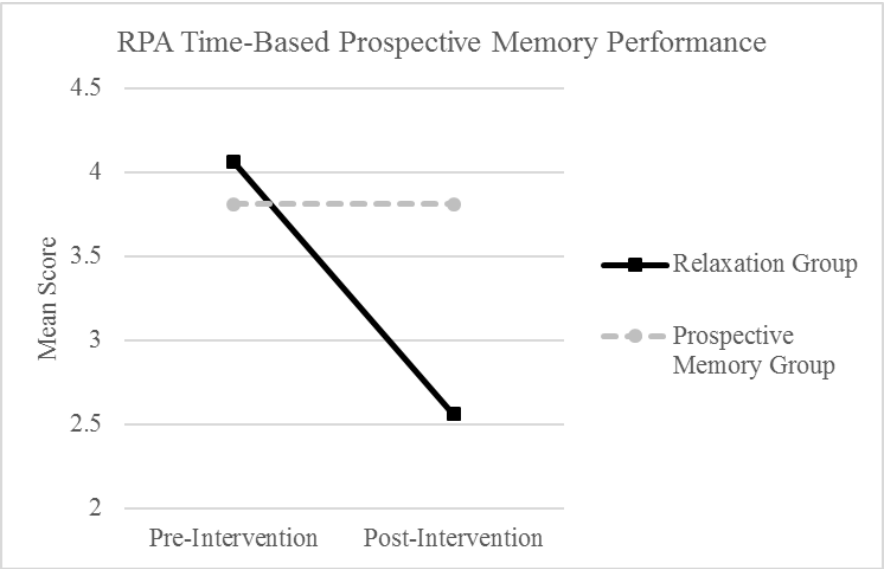

Figure 3. Performance on the Time-Based tasks of the Royal Prince Alfred Prospective Memory Test (RPA-Time score).

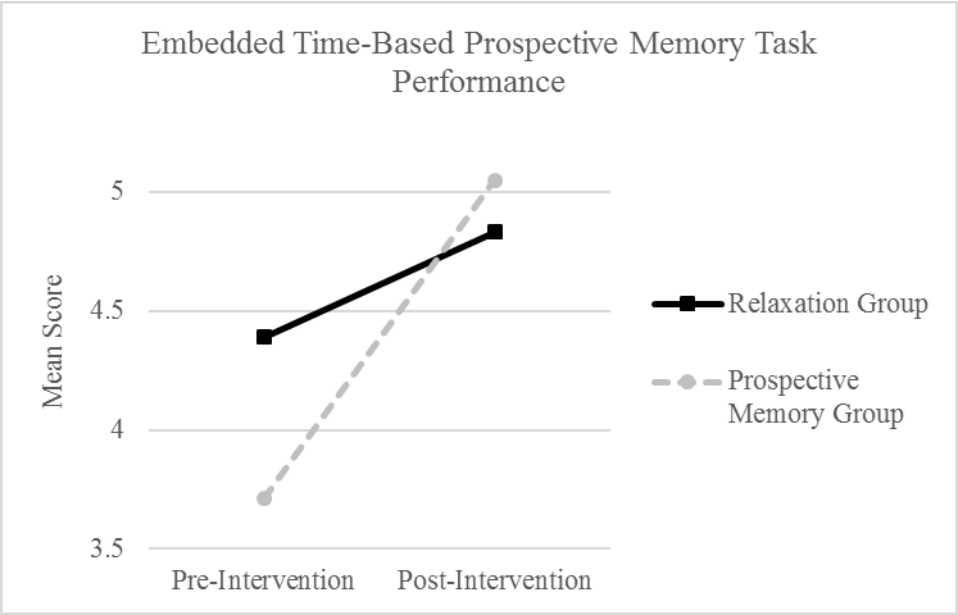

Figure 4. Performance on the embedded time-based prospective memory task (ETPM score).

In mixed repeated measures ANOVA, significant main effects for session were noted only for EEPM scores (F (1, 37) = 23.46, $p < 0.001$, $\omega^2_{partial} = .37$). There were no significant interaction effects for any of the event-based prospective memory tasks.

Given that there were no significant Group x Session effects in the expected direction for any of the measures, instead of comparing effect sizes for interaction effects, effect sizes for session were compared on time- versus event-based tests, where significant effects were observed for analogous tasks (that is, ETPM and EEPM scores). No significant difference was found for effect size between ETPM scores ($\omega^2_{partial} = 0.25$, 95% CI: 0.09 to 0.44) and EEPM scores ($\omega^2_{partial} = 0.37$, 95% CI: 0.21 to 0.56). These results may be due, in part, to a small sample size and the conservative nature of partial omega squared.

Table 5. *Event-Based Prospective Memory ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition				
PRMQ-Event	1	1.12	.00	.30
RPA-Event	1	0.12	-.02	.73
EEPM	1	0.14	-.02	.71
Session				
PRMQ-Event	1	0.29	-.02	.59
RPA- Event	1	0.67	-.01	.42
EEPM	1	23.46	.37	< 0.01
Condition x Session				
PRMQ-Event	1	0.02	-.03	.89
RPA- Event	1	0.11	-.02	.75
EEPM	1	0.40	-.02	.53
Error				
PRMQ-Event	37			
RPA-Event	37			
EEPM	37			

Note. *df*, degrees of freedom*; PRMQ-Event*, Event-Based Prospective Memory score on the Prospective and Retrospective Memory Questionnaire, *RPA-Event*, event-based prospective memory tasks on the Royal Prince Alfred Prospective Memory Test, *EEPM*, prospective memory component of the Famous Faces Task

Research Question 4

This research question examined whether those who receive prospective memory training subsequently had a significant increase in their perceived efficacy for self-regulated learning beyond that of those in the comparison condition following relaxation training. A mixed repeated-measures ANOVA was used for this analysis, using the SELF ratings, and the Academic Self-Efficacy Factor ratings from the MSPSE (MSPSE-ASE).

Paired-samples t-test were conducted to examine if there was significant improvement for the experimental intervention group on these measures. In the PM training group, significant improvement, as measured by an increase in scores, was found

for ratings on SELF rating ($t(20) = -2.11$, $p = .02$), though no significant improvements were seen for the MSPSE-ASE ratings ($t(20) = -.89$, $p = .19$).

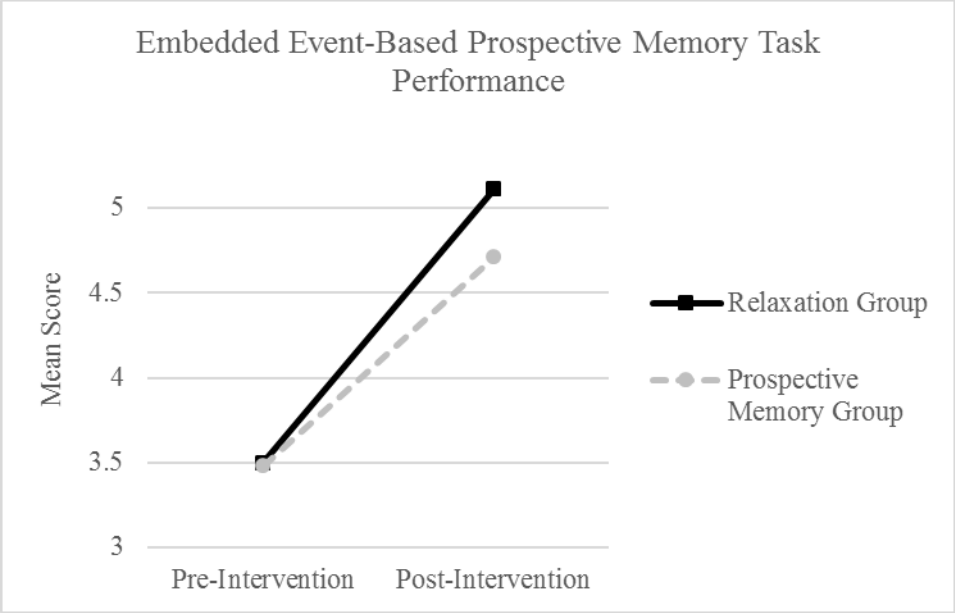

Figure 5. Performance on the embedded event-based prospective memory task (EEPM score).

Results from the ANOVA (see Table 5) showed a significant main effect for session on SELF rating (F (1, 37) = 11.29, $p < 0.01$, $\omega^2_{partial} = .21$) but no effect for the MSPSE-ASE ratings. The interaction terms for both the MSPSE-ASE and SELF ratings on this analysis were not significant ($p = .90$ and $p = .55$, respectively).

Research Question 5

This research question addressed the nature of the effect of the experimental intervention on self-efficacy; namely whether there is a differential effect between academic self-efficacy and self-efficacy for other domains. It was thought that participants in the prospective memory group would show greater improvement after the intervention on measures of academic self-efficacy compared to self-efficacy in other domains. The ANOVA from Research Question 4 (see Table 5) was contrasted with a

mixed repeated-measures ANOVA looking at the Social Self-efficacy and Self-Regulatory Efficacy factor ratings on the MSPSE (MSPSE-SSE and MSPSE-SRE, respectively).

Table 5. *Academic Self-Efficacy ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition				
MSPSE-ASE	1	0.53	-.01	.47
SELF	1	1.70	.02	.20
Session				
MSPSE-ASE	1	2.07	.03	.16
SELF	1	11.29	.21	.002
Condition x Session				
MSPSE-ASE	1	0.02	-.03	.90
SELF	1	0.36	-.02	.55
Error				
MSPSE ASE	37			
SELF	37			

Note. *df*, degrees of freedom; *MSPSE-ASE*, Academic Self-Efficacy Scale of the MSPSE; *SELF*, Self-Efficacy for Learning Form

Initially, one-tailed paired-samples t-tests were conducted to examine whether there was significant improvement for the experimental intervention group on these measures. Significant improvement, as measured by an increase in self-report ratings, was found for MSPSE-SSE ratings ($t(20) = -3.636$, $p < .001$), while improvement on MSPSE-SRE ratings was non-significant ($t(20) = -.56$, $p = .29$).

Table 6. *MSPSE Social and Self-Regulatory Efficacy ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition				
MSPSE-SSE	1	0.34	-.02	.56
MSPSE-SRE	1	1.00	.00	.32
Session				
MSPSE-SSE	1	12.64	.23	< .01
MSPSE-SRE	1	0.23	-.02	.63
Condition x Session				
MSPSE-SSE	1	0.48	-.01	.49
MSPSE-SRE	1	1.03	.00	.32
Error				
MSPSE-SSE	37			
MSPSE-SRE	37			

Note. *df*, degrees of freedom; MSPSE-SSE, Social Self-Efficacy factor of the MSPSE; MSPSE-SRE, Self-Regulatory Efficacy factor of the MSPSE

Results from this ANOVA (see Table 6) showed a main effect for session for the Social Self-Efficacy (F (1, 37) = 12.64, $p < 0.01$, $\omega^2_{partial} = .23$), with no other significant main effects. Interaction effects were not significant for either the Social Self-Efficacy scale ($p = .49$) nor the Self-Regulatory Efficacy scale ($p = .32$). Overall, this suggests that there are significant effects across time, for both the MSPSE-SSE and MSPSE-SRE ratings. A comparison of effect sizes reveals session effects for SELF rating ($\omega^2_{partial} = .21$) and MSPSE-SSE ratings ($\omega^2_{partial} = .23$) are not significantly different, with both being in the medium effect size range. No significant difference was found for session effect size between ratings on SELF rating ($\omega^2_{partial} = 0.21$, 95% CI: 0.01 to 0.42) and MSPSE-SSE ratings ($\omega^2_{partial} = .23$, 95% CI: 0.03 to 0.44).

Research Question 6

This question examined whether those receiving PM training had a greater reduction in reported levels of stress after intervention compared to the comparison group. A mixed repeated-measures ANOVA was conducted, using ratings from the Stress Scale on the DASS (see Table 7). A directional (one-tailed) paired-samples t-test revealed significant improvement for the experimental intervention group on these measures, as measured by a decrease in ratings, on the DASS Stress Scale ($t(20) = 3.26$, $p = 0.002$). A significant main effect for session was found (F (1, 37) = 9.42, $p < 0.01$, $\omega^2_{partial} = .18$), as was a significant interaction effect for condition x session (F (1, 37) = 4.26, $p < 0.05$, $\omega^2_{partial} = .08$). An independent sample t-test was conducted to see if the baseline differences were significant between groups. Results from this t-test found that these baseline differences were not significant (t (37) = -1.60, p = .12). A graph of this interaction can be seen in Figure 6.

Table 7. *DASS Stress Scale ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition	1	1.10	.00	.30
Session	1	9.42	.18	< .01
Condition x Session	1	4.26	.08	.05
Error	37			

Note. *df*, degrees of freedom, DASS, Depression Anxiety Stress Scale

To examine the possibility that more students participated during higher-stress times of semester in one group over the other, ancillary analyses using a Chi-square test was performed with time of semester dichotomized into either the first or second half of

the semester. Results of these analyses revealed no significant difference between groups on the time of semester during which they participated ($\chi^2(2) = 0.30$, $p = .86$).

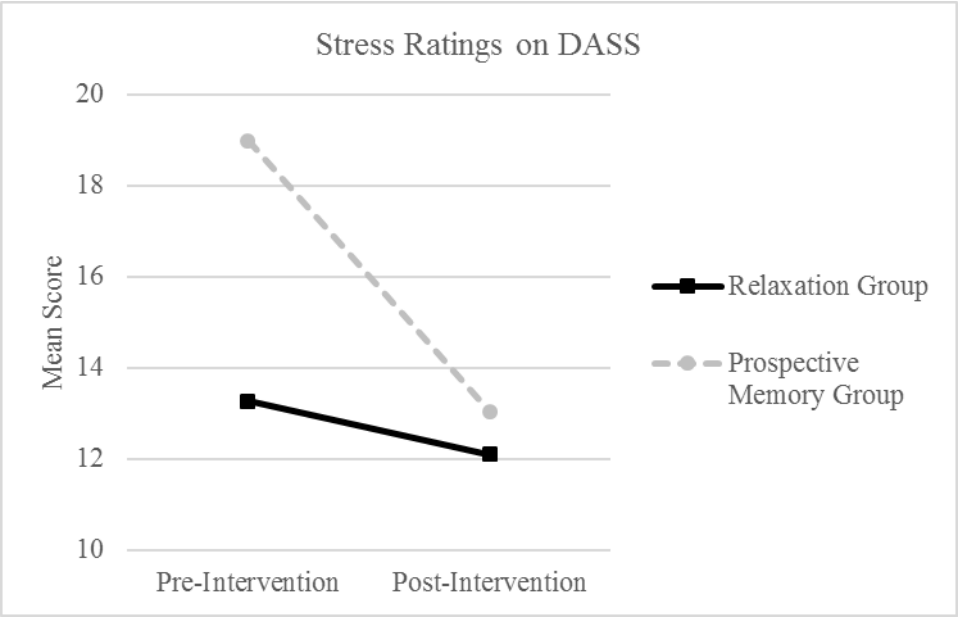

Figure 6. Ratings on the Stress scale of the Depression, Anxiety and Stress Scale.

Research Question 7

The final planned analysis for this study sought to examine whether participants receiving prospective memory intervention would show greater improvement in memory satisfaction after the intervention than the comparison group. A mixed repeated-measures ANOVA was used for the Memory Satisfaction Scale score of the MMQ (MMQ Satisfaction). A one-tailed paired-samples t-test was conducted for MMQ Satisfaction scores, and found no significant improvement for the experimental intervention group across sessions ($t(20) = -.543$, $p = .30$). The ANOVA showed no significant main effects for condition ($p = .94$) or session ($p = .38$), and showed a non-significant interaction effect ($p = .97$), suggesting no reliable differences were found.

Table 8. *MMQ Satisfaction Scale ANOVA Source Table*

	df	*F*	$\omega^2_{partial}$	*p*
Condition	1	0.01	-.03	.94
Session	1	0.83	.00	.37
Condition x Session	1	0.00	-.03	.97
Error	37			

Note. *df*, degrees of freedom, *MMQ*, Multifactorial Metamemory Questionnaire

Informal Feedback

Feedback from participants was elicited informally at the end of the second session, after testing was completed. Participants were asked if they used any of the techniques on which they were provided skills training and, if so, which techniques they found most helpful. Participants also were asked if they found the intervention, on a whole, to be useful. Suggestions for improvement were also elicited. The majority of participants remembered the techniques, though few had practiced them outside of the study. Participants in the relaxation condition most often reported that abdominal breathing was their preferred technique. For the prospective memory group, most students preferred using external memory aids (that is, Google Calendar and Google Keep) over the other techniques. Participants in both groups reported that they found the study to be helpful or interesting, though one participant felt the skills were not readily relatable to their academic life. While many participants enjoyed the study in its current form, suggestions for improvement included inclusion of more sports professionals in the Famous Faces task (for those unfamiliar with celebrities from music or television) and handouts containing information about the techniques covered during skills training to encourage use outside of the study.

CHAPTER 4

Discussion

The goal of this study was to explore whether prospective memory training improved self-regulated learning. It was thought that improved ability to meet goals and complete tasks would allow for increased academic-self efficacy as it related to university education. Two groups were given skills training: the first on prospective memory (the experimental group), the second on relaxation (the comparison group). The skills emphasized in the experimental group included improving intention encoding and cue detection, in addition to instruction on the use of external aids to aid in prospective memory. Prospective memory performance, self-report abilities for memory, and reports of stress were evaluated at two sessions. This study serves as a pilot, as prospective memory skills training and a possible influence of training on academic self-efficacy had not previously been explored with an undergraduate population.

Ratings of one's own prospective memory performance did not show significant improvement after training in either condition. That is, participants did not endorse having fewer problems with prospective memory abilities after skills training targeting prospective memory or after relaxation training. It should be noted that the degree of memory difficulty endorsed by either group was not severe compared to difficulties typically seen for prospective memory intervention (Gross et al., 2012; van den Berg et al., 2012). Though participants endorsed some difficulty with memory, this population is cognitively healthy and not expected to have difficulty on memory tasks (Smith et al., 2000). While research has shown efficacy for short-term intervention for behavioural changes and knowledge (Eaton et al., 2012; Feldman & Dreher, 2012; Troxel et al., 2012;

Wolters & Hoops, 2015), self-perceptions of ability are more resistant to change (Choi & Twamley, 2013; Fish et al., 2010; Waldum et al., 2014). Overall, these results indicate that a single-session intervention focusing on prospective memory skills training may not be sufficient to produce change on subjective self-ratings of prospective memory.

Other literature also suggests that producing change in self-perception of ability may require more than a single, focused session. Traditionally, cognitive training and rehabilitation involve protocols of 8 or more sessions both in general intervention and for prospective memory interventions specifically (Choi & Twamley, 2013; Fish et al., 2010; Waldum et al., 2014). In seeking change in self-perception, it may be beneficial to provide feedback on performance. Participants in the present study received no information on their performance on prospective memory tasks during the intervention, with no encouragement or feedback, and instead had to rely on their own perception of their performance (Choi & Twamley, 2013; Fish et al., 2010; Levine et al., 2000). During more extensive intervention, participants would have increased opportunity to see how their prospective memory abilities change over the weeks, which may impact their perception of their abilities.

Performance on some prospective memory tasks, in contrast to self-report measures of self-report, showed an effect from the prospective memory training. Improvements were seen across groups for both event- and time-based embedded prospective memory tasks. The prospective memory training group showed an absolute, but non-significant, improvement beyond that seen in the comparison condition for the time-based embedded prospective memory task, due in part to ceiling effect on performance of this task. It is possible that, given a higher degree of difficulty for this

tasks or longer period of time in which to forget, more meaningful results can be obtained.

In contrast, though both groups showed improvement after intervention on EEPM performance, the prospective memory group did not perform significantly different or better than the relaxation training group. In other words, an embedded event-based prospective memory task showed no clear advantage of prospective memory over relaxation training.

Performance on the RPA-ProMem showed somewhat surprising results in terms of performance. While the analysis showed a significant effect of group over time, it seemed to demonstrate that the comparison condition did more poorly on the second administration of the task. Indeed, the experimental group showed virtually flat performance between sessions, suggesting there was no improvement on their scores. While this may due to high performance at baseline, limiting participants' ability to improve their score, it may signify some other effects at play.

Motivation to complete the long-term components of the RPA-ProMem possibly was lower at the administration during the second session compared to first session. While performance on the long-term components of RPA-ProMem do not explain the entire difference seen here, it may explain part of it. Participants may have felt a duty to complete the long-term prospective memory tasks, as they would be returning to meet with the researcher for their second session. Several participants who did not complete the long-term tasks from the first session expressed embarrassment at their non-compliance and were apologetic. In contrast, after completion of the second session there may have been greatly diminished attention to the study, including the assignment to

complete the long-term components of the RPA-ProMem, as while they may feel obligated to complete the long-term components, the participants had already received their compensation through the Psychology Participant Pool (it should be noted that non-completion of measures would have no impact on their compensation for either session). Despite a possible lower motivation to complete the long-term RPA-ProMem items after Session 2, those who may have had a higher proficiency in these abilities due to PM skills training - that is, the experimental group – may have found the assignment less effortful and may have completed these tasks at a higher rate despite lower motivation to do so given that all credit for participation already had been awarded and there were not further contacts with the researcher.

The application of the techniques learned in the experimental condition may also explain in part these results. Participants in both groups were encouraged to leverage the skills they were taught for the embedded PM tests in the N-Back and Famous Faces task. For the experimental group, the skills learned would be directly applicable to the task being administered. However, no explicit instruction to apply the trained skills was given for the RPA-ProMem (for example, to use the external aids to help with the recall of the intention), though the experimenter confirmed that they could use Google Keep or Calendar if the participant asked. This reduced emphasis for implementing the skills relating to external aids may also account for the lack of improvement seen in the RPA-ProMem tasks. Prior research has shown that in skills training, it can be important for people to apply learned techniques in a structured environment in order to maximize the likelihood of skill generalization to everyday tasks (Choi & Twamley, 2013; Waldum et al., 2014).

Overall, there is modest evidence that the skills for prospective memory covered in the experimental condition benefited prospective memory task performance. The prospective memory condition showed significant and non-significant effects on time-based prospective memory performance on the RPA-ProMem and time-based prospective memory component within the attention task, respectively. It is possible that this latter aspect may be slightly confounded by both a ceiling effect on performance and a limited range of scores for these short-term prospective memory tasks. Despite the effects from the prospective memory skills training on performance, participants' perception of their time-based prospective memory ability did not show any effect from intervention.

In contrast, event-based prospective memory produced non-significant effects attributable to the prospective memory intervention. While there was a moderate improvement seen for EEPM tasks, the improvement was not significantly different between the experimental and comparison groups. Performance on the event-based items of the RPA-ProMem, unlike the time-based components, did not show an effect from intervention. Similar to the ratings for time-based prospective memory, self-report ratings of event-based prospective memory ability showed no reliable differences due to intervention.

Past research has found that time-based and event-based prospective memory, while relying on similar neural mechanisms (Burgess et al., 2001; Simons et al., 2006), show different degrees of response to training (Waldum et al., 2014). Time-based prospective memory tasks have shown stronger effects from training than event-based prospective memory tasks (Waldum et al., 2014)., The present study showed no significantly different effects between time- and event-based tasks, despite the difference

between time- and event-based tasks in the literature. This may imply that the effects from a single hour-long intervention are mild at best and do not differ between types of prospective memory. It is possible that with additional sessions of skills training and more difficult tasks, these effects would be more pronounced.

Due to the time constraints of this study, there were challenges including time-based prospective memory tasks in typical format. Past prospective memory interventions with time-based tasks typically allow for a long period of time (typically several hours) to perform in, allowing ample opportunity for participants to forget intentions and miss cues (Burkard, Rochat, Blum, et al., 2014; Fish et al., 2010; Waldum et al., 2014). In Waldum and colleague's 2014 study, time-based prospective memory tasks included hour-long periods with distractor tasks. As such, the time constraints for the present study resulted in a task that was perhaps too simple, or which did not provide sufficient opportunity for error.

Academic-self efficacy showed significantly higher ratings over time across both groups in one of two measures. These improvements were not significantly different between groups over time; both groups showed similar improvements between sessions in their self-report. That is, participants in both conditions felt better able to perform effectively in a university education setting. Results from this study suggested that prospective memory intervention may provide benefits by offering an intervention that a student perceives as helpful, though may not provide additional benefits related to prospective memory function. That is, if a student feels that skills training may help them improve their abilities related to academic function, empowering them, there may be an effect regardless of the intervention’s true efficacy (Mega et al., 2014; Zimmerman et al.,

1992). In addition, it may be that responses on the academic self-efficacy as measured by the MSPSE may assess slightly different domains than those assessed by the SELF. On the MSPSE, the domains being examined are explicitly labelled on the measure. It may be that there might be demand characteristics related to this, as the participants had previously endorsed difficulty with school.

Interestingly, when prompted for feedback about the study, participants reported that items on the SELF provided them with ideas on how to improve their academic performance. Instead of asking for a general rating on their abilities relating to learning, the SELF asks for ratings on the ability to conduct adaptive behaviours related to academic self-efficacy. For example, "When you are struggling to remember technical details of a concept for a test, can you find a way to associate them together that will ensure recall?" (Zimmerman & Kitsantas, 2007). On the post-intervention assessment, the participants were now aware of some of these adaptive techniques, and consequently may have felt more confident in their ability to carry them out.

Social self-efficacy also showed significant improvements after intervention, but did not show differences in degree of improvement between groups over time. This factor includes one's ability to enlist social resources, assert themselves, and participate in social leisure activities. In contrast, Self-Regulated Efficacy showed no effect from intervention. The strength of the effect for time for social self-efficacy and self-efficacy for learning were similar, with no significant difference between them. This suggests that participants receiving either intervention show gains beyond just academic-self efficacy, and may indicate a need for further research to understand the interaction at hand.

On a self-report measure of stress, those receiving the prospective memory intervention showed a decline in severity of stress symptoms to a degree that was significantly beyond that seen in the relaxation training group. Student reports of stress tend to vary throughout a semester, with higher levels of stress being reported during time of testing (for example, mid-terms) or assignment due-dates (Ross, Neibling, & Heckert, 1999). However, participants in both conditions were recruited and assessed through two semesters, and groups did not differ on the number of participants who had signed up during the first or second half of the semesters during which this study was run. Additionally, this difference is not thought to be due not to the condition, as they were randomly assigned, but simply a failure of randomization. As it stands, while the experimental group happened to more likely to report stress at the initial session, both groups did endorse non-zero levels of stress and thus both could have had reductions in reported stress. However, the rate of improvement for the prospective memory group was greater than that of the relaxation group. Ultimately, this does show that for individuals reporting mild elevations of stress and reporting difficulties with remembering to do things, prospective memory skills training may provide some benefit.

The use of questionnaires to evaluate memory performance, while convenient for research, is not without flaws. Self-report of memory failure is not always reliable; in some cases, participants may forget that they have forgotten (Gross et al., 2012; van den Berg et al., 2012). However, these failures in reporting are more likely in those with cognitive difficulties relating to neurodegenerative disorders or head injury. In a cognitively healthy sample, while this bias would not be completely eliminated, it becomes a much smaller factor and is less likely to impact on the findings. Despite this

potential shortcoming of questionnaires related to memory, they provide indispensable insight into cognitive processes. Without questionnaires, it is virtually impossible to evaluate meta-memory ability and endorsement of memory techniques (Brandimonte et al., 1996; van den Berg et al., 2012). As one of the goals of this research was to establish if cognitive strategies for prospective memory were affected, the use of questionnaires was imperative.

The use of a comparison condition for this study provides an improvement in methodology. It is possible that effects would likely be stronger and more likely to be significant if the experimental group were contrasted with a no intervention control condition. However, a pilot comparing an intervention to a control group does not necessarily mean that the intervention holds merit as an effective treatment. If an existing intervention produces similar (as was the case for relaxation training on some measures in this study), or even stronger results, than the intervention being proposed, there would less value in putting it forth. Relaxation training has been established to provide benefit to undergraduate students, largely through reducing the impact of stress on their academic function (Hindman et al., 2015; Mega et al., 2014; Ross et al., 1999). By contrasting the effects of prospective memory skill training to those of relaxation training, an approach often used with undergraduates (Hindman et al., 2015), we can explore whether it provides benefit compared to established techniques.

Participants reported that they had found the skills being taught in the prospective memory group to be helpful, and that they would be likely to use them in future scenarios. Many of these participants reported finding the use of smartphone applications, such as Google Keep and Google Calendar, to be particularly appealing, with some

participant already transitioning their to-do lists and upcoming appointments to these electronic counterparts. Participants' interest in the techniques and enjoyment of the study structure suggests that there may be a willingness for students to participate in an extended version of this study. Extended intervention, over a longer period of time, would likely produce stronger effects on performance and change in self-reported ability. Further, it would allow for improved generalization of techniques to everyday prospective memory performance through assigned practice between sessions. While a short-term intervention was not able to produce significant change in limited aspects of academic self-efficacy or overall satisfaction with memory ability, it was able to produce effects on a number of objective measures of prospective memory performance. The change seen in performance on prospective memory suggests that skills training in this domain may be effective for university-aged students expressing difficulty with their memory. Relaxation training may provide some benefit for self-efficacy related to academics, focusing on abilities linked to academic performance not examined in the prospective memory condition (Park, Edmondson, & Lee, 2012; Ross et al., 1999). An extended period of intervention and skills training based on this pilot may yield more robust and dramatic results.

This study provides evidence that a novel prospective memory intervention in undergraduates also shows promise as an effective intervention for academic self-efficacy. While a single-session intervention, as outlined in this study, was unable to produce change in perceived prospective memory abilities, participants showed improvements on some objective measures of prospective memory function. In addition, while not to a degree different from students receiving relaxation training, students

receiving prospective memory training felt better able to handle the demands of what is required of them in university.

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APPENDICES

Appendix A
Participant Pool Advertisement

Screening questions

- "Do you have difficulties with self-regulated learning or dealing with pressures relating to academic and daily life?"
- "Are you looking to improve your abilities to better deal with the stresses of academic life?"
- "Do you have a smartphone?"

Participant Pool Posting

“Do you find that you have trouble with self-directed learning? Do these difficulties impact your academic functioning? Are you looking to improve your abilities to better deal with these difficulties? This study may be for you!

This study looks at the use of one-on-one skill training focusing on skills which may help people remember to do things more effectively. In this study, you will be asked to complete several measures that look at your ability to remember to do things, academic function and mood, using both computer-based and paper-and-pencil tasks. You will receive an intervention designed to help you with some aspects of your memory. This study would take no longer than 180 minutes. If you choose with withdraw from this study before it is completed, you will receive 0.5 bonus points for attending. A smartphone or cellular phone would be needed for this study.”

Appendix B
Consent Forms

LETTER OF INFORMATION FOR CONSENT TO PARTICIPATE IN RESEARCH

Title of Study: *Improving Self-Regulated Learning through Skill Training (Training Session)*

You are asked to participate in a research study conducted by Jeff McCarthy and Dr. Anne Baird, from the **Department of Psychology** at the University of Windsor **for use in Jeff McCarthy's Master's thesis.**

If you have any questions or concerns about the research, please feel to contact **Dr. Anne Baird (abaird@uwindsor.ca; 519-253-3000, ext. 2234.**

PURPOSE OF THE STUDY
This study seeks to explore the use of a brief intervention in helping undergraduates better deal with some of the demands of a university education. Student often say that they have difficulties remembering to do things, such as going to meetings at specific times or buying specific things at the store if they don't have a list. It's possible that these abilities impact ability to perform effectively in a university setting.

This study has been cleared by the University of Windsor's Research Ethics Board.

PROCEDURES

If you volunteer to participate in this study, you will be asked to come for two sessions this semester. The first session is a training session, and the second is a follow-up session. The content for these sessions is intended to be educational, and not therapeutic or health care.

Training Session

This session will take about 120 minutes.

You will be asked about some background information, and to access an informal transcript of your marks in the last semester on a computer in this last. The researcher will look at the transcript with you, and show you where your sessional average is. The researcher will record this average and the number of courses you took in that semester, including incompletes and withdrawals.

You will also be asked to complete several questionnaires and tasks today which measure ability to remember to do things, academic ability, and mood. You will then receive skills training which may help with some aspects of academic performance.

Currently, you may be in a course for which the researcher or the research supervisor is an Instructor or GA. If you wish you are free to decide not to consent to be in the study.

However, during grading, such as exams, essays, or assignments, the researchers will prevent themselves from making an association between your identity and your performance by adopting masking procedures for the class as a whole. To this end, student numbers and anonymized marking will be used in place of names.

To mask information needed for transcripts in the following semester, we will create a separate list of participant numbers and Student Numbers on paper. This paper list will be kept in a locked environment in the lab separate from the list with your name and student number. In the following semester we will give the list to the Registrar's Office or a designee of the Research Office and request that this person supply your present semester's sessional average. Once the list is provided to the researcher, the academic averages will be entered into the database within 72 hours and the list linking participants and student numbers will then be destroyed.

Follow-up Session

When you return for the follow-up session, it will take about 60 minutes.

You will also be asked to complete several questionnaires and tasks which measure ability to remember to do things, academic ability, and mood. You will also be asked to provide feedback about your experience with the training, to help improve it for the future.

POTENTIAL RISKS AND DISCOMFORTS

Information will be treated as confidential. It is not anticipated that you will experience distress as a result of completing these measures. However, some of these measures are designed to be challenging, and it is possible that one or more measures may induce mild distress in some participants or that you may be worried by allowing the researcher to access your transcript and keep your identifying information until September 31, 2016.

Should you become distressed for any reason, you may wish to consult the University of Windsor Student Counselling Centre (SCC) in Room 293 of the CAW Centre (Hours: Monday through Friday 8:30 AM to 4:30 PM). If this will be your first visit you need to come in person to Room 293. If you have been to the SCC in the last 6 months you may call 519-253-3000 ext 4616 to make an appointment or email scc@uwindsor.ca.

You also may contact a free confidential 24 hour/7 days a week helpline for university and college students: 1-866-925-5454. This helpline provides professional counselling and referrals.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

Participants will have the opportunity to experience tasks which you may find interesting

and make you think about your abilities. You also will have the opportunity to contribute to research which may improve and educational training techniques for students who are having difficulties with self-directed learning. This research may also provide insight into adults with perceived or actual difficulties with memory or self-directed activity.

COMPENSATION FOR PARTICIPATION

Participants will receive 2.0 bonus points for 120 minutes of participation towards the psychology participant pool, if registered in the pool and enrolled in one or more eligible courses upon completion of this Training session.

Participants will receive 1.0 bonus points for 60 minutes of participation towards the psychology participant pool, if registered in the pool and enrolled in one or more eligible courses upon completion of the Feedback session.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission.

Identifying information (that is, consent forms, linking documents) information will be stored in a locked environment in a locker and will be destroyed one year after this semester. These linking documents will be stored in a password-protected file on the researcher's computer, in an encrypted medium. Consent forms will be kept until the end of the semester; after which they will be securely shredded. Your data will also be stored under lock and key separately from your identifiable information until the data from the sessions has been scanned or coded into the computer, after which will be destroyed (no later than the end of the current semester). The information on the computer will be password protected, and only researchers involved in this study will have access to these files. The information will not be released to any third parties.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. As noted earlier, one or more researchers may be an Instructor or GA for classes in which you are enrolled in the current semester. Therefore, as described earlier, we will mask students' identity for grading we do this semester, and we will decouple your name from the academic information provided by the Registrar or their designee in in the following semester.

Nonetheless, should you be concerned about the PI and/or other Research Assistants becoming aware of your academic performance and other information and linking it to your identity, you have the right not to consent to the Training and Follow-up Sessions.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you

may withdraw participation at any time with the exception of your consent for the Registrar to provide us with the academic information provided above. In the first (training) session, you will receive 0.5 bonus points if you withdraw before the first 30 minutes of participation, and up to 2.0 credits for completion of the entire session. In the follow-up session, you will receive 0.5 bonus points if you withdraw before the first 30 minutes of participation, and up to 1.0 credits for completion of the entire session

You have the option of removing your data from the study by emailing a request to Jeff McCarthy at mccar112@uwindsor.ca no later than 24 hours after this Training session. If you withdraw your data at this time, you also may withdraw your consent for the Registrar to supply the researchers with the academic performance data described earlier.

Once beyond 24 hours after completion of this Training session, you will no longer have the right to withdraw any of the data you have contributed to the study, including data you may have contributed during the Follow-up sessions and including data obtained from the Registrar. Once beyond 24 hours after completion of this Training session, you may no longer withdraw consent for us to access your current semester's sessional average from the Registrar.

You may not participate in the Follow-up session if you do not complete the Training session or if you withdraw your data from the Training session.

The investigator may withdraw you from this research if circumstances arise which warrant doing so.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE PARTICIPANTS

A summary of the study results will be accessible on the following website:
Web address: **http://www1.uwindsor.ca/reb/study-results**
Date when results are available: **December 31, 2016**

SUBSEQUENT USE OF DATA

These data may be used in subsequent studies, in publications and in presentations.

RIGHTS OF RESEARCH PARTICIPANTS

If you have questions regarding your rights as a research participant, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario N9B 3P4; Telephone: 519-253-3000, ext. 3948; e-mail: ethics@uwindsor.ca

SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I understand the information provided for the study **Improving Self-Regulated Learning through Skill Training (Training Session)** as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a

copy of this form.

_____
Name of Participant

_____ _____
Signature of Participant Date

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research.

_____ _____
Signature of Investigator Date

LETTER OF INFORMATION FOR CONSENT TO PARTICIPATE IN RESEARCH

Title of Study: *Improving Self-Regulated Learning through Skill Training (Follow-up Session)*

You are asked to participate in a research study conducted by Jeff McCarthy and Dr. Anne Baird, from the **Department of Psychology** at the University of Windsor **for use in Jeff McCarthy's Master's thesis.**

If you have any questions or concerns about the research, please feel to contact **Dr. Anne Baird (abaird@uwindsor.ca; 519-253-3000, ext. 2234.**

PURPOSE OF THE STUDY

This study seeks to explore the use of a brief intervention in helping undergraduates better deal with some of the demands of a university education. Student often say that they have difficulties remembering to do things, such as going to meetings at specific times or buying specific things at the store if they don't have a list. It's possible that these abilities impact ability to perform effectively in a university setting.

This study has been cleared by the University of Windsor's Research Ethics Board.

PROCEDURES

If you volunteer to participate in this study, you will be asked to come for two sessions this semester. The first session is a training session, and the second is a follow-up session. The content for these sessions is intended to be educational, and not therapeutic or health care.

Follow-up Session

This session will take about 60 minutes.

You will be asked to complete several questionnaires and tasks which measure ability to remember to do things, academic ability, and mood. You will also be asked to provide feedback about your experience with the training, to help improve it for the future.

POTENTIAL RISKS AND DISCOMFORTS

Information will be treated as confidential. It is not anticipated that you will experience distress as a result of completing these measures. However, some of these measures are designed to be challenging, and it is possible that one or more measures may induce mild distress in some participants or that you may be worried by allowing the researcher to access your transcript and keep your identifying information until September 31, 2016.

Should you become distressed for any reason, you may wish to consult the University of Windsor Student Counselling Centre (SCC) in Room 293 of the CAW Centre (Hours:

Monday through Friday 8:30 AM to 4:30 PM). If this will be your first visit you need to come in person to Room 293. If you have been to the SCC in the last 6 months you may call 519-253-3000 ext 4616 to make an appointment or email scc@uwindsor.ca.

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Participants will have the opportunity to experience tasks which you may find interesting and make you think about your abilities. You also will have the opportunity to contribute to research which may improve and educational training techniques for students who are having difficulties with self-directed learning. This research may also provide insight into adults with perceived or actual difficulties with memory or self-directed activity.

COMPENSATION FOR PARTICIPATION

Participants will receive 1.0 bonus points for 60 minutes of participation towards the psychology participant pool, if registered in the pool and enrolled in one or more eligible courses upon completion of the Feedback session.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission.

Identifying information (that is, consent forms, linking documents) information will be stored in a locked environment in a locker and will be destroyed one year after this semester. These linking documents will be stored in a password-protected file on the researcher's computer, in an encrypted medium. Consent forms will be kept until the end of the semester; after which they will be securely shredded. Your data will also be stored under lock and key separately from your identifiable information until the data from the sessions has been scanned or coded into the computer, after which will be destroyed (no later than the end of the current semester). The information on the computer will be password protected, and only researchers involved in this study will have access to these files. The information will not be released to any third parties.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. As noted earlier, one or more researchers may be an Instructor or GA for classes in which you are enrolled in the current semester. Therefore, as described earlier, we will mask students' identity for grading we do this semester, and we will decouple your name from the academic information provided by the Registrar or their designee in in the following semester.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw participation at any time with the exception of your consent for the Registrar to provide us with the academic information provided above. In the follow-up session, you will receive 0.5 bonus points if you withdraw before the first 30 minutes of participation, and up to 1.0 credits for completion of the entire session

The investigator may withdraw you from this research if circumstances arise which warrant doing so.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE PARTICIPANTS

A summary of the study results will be accessible on the following website:
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Date when results are available: **December 31, 2016**

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These data may be used in subsequent studies, in publications and in presentations.

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If you have questions regarding your rights as a research participant, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario N9B 3P4; Telephone: 519-253-3000, ext. 3948; e-mail: ethics@uwindsor.ca

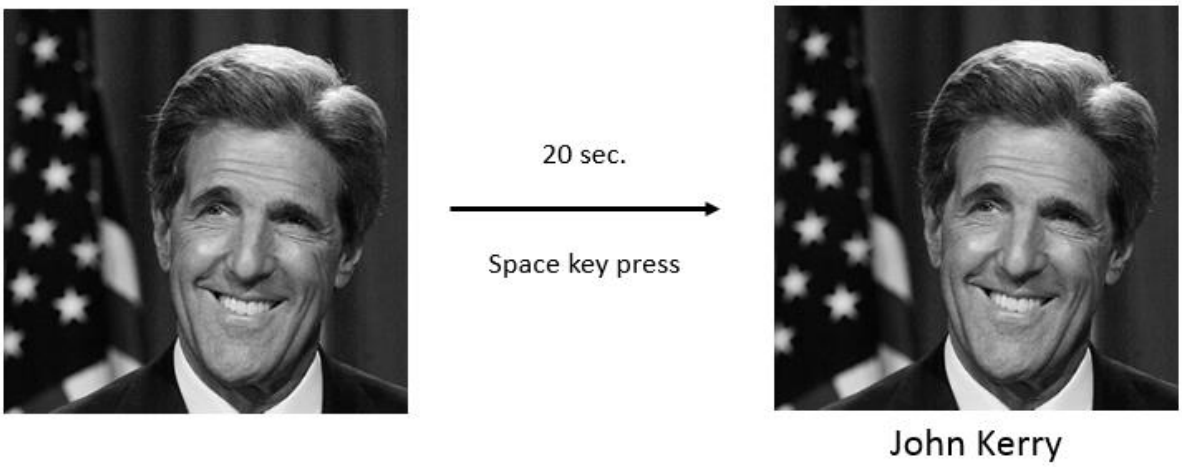
SIGNATURE OF RESEARCH PARTICIPANT/LEGAL REPRESENTATIVE

I understand the information provided for the study **Improving Self-Regulated Learning through Skill Training (Follow Up Session) as** described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____
Name of Participant

_____ _____
Signature of Participant Date

Appendix C
Famous Faces Task



John Kerry (CC BY-NC-SA 2.0)
Vladimir Putin (CC BY-NC 2.0)
Barack Obama (CC BY 2.0)
Kim Jong Il (CC BY 2.0)
Justin Trudeau (CC BY-ND 2.0)
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Matthew McConaughey (CC BY-NC 2.0)
Brad Pitt (CC BY 2.0)
George Clooney (CC BY-SA 3.0)
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Tobey Maguire (CC BY-SA 2.0)
James Franco (CC BY 3.0)
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Dwayne "The Rock" Johnson CC BY-SA 2.0)
Vin Diesel (CC BY-SA 2.0)
Tom Cruise (CC BY-SA 3.0)
Pharrell Williams (CC BY-SA 2.0)
Drake (CC BY-NC 2.0)
Albert Einstein (Public domain)
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Emma Stone (CC BY-SA 3.0)
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Rachel McAdams (CC BY 3.0)
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Angelina Jolie (CC BY 2.0)
Amy Adams (CC BY-SA 2.0)
Tina Fey (CC BY-SA 2.0)
Michelle Pfeiffer (CC BY 2.0)
Anna Kendrick (CC BY 2.0)
Miley Cyrus (CC BY-SA 2.0)
Taylor Swift (CC BY-SA 3.0)
Beyoncé (CC BY-NC-SA 2.0)
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Katy Perry (CC BY-SA 2.0)
Britney Spears (CC BY-SA 2.0)
Carrie Underwood (CC BY 2.0)
Kim Kardashian (CC BY 3.0)
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Brendan Fraser (CC BY-SA 3.0)
Ali Larter (CC BY 2.0)
Alicia Keys (CC BY 2.0)
Andrew Lincoln (CC BY-SA 3.0)
Anne Hathaway (CC BY 2.0)

Ariana Grande) (CC BY 2.0)
Arnold Schwarzenegger (CC BY-SA 3.0)
Ashley Greene (CC BY-SA 2.0)
Avril Lavigne (CC BY-SA 3.0)
Ben Affleck (CC BY-SA 3.0)
Ben Stiller) (CC BY-SA 3.0)
Bradley Cooper (CC BY 3.0)
Bruce Willis (CC BY-SA 3.0)
Cameron Diaz (CC BY 3.0)
Catherine Zeta-Jones (CC BY 3.0)
Céline Dion (CC BY-SA 3.0)
Chris Hemsworth (CC BY-SA 2.0)
Courtney Cox (CC BY 3.0)
Dakota Fanning (CC BY 2.0)
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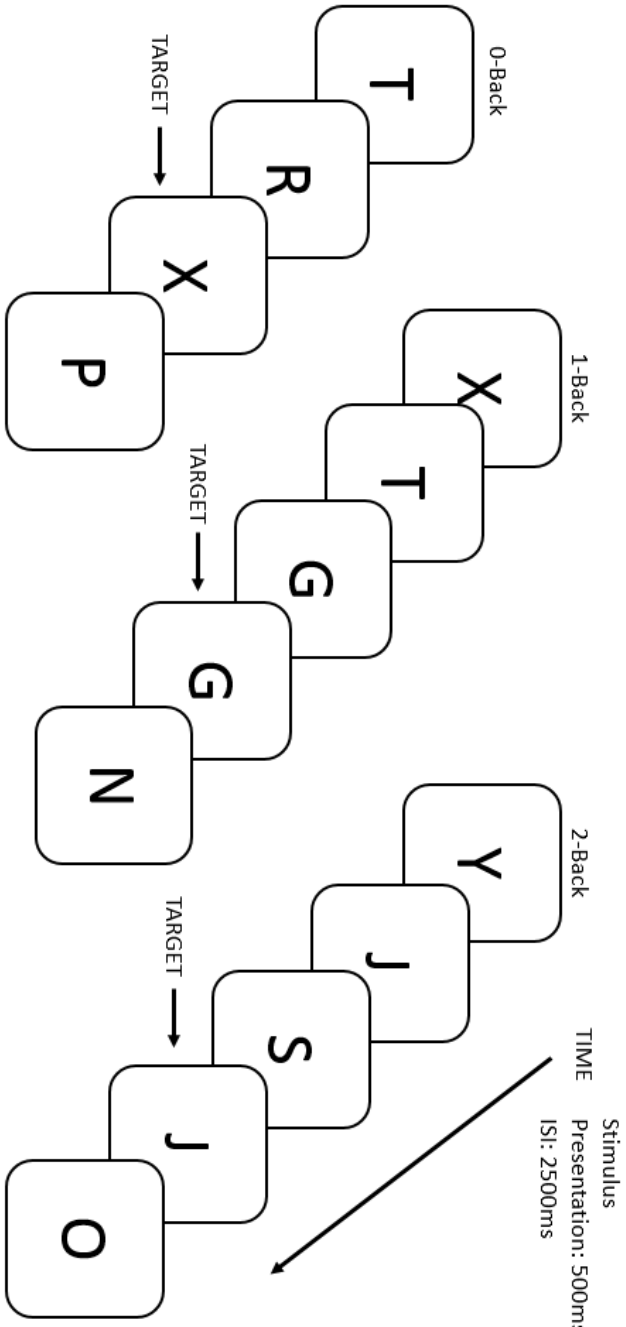
Denzel Washinton (CC BY-SA 2.0)
Donald Trump) (CC BY-SA 2.0)
Drew Barrymore (CC BY-SA 2.0)
Ellen DeGeneres (CC BY 2.0)
Elton John (CC BY 3.0)
Eva Longoria (CC BY-SA 3.0)
Evangeline Lilly (CC BY-SA 2.0)
Gwen Stefani (CC BY 2.0)
Gwyneth Paltrow (CC BY-SA 3.0)
Halle Berry (CC BY-SA 3.0)
Harrison Ford) (CC BY-SA 3.0)
Hayden Panettiere) (CC BY-SA 3.0)
Heidi Klum) (CC BY 2.0)
Stephen Colbert (CC BY 2.0)
Ian McKellen (CC BY-SA 2.0)
Jack Nicholson (CC BY 2.0)
Jackie Chan (CC BY-SA 3.0)
Jason Statham (CC BY-SA 3.0)
Jessica Alba (CC BY-SA 2.0)
Jessica Biel (CC BY-SA 3.0)
Jessica Simpson (CC BY-SA 2.0)
Jim Carrey (CC BY-SA 2.0)
John Travolta (CC BY-SA 3.0)
Julia Roberts (CC BY 3.0)
Justine Bieber (Public Domain)
Kanye West) (CC BY 2.0)
Kate Beckinsale) (CC BY-SA 2.0)
Kate Middleton) (CC BY-SA 4.0)
Keira Knightly (CC BY-SA 3.0)
Kevin Spacey (CC BY-SA 2.0)
Kirsten Dunst (CC BY-SA 2.0)
Kristen Bell (CC BY 2.0)
Leonardo Dicaprio (Public Domain)
Liam Neeson (CC BY-SA 3.0)
Madonna Louise Ciccone (CC BY-SA 3.0)
Mandy Moore (CC BY 2.0)
Mariah Carey (CC BY-SA 3.0)
Matt Damon (CC BY-SA 3.0)
Megan Fox (CC BY-SA 2.0)
Mike Tyson (CC BY 2.0)
Mila Kunis (CC BY-SA 3.0)
Miranda Kerr (CC BY 2.0)
Morgan Freeman) (CC BY 2.0)
Natalie Portman (CC BY 3.0)
Olivia Wilde) (CC BY 2.0)
Peter Jackson (CC BY-SA 2.0
Pierce Brosnan (CC BY-SA 3.0)
Rachel Bilson (CC BY 2.0)
Stanley Tucci (CC BY 2.0)
Gary Oldman (CC BY-SA 3.0)
Andy Dick (CC BY 3.0)
Christina Hendricks (CC BY-SA 2.0)
Meryl Streep (CC BY-SA 2.0)
Jeffrey Tambor (CC BY-SA 2.0)
Michael Caine) (CC BY-SA 3.0)
Reese Witherspoon (CC BY-SA 2.0)
Robert De Niro (CC BY-SA 3.0)
Robert Downey Jr. (Public Domain)
Robin Williams (Public Domain)
Rowan Atkinson (CC BY-SA 2.0)
Salma Hayek (CC BY-SA 2.5)
Samuel L Jackson (CC BY 2.0)
Sandra Bullock) (CC BY-SA 2.0)
Sarah Hyland (CC BY-SA 2.0)
Sean Connery) (CC BY-SA 3.0 NL)
Selena Gomez (CC BY 2.0)
Shia LeBeouf (CC BY-SA 3.0)
Sofia Vergara) (CC BY 2.0)
Stefani "Lady Gaga" Germanotta (CC BY 2.0)
Steve Carell (CC BY 2.0)
Steven Spielberg (CC BY-SA 3.0)
Tom Hanks (Public Domain)

Vanessa Hudgens (CC BY-SA 2.0)
Will Ferrell (CC BY-SA 2.0)
Will Smith (CC BY 2.0)
Winona Ryder (CC BY-SA 2.0)
Zach Braff (CC BY 3.0)
Zach Galifianakis (CC BY 2.0)
Christina Hendricks (CC BY-SA 2.0)

Appendix D
Modified Letter N-back Task



Appendix E
Script for Intervention Condition

[After pre-intervention testing]

Implementation Intention Component

The first technique we will be looking at is a technique called implementation intention. The main idea behind this is that it helps you improve the encoding, or writing, of the intention, which may help you recall the information later on. Implementation intention helps you by having you form your plan of action. This means the when, the where, and the how of your future behavior. Research has shown that this allows for an improved link between the cues for your behavior and your response. This tends to reduce the effort required for the recall of the intention. This approach is really quite useful for things that require a more subtle cue for action, in contrast to those cues that are a little more obvious. Overall, this technique might help most for those tasks that require a lot of self-initiation. Relating this to your schooling, you may think of remembering to study for quizzes or midterms. It may not be as useful for things that are really obvious when the situation comes up such as handing in a paper when you get to class. What are some ways you think that this approach might help you?

[Record participant responses, encouraging at least two event-based prospective memory tasks]

So let's imagine some of these scenarios and think of ways we can use in implementation intention for them. So for your first scenario let's think about what this would look. One of the first things we can do is think about the when of the behavior, so when would the behavior take place? [Record response] Let's also think about the where of the behavior -- where would when would this take place? [Record response] Let's also think about how the behavior would happen, too. What would that look like?

The last step for implementation intention is to say to yourself, either out loud or in your head, these components. That is, say to yourself "When *this* situation comes up, at *this* location, I'm going to do *this*." So, let's give that a try for this scenario.

[Repeat as appropriate for the number of scenarios the participant provides]

Famous Faces Task

So now that we've discussed some of these techniques, let's try to implement them. For these tasks, we'll take a little bit of time to brainstorm how we can leverage the technique we've been learning to improve performance on the task that we're doing now.

On this task you will be asked to identify some famous faces. These will include politicians, actors, actresses, and musicians. For each face, I'm going to ask you to try to think of their full name. Write their name on this piece of paper here by the number of the picture. If you can't think of the full name, write down where you know the person from.

However, there will be a twist. When you see someone wearing glasses I want you to hit this key here.

Now, given the techniques we talked about so far how do you think you could remember to do the secondary task?

Clock-Checking Component

Another effective intervention for prospective memory includes what's called “cue monitoring interventions”. The basic idea is that if we can more easily detected the cue we can better recall what our intention was. For event-based tasks we try to make the cue a little more distinct, like putting a pill bottle and to remind you to take your medication. However, what we will focus on today is for time-based prospective memory tasks – remembering to do things at particular times. For this, we’ll practice a technique called “clock checking”. The basic principle here is that you check a clock to see if you’re coming up on the time at which you’re supposed to do something. Studies have shown that participants that use this clock checking behavior improve their performance on these tasks. One of the most obvious links to your academic life is using this for deadlines. For instance, you can make note of the date and time as you are working on a task and make note of the time you have left. Another example would be a reminder to show up to an instructor's office hours at a certain time. You can simply take a look at your watch or cell phone and make note of the current time, which cues you in to the upcoming event – in this case, going to office hours. What are some tasks that you can think of in your everyday life that would relate to clock checking?

[Record participant responses, encouraging at least two time-based prospective memory tasks]

Modified Letter N-back Task

Right, those are great examples. As this is a little difficult to practice in this session, we’ll try to practice this technique with a computer task. Again, for these tasks, we’ll take a little bit of time to brainstorm how we can leverage the technique we've been learning on the task that we're doing now.

For this task I'm going to have you do a series of tasks that require your working memory. There will be three components requiring you to hit this key when you see a target. The twist is you will have to remember to hit this key every 60 seconds or 1 minute. You can hit the teacher to remember to display a clock that will tell you the current time in minutes hours and seconds.

Now, given the techniques we talked about so far how do you think you could remember to do the secondary task?

External Aids Component

The last technique I wanted to talk about is the use of external aids like your cell phone or computer. There's been evidence that people with severe memory impairments can compensate for their memory difficulties by using these technologies. These aids can include things like getting reminders from other people, setting alarms, post-it notes, and calendars. What we'll try to focus on are the aids that which don't really require you to do anything. These include things like alarms on your cell phone. For the most part will focus on the use of Google Calendar and Google Keep. Do you happen to have these installed on your phone? [If not, ask the participant to download/install the application, and sign-in with the uWindsor account]

Okay, so let's take a look at your calendar. I'll show you how to set up an event that has a reminder which will remind you at whatever time you specify that you have an event coming up. These can be for classes, for tests, or everyday things in your personal life. So, what are some things that would be coming up in the next week or so for you? [Put the first event in to their calendar, modelling the approach]. See how that's done? Now, I'll have you give it a try [Have them input the remainder of their events into the calendar].

Now let's take a look at Google Keep. Google Keep is essentially a to-do list that can use both time- and location-based reminders. For example, if you have to remember to pick up milk at the grocery store you can have Google keep remind you as you get close. Alternatively, if you have to remember to do something on Friday you can put it into your Google keep and it will remind you at that date and time. Some tasks that relate to your academic life would include remembering to put a text book in your bag when you got home. Alternatively, you can have a reminder to bring up a question you had about the lecture content to the professor before class. What are some ways you can think of using this application for your classes?

[Record participant responses, encouraging at least two time-based reminders, two location–based reminders]

Okay, so I'll show you how to set up a time-based reminder in Google Keep. It's not too different from the calendar, but it tends to work well for things on your "to-do" list. [Model input of time-based reminder] Now, I'll have you give it a try.

Okay, so I'll show you how to set up a location-based reminder in Google Keep. This can be a little trickier, but I'll show you how to do it first. [Model input of time-based reminder] Now, I'll have you give it a try.

[Begin post-intervention testing]

Appendix F
Script for Comparison Condition

[After pre-intervention testing]

Deep Breathing Component

There's a large amount of research that stress has a higher impact on us than we may realize. It can even affect things like our memory. What I'd like to try with you now is a breathing exercise that may help you reduce your level of stress. I'll tell you more about it, and then we can try to go through the exercise together.

In your abdomen, there are many muscles that become tense in response to stress. These muscles can push against your diaphragm – the muscle that you use to breathe – limiting its effectiveness. That means you can take in less air and prevents you from getting as much oxygen into your system as your body would like. When you breathe in this "shallow" way, you may even feel like you're not getting enough air. This can make things feel even more stressful for you, and cause you to increase the rate of your breathing. In some circumstances, this can cause you to hyperventilate.

Deep breathing, that is, breathing that uses the abdomen, helps you overcome this by relaxing the muscles that are preventing your diaphragm from fully extending. It's a relatively easy technique to learn, and can help you relax in a short period of time once you are proficient in it.

If you are up for it, I'd like to guide you through a brief deep breathing exercise.

[Script from McKay, Davis & Fanning, 2011, p 61]

> Sit comfortably with your back straight and your feet on the floor, and close your eyes. Take a moment to notice the sensations in your body, particularly where your body is holding any tension. Take several breaths and see what you notice about the quality of your breathing. Where is your breath centered? Are your lungs expanding fully? Does your chest move in and out when you breathe? Does your abdomen? Do both?
>
> Place one hand on your chest and the other on your abdomen, right below your waist. As you breathe in, imagine that you're sending your breath as far down into your body as it will go. Feel your lungs expand as they fill up with air. As you do this, the hand on your chest should remain fairly still, and the hand on your abdomen should rise and fall with each breath. If you have difficulty getting the hand on your abdomen to move, or if both hands are moving, try gently pressing down with the hand on your abdomen. As you breathe, direct the air so it pushes up against the pressure of your hand, forcing it to rise.
>
> Continue to gently breathe in and out. Let your breath find its own pace. If your breathing feels unnatural or forced in any way, just maintain your awareness of that

sensation as you breathe in and out. Eventually any straining or unnaturalness should ease up by itself.

After breathing deeply for several breaths, begin to count each time you exhale. After ten exhalations, start the count over with one. When thoughts intrude and you lose track of the number you are on, simply return your attention to the exercise and start counting again from one. Continue counting your breaths for ten minutes, with some awareness devoted to ensuring that the hand on your abdomen continues to rise with each breath

When your breathing settles into a regular rhythm, observe as much detail about your breath as you can. Notice the coolness of the air as it flows into your nostrils, down the back of your throat, and into your lungs. Be aware of how your diaphragm feels as it sinks with each inhalation. Feel how much warmer the exhaled air is as it carries a fraction of your body heat with it. Focus on every detail you can tease out of the simple act of deep breathing

Famous Faces Task

So now that we've tried this technique, let's a computer task. On this task you will be asked to identify some famous faces. These will include politicians, actors, actresses, and musicians. For each face, I'm going to ask you to try to think of their full name. Write their name on this piece of paper here by the number of the picture. If you can't think of the full name, write down where you know the person from. However, there will be a twist. When you see someone wearing glasses I want you to hit this key here.

Now, given the techniques we talked about so far how do you think you could remember to do the secondary task?

Progressive muscle relaxation component

I would like to guide you through another relaxation technique called progressive muscle relaxation. The basic idea behind it is that by forcing muscles to contract and relax, we can trick muscles that may be tense in to relaxing too. With your permission, I'll guide you through the process.
[Script quoted from McKay, Davis & Fanning, 2011, p 62-63]
As you go through the exercise, do two cycles of tensing and relaxing for each muscle group. Tighten each group for seven seconds, then relax for twenty seconds, then repeat. Each time you tense a muscle group, tighten the muscles as much as you can without straining. When it's time to release the tension, let go of it suddenly and completely and notice the feeling of relaxation. Do your muscles feel heavy, warm, or tingly? Learning to recognize the physical signs of relaxation is a key part of the process.
…

ARMS
1. Clench both hands tightly, making them into fists. Hold the tightness for seven seconds. Pay attention to the sensations in the muscles as they contract. Then, all at

once, let go of the tension and notice the difference. Stay focused on the sensations you feel. After twenty seconds of allowing the muscles to relax, clench your fists again. Hold the tension for seven seconds, then relax for twenty seconds.
2. Next, bend both elbows and flex your biceps. Hold this pose for seven seconds, then let go of the tension. Pay attention to the physical sensations of relaxation. Flex a second time, then relax.
3. Tense your triceps—the muscles on the back of your upper arms—by locking your elbows and stretching your arms down by your sides as hard as you can. Let go of the tension and notice the sensations of relaxation. Flex and release a second time.

HEAD
1. Raise your eyebrows up as high as you can and feel the tension in your forehead. Hold for seven seconds, then suddenly let your brow drop and become smooth for twenty seconds. Repeat.
2. Squinch up your entire face as though you were trying to make every part of it meet on the tip of your nose. Hold for seven seconds and feel where the strain is. Then release the tension and notice the feeling of relaxation. Repeat.
3. Close your eyes tightly and stretch your mouth open as wide as you can, then relax. Repeat.
4. Clench your jaw and push your tongue up to the roof of your mouth, then release. Notice how the sensations change. Repeat.
5. Open your mouth into a big, wide O, then release so that your jaw goes back into a normal position. Feel the relaxation and notice the difference. Repeat.
6. Tilt your head back as far as you can until it presses against the back of your neck, then relax. Repeat.
7. Stretch your head to one side so it rests near your shoulder, then relax. Repeat. Roll your head over to the other side, so it rests near your other shoulder, then relax. Repeat, and then lift your head to its natural resting position and feel the tension drain away. Let your mouth fall open slightly.
8. Stretch your head forward until your chin is resting on your chest. Feel the release of tension as you return your head to its natural resting position. Repeat.

MIDSECTION
1. Bring your shoulders up as high as you can, as though you're trying to bring them up to your ears.
Hold for seven seconds, then let them fall back down and relax for twenty seconds. Feel the heaviness in the muscles as they relax. Repeat.
2. Stretch your shoulders back, as though you were trying to touch your shoulder blades together, then let your shoulders relax. Repeat.
3. Bring your arms straight out in front of you at chest level and, while keeping them straight, cross them as high up on your arms as you can and feel the stretch in your upper back. Then let your arms drop down to your sides and notice the sensation of letting go. Repeat.
4. Take a deep breath. Before you exhale, contract all the muscles in your stomach and abdomen, then exhale and release the contraction. Repeat.
5. Gently arch your back, then relax. Repeat.

LEGS
1. Tighten your buttocks and thighs. Increase the tension by straightening your legs and pushing down hard through your heels and hold this position for seven seconds. Let go for twenty seconds and notice the feeling of relaxation. Repeat.
2. Tense your inner thigh muscles by pressing your legs together as hard as you can. Release and feel the sense of ease spread throughout your legs. Repeat.
3. Tighten your leg muscles while pointing your toes, then release as you return your toes to a neutral position. Repeat.
4. Flex your toes, drawing them up toward your head as you tighten your shin and calf muscles, then release and let your feet hang loosely. Repeat.

Modified Letter N-back Task

Let's try another computer task. For this task I'm going to have you do a series of tasks that require your working memory. There will be three components requiring you to hit this key when you see a target. The twist is you will have to remember to hit this key every 60 seconds or 1 minute.

[Begin post-intervention testing]

Appendix G
Descriptive Statistics by Group for Dependent Measures

Measure	Relaxation M (SD), n = 18	Prospective Memory M (SD), n = 21
PRMQ-PM		
Pre-Intervention	24.00 (5.71)	21.43 (6.27)
Post-Intervention	23.56 (5.95)	21.62 (6.01)
PRMQ-Event		
Pre-Intervention	11.61 (3.09)	10.48 (3.60)
Post-Intervention	11.78 (3.44)	10.76 (3.51)
PRMQ-Time		
Pre-Intervention	12.39 (2.87)	10.95 (2.96)
Post-Intervention	11.78 (2.69)	10.86 (3.05)
MMQ Total		
Pre-Intervention	128.94 (22.09)	132.00 (25.17)
Post-Intervention	127.11 (21.74)	132.57 (26.67)
RPA-Total		
Session 1	8.78 (2.34)	8.52 (1.91)
Session 2	6.83 (1.92)	8.33 (2.61)
RPA-Event		
Pre-Intervention	4.72 (1.45)	4.71 (1.68)
Post-Intervention	4.28 (1.49)	4.52 (1.78)
RPA-Time		
Pre-Intervention	4.06 (1.77)	3.81 (1.44)
Post-Intervention	2.56 (1.58)	3.81 (1.33)
EEPM		
Pre-Intervention	3.50 (1.79)	3.48 (1.81)
Post-Intervention	5.11 (2.27)	4.71 (2.05)
Famous Faces		
Pre-Intervention	26.81 (11.01)	26.81 (11.96)
Post-Intervention	21.03 (10.41)	21.69 (12.14)
ETPM		
Pre-Intervention	4.39 (1.79)	3.71 (2.33)
Post-Intervention	4.83 (1.82)	5.05 (1.83)
N-Back Task		
0-Back		
Pre-Intervention	9.28 (.90)	8.81 (1.54)
Post-Intervention	4.83 (1.82)	5.05 (1.83)
1-Back		
Pre-Intervention	8.28 (2.56)	7.38 (2.13)
Post-Intervention	9.00 (1.28)	8.86 (2.31)
2-Back		
Pre-Intervention	6.67 (2.70)	5.00 (2.88)

Post-Intervention	8.67 (1.46)	8.19 (1.40)
MSPSE ASE		
Pre-Intervention	4.57 (.51)	4.72 (.78)
Post-Intervention	4.68 (.53)	4.82 (.74)
MSPSE SSE		
Pre-Intervention	4.76 (.95)	4.87 (.62)
Post-Intervention	4.92 (.81)	5.10 (.68)
MSPSE SRE		
Pre-Intervention	6.04 (.56)	6.15 (.63)
Post-Intervention	5.90 (.98)	6.20 (.54)
SELF		
Pre-Intervention	62.85 (8.67)	67.47 (10.65)
Post-Intervention	66.34 (7.94)	69.90 (12.19)
DASS - Stress*		
Pre-Intervention	13.28 (9.95)	19.00 (12.02)
Post-Intervention	12.11 (9.24)	13.05 (10.42)

Note. Scores represent raw scores unless otherwise indicated. *PRMQ-PM*, Prospective Memory total score of the Prospective and Retrospective Memory Questionnaire (PRMQ), *PRMQ-Event*, total score of event-based prospective memory items of the PRMQ, *PRMQ-Time*, total score of time-based prospective memory items of the PRMQ, *MMQ Total*, sum of scores from the Multifactorial Metamemory Questionnaire, *RPA-Total*, overall score for the Royal Prince Alfred Prospective Memory task (RPA-ProMem), *RPA-Event*, total score for event-based prospective memory components of the RPA-ProMem, *RPA-Time*, total score for time-based prospective memory components of the RPA-ProMem, *EEPM*, performance on the embedded event-based prospective memory within the Famous Faces task, *ETPM*, performance on the embedded time-based prospective memory within an N-Back task, M*SPSE-ASE*, Academic Self-Efficacy Scale of the Multidimensional Scale of Perceived Self-Efficacy questionnaire (MSPSE), *MSPSE-SSE*, Social Self-Efficacy Scale of the MSPSE, *MSPSE-SRSE*, Self-Regulatory Efficacy Scale of the MSPSE

* Lower numbers indicate more favourable self-ratings of stress.

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