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GOAL MANAGEMENT TRAINING IN UNDERGRADUATE STUDENTS: THE EFFECTS ON EXECUTIVE FUNCTIONING SKILLS AND ACADEMIC SELF-EFFICACY

by
Jenny Carstens

A Dissertation
Submitted to the Faculty of Graduate Studies
Through the Department of Psychology
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy at the
University of Windsor

Windsor, Ontario, Canada

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Goal Management Training in Undergraduate Students:
The Effects on Executive Functioning Skills and Academic Self-Efficacy

by

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AUTHOR’S DECLARATION OF ORIGINALITY

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ABSTRACT

Goal Management Training (GMT) has been studied extensively in the past and has been established as a successful intervention for individuals with executive functioning (EF) difficulties. The populations included in the literature so far consist of individuals with severe EF problems, such as those who have sustained a brain injury. However, GMT has never been used with younger individuals who report subclinical levels of EF difficulties. This study addressed this gap in the literature as it involved 35 undergraduate students with self-reported EF difficulties. Participants either received one four-hour GMT workshop (GMT group) or no workshop (control group), but otherwise an equivalent amount of contact with the principal investigator. Participants' EF capabilities and self-reported difficulties were assessed three times: once before and after the GMT group received the workshop, and once at a three-month follow-up. In addition, measures of academic self-efficacy and grade point averages (GPAs) were collected. Self-reported goal management difficulties decreased in both groups from the baseline to the second follow-up assessment. Processing speed improved in both groups over the same period, but there was a bigger gain in the GMT group. Further, overall significant improvements were observed for all participants, regardless of group membership, on all EF measures, self-report questionnaires, and GPA. The results indicate that exposure to this study may have had an overall significantly positive effect for both groups. Further research is needed to understand the factors that played a role in this significant increase for both groups and the contribution of GMT in the significant improvement of processing speed and self-reported GM skills in the GMT group.

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DEDICATION

To my family. Thank you for going through all the ups and downs together with me.

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ACKNOWLEDGEMENTS

Thank you very much to my supervisor, Dr. Anne Baird, for all of her support over the last years. This has been a very extensive project and without her help and guidance, I would not have been able to finish it. In addition, I thank my committee members Dr. Joseph Casey, Dr. Chris Abeare, Dr. Erika Kustra, and Dr. Nicole Anderson. Their support and feedback throughout all of the meetings have improved this project and have lessened the stress of being evaluated.

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LIST OF ABBREVIATIONS

ADHD = Attention Deficit Hyperactivity Disorder
ADL = Activity of Daily Living
ANOVA = Analysis of Variance
BADS = Behavioural Assessment of the Dysexecutive Syndrome
BRIEF-A = Behavior Rating Inventory of Executive Function – Adult Version
CFQ = Cognitive Failure Questionnaire
CPT-II = Continuous Performance Test – Second Edition
DEX = Dysexecutive Questionnaire
D-KEFS = Delis-Kaplan Executive Function System
DS = Digit Span
EF = Executive Function
EFSS = Executive Function Skill Score
EL = Errorless Learning
ETG = Early Training Group
fMRI = Functional Magnetic Resonance Imaging
GCQ = General Coping Questionnaire
GEC = Global Executive Composite
GM = Goal Management
GMT = Goal Management Training
GMTQ-S = Goal Management Training Questionnaire - Self
GPA = Grade Point Average
GPQ = Goal Processing Questionnaire
HSCL-25 = Hopkins Symptom Checklist 25
IQ = Intelligence Quotient
LNS = Letter Number Sequencing
LTG = Late Training Group
MMSE = Mini-Mental State Examination
MT = Memory Training
PMR = Progressive Muscle Relaxation
PST = Problem-Solving Therapy
RM ANOVA = Repeated Measure Analysis of Variance
RMAS = Robert Morris Attention Scale
RT = Reaction Time
SART = Sustained Attention to Respond Task
SCL-90 = Symptom-Check-List 90
SELF-A = Self-Efficacy for Learning Form – Abbreviated Version
SF-36 = Short-Form 36 health survey version 2
SRBAI = Self-Report Behavioural Automaticity Index
SRHI = Self-Report Habit Index
SRLT = Simulated Real Life Task
STEPS = Skills To Enhance Personal Success
WAIS-III = Wechsler Adult Intelligence Scale – Third Edition
WAIS-IV = Wechsler Adult Intelligence Scale – Fourth Edition
WISC-IV = Wechsler Intelligence Scale for Children – Fourth Edition

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CHAPTER 1

INTRODUCTION

Students in the academic field often struggle adjusting to the high expectations and self-directed learning that is necessary to succeed in university. Managing distractions and organizing one's thoughts and work are often described as particularly challenging. Such difficulties are present in many other populations, such as individuals who have sustained brain damage, or healthy older adults. Many cognitive interventions have been developed to address the concerns of these individuals, but because the difficulties experienced by undergraduate students are often considered to be less severe and to have less of an impact on their lives, there is a lack of research addressing the troubles of this population. In truth, student dropout rates at universities and colleges are an increasingly challenging concern. A 2007 survey conducted by Statistics Canada found that between 1999 and 2005, 15% of undergraduate students dropped out of a four-year degree program, and 9% were still working toward such a four-year degree after six years (Statistics Canada, 2007). In the United States, only 59% of full-time students who began their first four-year degree in 2006 graduated within six years (United States Department of Education, 2014). Several authors have voiced concern about dropout rates (for example, Allen, 1999; Hsieh, Sullivan, and Guerra, 2007), and underlined the importance of providing struggling students with effective interventions. The purpose of this study is to address the lack of research that currently exists in regards to successful interventions that meet the needs of undergraduate students.

Before outlining the current study in more detail, the relevant literature will be reviewed. The term executive functions (EFs),, the concept of self-efficacy, and more

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specifically academic self-efficacy, will be described, along with how academic self-efficacy relates to executive functioning. Previous research involving interventions to improve EFs, including Goal Management Training (GMT), will also be discussed. GMT, as the focus of the paper, will be described in more detail and several studies that have used and adapted this approach will be reviewed. The rationale for the present study will be outlined, as well as the specific hypotheses that were investigated.

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CHAPTER 2

REVIEW OF THE LITERATURE

Executive Functioning

Executive functioning has often been referred to as a particularly difficult area of functioning to operationally define (Barkley, 2012). That being said, however, a vast array of research over the past decades has made it possible to begin doing so. There is general consensus that EFs are necessary for a variety of more complex cognitive tasks, and thus are sometimes referred to as “higher-level” functions. Stuss (1992) noted several of those, including planning, making decisions, selecting goals, and monitoring one’s behaviour. Malloy, Cohen, and Jenkins (1998) listed six capabilities that describe EFs, namely, “1. Formulating goals with regard for long-term consequences. 2. Generating multiple response alternatives. 3. Choosing and initiating goal-directed behaviors. 4. Self-monitoring the adequacy and correctness of the behavior. 5. Correcting and modifying behaviors when conditions change. 6. Persisting in the face of distraction” (p. 567). Barkley (2012) cited a variety of EF definitions that have been offered in the literature. These definitions included functions such as working memory, inhibition, and self-monitoring (Robbins, 1996), and were described as necessary for “guiding, directing, and managing cognitive, emotional, and behavioural functions, particularly during active, novel problem-solving” (Gioia, Isquith, Guy, & Kenworthy, 2000, p.1). For a complete summary of these definitions, see Barkley (pp. 4-7). Although there still exists a debate regarding which cognitive processes exactly can be defined as EFs, certain components have often been agreed upon, namely inhibition, working memory, and strategic processing or planning (Connor & Maeir, 2011).

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Focal lesions to the frontal lobes often result in impairment of EFs. However, it is more appropriate to conceptualize the cognitive processes of the frontal lobes as integrative and interactive. Furthermore, it may be more appropriate to describe those cognitive processes as psychological constructs instead of separable systems that can be specifically localized in the brain (Stuss, 1992).

Miyake et al. (2000) studied EFs in more depth to determine the contributions of switching, monitoring, and inhibiting in complex EF tasks. They asked 137 undergraduate students to perform a variety of tasks that were hypothesized to require EFs for successful performance, as well as several tasks that specifically targeted switching, monitoring, and inhibiting skills. The authors first conducted a confirmatory factor analysis on those EF tasks, and indeed found that the EF constructs mentioned above were distinguishable. For example, scores on an Antisaccade task, Stop-Signal task, and Stroop task all related to a factor associated with inhibition capabilities. Following this, the authors examined several structural equation models to determine whether participants' performances on the selected complex executive tasks (including the Tower of Hanoi Test and the Wisconsin Card Sorting Test) were related to their performances on the tasks representing the separate EF capabilities. Their results indicated not only that these specific EF skills are moderately associated with each other, but also that certain EF skills were utilized more than others on different tasks. For example, successful performance on the Tower of Hanoi Test was most strongly related to one's inhibition capabilities, whereas successful performance on the Wisconsin Card Sorting Test was most strongly related to one's switching capabilities. These results further serve to illustrate the complexity of EFs (Miyake et al., 2000).

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Self-Efficacy

In addition to the EFs just listed, self-efficacy, especially academic self-efficacy, was a focus of this study. Self-efficacy has been extensively studied in the past. Bandura (1997) defines this concept as the "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). According to him, self-efficacy plays a role in one's functioning as it affects cognitive processes. That is, one's self-efficacy beliefs affect an individual's thought patterns (Bandura, 1997), as well as how one interprets situations, visualizes one's future, and anticipates outcomes in different scenarios (Krueger & Dickson, 1994). These thought patterns in turn either have a positive or negative influence on performance. Individuals with a high sense of self-efficacy are more future-oriented when organizing their lives (Bandura & Wood, 1989), are more likely to interpret situations as attainable possibilities, and to visualize success. These tendencies that individuals with high self-efficacy beliefs show positively affect their performance (Krueger & Dickson, 1994). One's self-efficacy also plays an important role in setting goals, as higher self-efficacy is related to making more challenging goals and having a stronger commitment to them. Higher self-efficacy beliefs further raise one's motivation and attainment of these goals (Bandura & Wood, 1989). In contrast, individuals with low self-efficacy beliefs are more likely to interpret situations in a more negative way, visualize failure more often, and interpret situations as riskier. It is important to note that, while self-efficacy beliefs influence one's cognitive processes, the same applies to the influence of one's cognitive processes on self-efficacy beliefs. For example, visualizing successful performance enhances one's self-efficacy (Krueger & Dickson, 1994).

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Self-efficacy has been described as a cognitive, and thus changeable, concept (Devonport & Lane, 2006). One's perception of the demands of a particular task and one's ability to manage these demands influence one's self-efficacy beliefs. According to Devonport and Lane (2006), taking the individual's cognitive appraisal of a stressor into account is important when trying to increase their self-efficacy. This cognitive appraisal refers to an individual's evaluation of the relevancy of the stressor to their lives. It involves the primary appraisal process during which the individual assesses whether or not a stressor could potentially affect their well-being. Next, it involves the secondary appraisal process during which the individual assesses the coping strategies available to meet the demands of the stressor (Lazarus, 1991). Coping strategies vary, but their functions are thought to fall into one of two categories: either emotion-focused coping functions (for example, positive reframing) or problem-focused coping functions (for example, planning strategies; Lazarus, 1999).

Devonport and Lane (2006) investigated the relationship between coping strategies and self-efficacy in the academic field, and how these concepts relate to student retention. In their study, 131 first year undergraduate students enrolled in a sports degree were asked to fill out a measure of self-efficacy that was specifically designed to address concerns about passing the first year in their degree, as well as a coping measure. In addition, retention data was gathered at the end of the academic year. Their results indicated that active coping strategies, such as planning, time-management, and social support, were linked to higher self-efficacy. For example, planning was associated with student's self-efficacy related to their time-management skills, skills during lectures, as well as communication skills. Devonport and Lane suggested that planning helps

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individuals with their goal management (for example, setting subgoals to achieve a greater goal), which should increase their achievement of subgoals, which in turn will affect the students' self-efficacy. Furthermore, their results indicated that 81.3% of students who dropped out of their program were successfully identified using the self-efficacy measure. The authors concluded that "self-efficacy measures may be used to identify students at risk of failure and/or dropout. Once identified, interventions could be implemented which are designed to develop and habitualize active-coping strategies" (p.137).

Wiedenfeld et al. (1990) looked at whether self-efficacy beliefs can be positively altered. More specifically, they studied intervention effects on self-efficacy while studying the influence of personality factors on a person's health. They pointed out that stress is an important factor in many health problems, and that the ability to control or alter one's self-efficacy to cope with stressors influences one's physical reactions to them. In their study, they attempted to increase the perceived self-efficacy of 20 participants with severe snake phobias through two two-hour sessions that included modeling of effective coping strategies, as well as guided mastery exercises. Their results indicated a significant increase in perceived self-efficacy in ability to cope with the snake after each of the sessions, as well as between the first and second session. They further indicated that the increase in perceived self-efficacy was significantly related to an enhanced effect on the individuals' immunological functioning, namely an increase in lymphocytes, T lymphocytes, helper T cells, regulatory T cells, as well as HLA-DR, which is an important receptor in the antibody production process.

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Overall, research has demonstrated the importance of self-efficacy beliefs in several areas of one's life. As the population of this study consisted of undergraduate students, the concept of self-efficacy for academic capabilities was of further interest and is described in more detail below.

Academic Self-Efficacy in Students

Academic self-efficacy is a concept that refers to students' perceived capability to succeed on a certain task in the academic field (Schunk & Pajares, 2002). It has been described as essential for successful learning (Zimmerman, 2000). It is positively related to academic achievement (for example, Wood & Locke, 1987) and to a multitude of factors that play a role in students' achievement. More specifically, it has been noted that the beliefs about one's capabilities cause individuals to raise the goals that they set for themselves, their motivation to do well, and their performance level, effort, and task persistence (Pajares, 1996; Wood & Locke, 1987). Additionally, these beliefs decrease students' stress reactions (Pajares, 1996; Wood & Locke, 1987). Past researchers have reported positive relationships between students' academic self-efficacy and their performance in the domains of math, reading, and overall college achievement (e.g. Gore, 2006; Zajacova, Lynch, & Espenshade, 2005). Additionally, academic self-efficacy is known to directly affect students' levels of skill (Pajares, 1996).

Zimmerman, Bandura, and Martinez-Pons (1992) studied the effects of academic self-efficacy, as well as parental and self-set grade goals, on academic achievement. Participants were 102 grade nine and ten students in a social studies course. In particular, the authors chose the Self-Efficacy Scale for Self Regulated Learning and Self-Efficacy for Academic Achievement Scale of the Children's Multidimensional Self-Efficacy

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Scales. A path analysis indicated a significant causal link between students' self-efficacy for self-regulated learning and self-efficacy for academic achievement. Interestingly, the latter was significant in predicting their self-set grade goal and their final grade in the social studies course. In conclusion, the students' self-efficacy for academic achievement combined with their self-set grade goals predicted 31% of the variance in their final grades. Zimmerman et al. (1992) also looked at the relationship between students' prior grades and final grades, which was not significant. They concluded that "self-regulatory factors not only mediated the influence of prior achievement, but also contributed independently to students' academic achievement" (p. 672).

Hsieh et al. (2007) reported that academic self-efficacy, as well as goal orientation, are important factors in predicting students' academic achievement, as well as their likelihood of dropping out. In this study, the authors investigated the relationship between academic self-efficacy and goal orientation in high-achieving (GPA > 2.0) and low-achieving (GPA < 2.0) students. Results showed that high-achieving students utilized mastery goals (which are focused on learning a certain task or content and eventually mastering it) significantly more often than performance goals (which are focused on one's performance in relation to that of others) or avoidance goals (which are focused on preventing others from noticing their inabilities). In addition, high-achieving students had significantly higher academic self-efficacy compared to low-achieving students. When the types of goals among students with high academic self-efficacy were examined more closely, it was found that low-achieving students adopted significantly more performance goals than high-achieving students.

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A similar study was conducted by Pintrich (2000), who investigated the relation between academic self-efficacy and student goals. He differentiated between mastery goals and performance goals, and found that there was a significant association between the type of goals students adopted and outcomes. More specifically, mastery goals were linked to adaptive outcomes, including “higher levels of efficacy, task value, interest, positive affect, effort and persistence, the use of more cognitive (including rehearsal, elaboration, and organization) and metacognitive strategies, as well as better performance” (Pintrich, 2000, p. 544), whereas performance goals were associated with less exhibition of these adaptive outcomes. Although Pintrich (2000) points out that setting performance goals in addition to mastery goals resulted in comparable adaptive outcomes, performance goals alone did not significantly contribute to these outcomes.

O’Sullivan (2011) investigated the role of undergraduate students’ hope, eustress, and academic self-efficacy in predicting their overall life-satisfaction. She created a scale to measure levels of eustress in undergraduate students. *Eustress* can be defined as an individual’s positive reactions to and appraisal of stress. For this study, 118 college students were asked to complete self-rating measures of their levels of hope (Trait Hope Scale), eustress (original scale), academic self-efficacy (modified version of Bandura’s 2006 scale), life-satisfaction (The Satisfaction With Life Scale), and stress (modified version of the Perceived Stress Scale). Results indicated that there was a significant positive correlation between eustress, academic self-efficacy, and hope. These variables together accounted for 22.1% of the variance in undergraduate students’ life-satisfaction, with hope being the most significant predictor. Not surprisingly, results showed that stress was negatively correlated with each of these variables, as well as life-satisfaction.

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The significant positive correlation between students' academic self-efficacy and eustress, as well as between academic self-efficacy and hope, is an important area of investigation. That is, the effects of teaching undergraduate students strategies that ultimately increase their academic self-efficacy may generalize to their levels of hope and eustress, and thereby increase life-satisfaction.

Most past research has focused on the relations between academic self-efficacy and achievement or cognitive strategy use (for example, Krueger & Dickson; Multon, Brown, & Lent, 1991). This research indicates that there is a strong positive relation between the two constructs. Academic self-efficacy has also been hypothesized to have a positive effect on numerous factors in one's life; for example, "choice of activities, effort expended, persistence, and task accomplishments" (Schunk & Cox, 1986, p. 201). As there is an abundance of research that indicates positive outcomes of academic self-efficacy, it has been described as an important influence on motivation and achievement in the academic field (Multon et al., 1991). However, not many studies have examined effects of educating and training participants about cognitive strategies on self-efficacy beliefs. Although there is some evidence in the literature suggesting that academic self-efficacy can be altered (Wiedenfeld et al., 1990), more research is needed in this area. The present study was designed to address this, as it examined the influence of an EF intervention on academic self-efficacy, as well as the association between this construct and EFs.

Academic Self-Efficacy and Executive Functions

Higher academic self-efficacy in students is suggested to have a positive influence on level of cognitive processing, cognitive engagement, task persistence and initiation, as

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well as self-regulatory strategies (Pintrich, 2000). Having higher academic self-efficacy is also related to a greater likelihood of utilization of certain self-regulating mechanisms. Such mechanisms include goal setting, self-evaluation, and self-monitoring (Zimmerman, 2000). It has been suggested that academic self-efficacy is indirectly linked to higher achievement in academic institutions since it influences one's learning strategies, effort regulation, and goal setting.

Overall, the literature suggests that there is a strong link between effective cognitive strategy use, related to EFs, and academic self-efficacy. That is, individuals with higher academic self-efficacy are more successful in using cognitive strategies, such as setting goals (for example, Bandura & Wood, 1989; Pintrich, 2000) or visualization of success (for example, Krueger & Dickson, 1994). Further, the literature shows that introducing and teaching individuals certain cognitive strategies has a positive effect on their academic self-efficacy (Wiedenfeld et al., 1990). This study utilized an intervention that has been implemented to increase EFs in a variety of populations. As such, based on earlier studies, this cognitive intervention was hypothesized to not only increase participants' EF skills, but also increase their academic self-efficacy.

Interventions for Executive Functions

In recent years, there has been an increased focus on intervention strategies that target difficulties with EFs (for example, Cuevas et al., 2014; Gioia, Isquith, Kenworthy, & Barton, 2002; Kennedy et al., 2008; Strobach, Salminen, Karbach, & Schubert, 2014). Four approaches emerge as the most common (Miotto, Evans, Souza de Lucia, & Scaff, 2009). Strategy one involves retraining the specific EFs that participants are often lacking through education and practice (e.g., von Cramon, Matthes-von Cramon, & Mai,

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1991). In strategy two, the focus is on finding ways to compensate for the participants' EF difficulties through internal and external strategies that will alleviate their difficulties, such as using post-it notes or pictures to remember certain things (for example, Toglia et al., 2011). For strategy three, researchers promote the implementation of modifications in individuals' environment and behaviour by involving family members and friends in the intervention (for example, Ylvisaker et al., 2001). Lastly, strategy four involves medication affecting dopaminergic systems in the brain, such as stimulants and neuroleptics (Hosenbocus & Chahal, 2012). For example, methylphenidate and dextroamphetamine often have been linked with improved EF in children with ADHD (Hosenbocus & Chahal, 2012). All the intervention studies described in the following sections of this paper are examples of strategy one as these interventions aim to restore and retrain the EFs of the participants.

Von Cramon et al. (1991) set out to investigate an intervention designed to improve participants' problem-solving skills, specifically in terms of "problem orientation," "problem definition and formulation," "generating alternatives," decision-making," and "solution verification" (pp. 52-53). For this, they compared the different effects of problem-solving therapy (PST) and memory training (MT) in 37 individuals with brain injuries (20 participants in the PST group and 17 participants in the MT group). Both interventions consisted of 25 sessions that spanned six weeks. Participants in the PST group were taught strategies that were hypothesized to help them solve problems more efficiently. They completed exercises that focused on diminishing the complexity of a problem, as well as using a step-by-step process when solving it. Participants were evaluated on a planning test, a general intelligence test, the Tower of

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Hanoi test, and a problem-solving rating before and after the intervention. The results indicated that there was a significant improvement in the PST group on most measures at the post-assessment. More specifically, improvements in this group were noted on several subtests of the general intelligence test (including inductive reasoning, categorizing, and similarities), as well as the planning test, Tower of Hanoi test, and several aspects of the problem-solving rating (including "awareness of (cognitive) deficits," "goal-directed ideas," "problem-solving ability," and "action style"; p. 58). In addition, the PST group performed significantly better than the MT group on the planning tasks during the post-assessment. However, von Cramon et al. noted that the positive effects on the problem-solving skills found in the PST group did not generalize to their everyday functioning.

Another study that investigated the effectiveness of an EF intervention to increase participants' self-monitoring and time-management skills was conducted by Manly, Hawkins, Evans, Woldt, & Robertson (2002). Here, the experimental group consisted of ten individuals with a brain injury and EF difficulties who were matched on age, gender, and IQ to a control group of individuals who did not suffer a brain injury. Participants were asked to complete the Hotel Task, which consists of six subtasks that a hotel employee may face (for example, compiling bills, finding telephone numbers, and opening/closing the garage door). They were told that they would be given insufficient time to complete all of these tasks (15 minutes), but that all tasks were equally important. Then they were instructed to complete as much of each task as they could in the given time frame. To succeed on this task, participants needed to be able to multitask while keeping their main goal (that is, to attempt all tasks) and subgoals (for example, opening

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the garage door at a specific time) in mind, as well as to monitor themselves. The participants in the experimental group completed this task twice, once with and once without an auditory cue. On the other hand, the participants in the control group completed the task twice but without an auditory cue in both trials. The purpose of the auditory cue was to re-direct the participants' attention to the task at hand, which was to allocate some time to each task. The results showed that the experimental group significantly improved their performance when provided with the auditory cue. Furthermore, it was found that the experimental group did not differ significantly in their performance from the control group when the auditory cue was provided.

Goal management training. The intervention that has received the most attention is GMT. Goal management (GM) is defined as "maintaining intentions in goal-directive behavior" (Levine et al., 2000, p. 299). GMT is an EF intervention that is based on Duncan's (1986) *theory of goal neglect*. This theory proposes that lists of goals and subgoals are essential for the organization of one's behaviour. GMT is a metacognitive intervention that has been developed to encourage mindfulness and cognitive control in individuals with EF difficulties by addressing weaknesses in planning, formulating strategies, and self-monitoring when attempting to reach a certain goal (Krasny-Pacini, Chevingard, & Evans, 2014; Levine et al., 2000). Individuals with EF difficulties often struggle to complete a task as they become distracted or veer away from their goal before the desired outcome is attained. Troubles and annoyances faced by individuals with these difficulties can range in frequency from occasional to daily. A goal list is an important aspect of GMT as it is thought to impose structure and consistency on one's thoughts and behaviour, and thus facilitate one's progress towards a goal (Duncan, Emslie, Williams,

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Johnson, & Freer, 1996). According to Levine et al. (2000), GM is a higher-level process. Levine et al. (2011) provided a comprehensive summary of the purpose of GMT, which is "to promote a mindful approach to problem-solving by raising awareness of attentional lapses and reinstating cognitive control when behavior is mismatched to the ongoing goal hierarchy" (p. 6).

GMT was described by Robertson in 1996 (as cited in Levine et al., 2000) and later adapted by Levine et al. (2000). It keeps individuals moving toward outcome goals by using a five-stage sequence as a guide. The first of these stages is orientation, in which individuals are trained to identify their current state and maintain focus on a relevant task. To do this successfully, individuals need to suspend their current activity and direct their attention to the situation at hand and their specific goal. Individuals often use a catchphrase that facilitates this process (for example, "STOP"). In the second stage, individuals are asked to select goals that will ensure that the desired outcome is reached, while in the third stage individuals divide their goals into subgoals to minimize the complexity. Encoding and retention of goals and subgoals is the focus of stage four. Lastly, stage five asks individuals to consider the outcome and whether or not their goals have been accomplished. If the intended results have not been obtained, the GMT process should be repeated and adjusted as necessary.

Goal management training with brain injured individuals. Many studies to this date that looked at GMT interventions have been conducted with individuals who have sustained a brain injury. Levine et al. (2000) were the first authors to do so as they described the use of GMT to enhance participants' GM skills in two studies. In the first study, 30 participants with traumatic brain injuries were randomly grouped receiving one

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hour of either GMT ($N = 15$) or Motor Skills Training ($N = 15$). Both groups completed an everyday paper-and-pencil measure (consisting of three separate tasks) designed to assess EFs before and after the training was given. These tasks were designed to have participants hold goals in mind, utilize subgoal analysis, and monitor themselves. More specifically, the first task given (proofreading task) required the participants to analyze a paragraph and either circle, underline, or cross out words according to criteria provided. The instructions for this task were only available for 60 seconds. On the second task (grouping task), the instructions outlining criteria for grouping 46 individuals by age and gender were also only available to participants for 60 seconds. These individuals' age and gender were provided as "25M" for example. More specifically, participants were asked to assign a number based on age (number 1 for individuals age 30 or under, and number 2 for individuals over age 30), place a checkmark based on gender (next to every female), and circle individuals based on age (all individuals age 65 or over). The third and final task (room layout task) involved a 5x5 grid on which rows and columns were assigned numbers 1 to 5 while each individual block within the grid was assigned a letter ranging from A to E. The grid was used to answer five questions that varied in degree of difficulty. The results of this study suggested that GMT was successful in improving EFs. That is, participants in the GMT group performed overall significantly better on the post-assessment than participants in the Motor Skills Training group did. More specifically, there was a significant decrease in GMT participants' error rates on the proofreading and grouping tasks. As mentioned before, to successfully complete these tasks, participants needed to hold their goals and subgoals in mind, and monitor their performance. It was noted that participants in the GMT group performed more slowly

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than before the intervention. This finding was hypothesized to be due to a more careful and attentive approach to the tasks after GMT (Levine et al., 2000).

The second study reported in Levine et al. (2000) was a case study of a post-encephalitic patient. The aim of this study was to utilize GMT to address a specific day-to-day skill with which the individual struggled (that is, to teach the individual to prepare her own meals). The individual received five sessions of GMT. The first two sessions included the five stages of GM and the last three sessions specifically focused on the application of GMT principles in meal preparation. The effect of this intervention was assessed through paper-and-pencil tasks identical to those used in the first study and observation of problematic behaviours during meal preparation, which included "failure to assemble the necessary ingredients, misinterpretation of written instructions (e.g., focusing on irrelevant details), repeated checking of instructions, and sequencing-omission errors" (Levine et al., p. 306). There was a general improvement in this individual's performance on the paper-and-pencil tasks, as well as a significant reduction in problematic behaviours when engaging in the meal preparation task after the GMT. Furthermore, the results of the meal preparation task remained significant at follow-up assessments one, three, and six months after the intervention. These results suggested that goal-management skills can be transferred to real-life situations.

These two studies conducted by Levine et al. (2000) not only marked the beginning of GMT research, but also supported the effectiveness of GMT across a range of formats varying in length of intervention and number of sessions. Two studies similar to these were conducted by Fish et al. (2007), who looked at the effectiveness of a single

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GMT session when combined with electronic reminders via text messages, and Schweizer et al. (2008), who completed another case study using GMT.

In the study by Fish et al. (2007), 20 participants with brain injuries were assessed on a prospective memory telephone task. For this, participants had to call a voice message system four times per day during specified times for one week. Then participants completed one 30-minute session of GMT that included a description of prospective memory, as well as the concepts of absent-mindedness and the "mental blackboard" (Fish et al., p. 1323; also described in Levine, Manly, & Robertson, 2012a). Following this, participants again engaged in the telephone task for two-weeks. During these two weeks, participants received eight text-messages per day for half of those days. The text-message simply stated "STOP", which was an acronym for "Stop, Think, Organize and Plan" (p. 1323). The results of this study showed a significant improvement in the participants' completion of the prospective memory telephone task on days on which they received the "STOP" cue.

Schweizer et al. (2008) utilized GMT with a 41-year old male with isolated right cerebellar hemorrhage and executive dysfunction. They stated that the neural connections between the cerebellum and the frontal cortex, as well as cerebellar activity during tasks that require EFs, are likely the reason for clinical reports of EF difficulties in patients with cerebellar lesions. EFs and attention have been described as a cognitive domain in which individuals with cerebellar lesions often have difficulties, including planning and response switching. The intervention consisted of seven two-hour sessions that occurred weekly. Several questionnaires and measures of EF and attention were utilized to establish the value of the intervention, including the Revised-Strategy

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Application Test, Hotel Task, the Sustained Attention to Respond Task (SART), Tower Test (Delis-Kaplan Executive Function System; D-KEFS), DEX (Dysexecutive Questionnaire, self and informant forms), and CFQ (Cognitive Failure Questionnaire). A ceiling effect was present during the pre-assessment on the Revised-Strategy Application Test and the Hotel Task. The results on Tower Test and the SART indicated a general improvement after the intervention and the patient maintained his gains at four months follow up. In addition, the scores on the DEX-informant form showed less EF difficulties after the intervention and no EF difficulties at follow-up.

In 2011, research teams headed by Levine (Levine et al.) and by Chen and Novakovic-Agopian (Chen, Novakovic-Agopian et al., and Novakovic-Agopian, Chen et al.) designed studies that looked at the effect of GMT and educational interventions in brain-injured individuals. In Levine et al.'s (2011) study, 19 individuals were randomly assigned to either a GMT group (*N* = 11) or a matched control group (*N* = 8). Interventions were structured as seven weekly two-hour sessions. The intervention used in the control group included an educational component on brain injuries and the impact on cognitive functioning, as well as "lifestyle interventions" (p. 3) commonly provided by rehabilitation facilities. The lifestyle interventions addressed everyday topics such as exercise, nutrition, and sleep. Both interventions involved in-group exercises and weekly homework assignments. A detailed overview of the contents of each session for both groups can be found in Levine et al.

Participants were assessed on several tests of EF and attention and were given several questionnaires (Levine et al., 2011). More specifically, the SART, D-KEFS Tower Test, and the Hotel Task were used as standardized performance measures, and

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the DEX, CFQ, and a questionnaire designed by the researchers were questionnaires used to assess EF difficulties in everyday life. Although the results showed that GMT was successful in reducing participants' EF difficulties as measured on the performance tests, no significant change was found on the self-report questionnaires. It is important to note that the sample was quite heterogeneous, which, given its small size, may have affected the findings of this study. In addition, the authors noted that the failure to obtain significant changes in the self-report data may also be due to an increase in the participants' insight into their levels of difficulty following the intervention. At a four-month follow-up, these changes largely remained.

Chen and Novakovik-Agopian and colleagues recruited 16 individuals who had sustained a brain injury to study the effects of rehabilitation of attention and executive control and issued two major reports of the results with different emphases (Chen et al., 2011; Novakovik-Agopian et al., 2011). Novakovic-Agopian et al. expand on results from an extensive neuropsychological and functional battery, while Chen et al. focus mostly on the functional magnetic resonance imaging (fMRI) and associated cognitive task results acquired from 12 of the 16 participants. The research team randomly assigned 8 participants first to receive "goal-oriented attentional self-regulation training" (Novakovic-Agopian et al., 2011, p. 325) and then a psychoeducational program (the *goal-edu* group) and the other 8 to receive the psychoeducational program first and subsequently the self-regulation training (the *edu-goal* group). The first intervention occurred in Weeks 1 through 5 and the second in Weeks 6 through 10. In the self-regulation intervention, over 5 weeks participants completed 10 two-hour group training sessions, 3 one-hour individual sessions, and 20 hours of practice at home. This self-

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regulation training intervention was based on GMT and on Problem Solving Therapy and consisted of mindfulness-based instruction and practice and goal-management strategies applied to the participants' self-defined goals. In the psychoeducational intervention, during a 5-week period participants received one two-hour session of group instruction about brain injury and relevant resources. As explained in Chen et al. and Novakovic-Agopian et al., neuropsychological and functional assessment and fMRI (the latter only for the 12 participants who consented to it) occurred three times: before the first intervention, after the first intervention (Week 5), and after the second intervention (Week 10). Alternate form or norms for repeated administration were used when available (Chen et al.; Novokovic-Agopian et al.).

The neuropsychological battery given on all three occasions assessed three domains commonly affected by TBI: attention and EF, memory, and psychomotor speed and reaction time (Chen et al., 2011; Novakovic-Agopian et al., 2011). The authors hypothesized that the self-regulation intervention directly would affect performance in the attention and EF domain and indirectly might affect performance in the memory domain, but they expected no impact in the psychomotor speed and reaction time domain (Chen et al.; Novakovic-Agopian et al.). Domain and subdomain scores were calculated by averaging *z* scores. The attention and EF domain score was based on the Auditory Consonant Trigrams Test, the WAIS-III Letter Number Sequencing subtest (LNS), the Digit Vigilance Test, the Color-Word Interference Test – Inhibition and Inhibition/Switching (D-KEFS), the Trails B test, the Design Fluency Switching (D-KEFS) test, and the Verbal Fluency Switching (D-KEFS) test. Subdomain scores were calculated for mental flexibility, sustained attention, working memory, and inhibition of

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automatic responding. The memory domain (with learning and delayed recall subdomains) included scores from the Hopkins Verbal Learning Test-Revised and the Brief Visual Memory Test-Revised, and the processing speed domain included scores from the Trails A test and a Visual Attention Task Overall RT (Novokovic-Agopian et al.).

At the 5-week assessment the 8 participants who had received self-regulation training showed marked improvement over baseline in the attention and EF domain and all subdomains. Participants who only had completed the psychoeducational training at that point had no more than minimal change (Novokovic-Agopian). Changes in the memory domain and subdomains were greater for the group who had received self-regulation training. Participants who had received self-regulation training by 5 weeks did not differ on processing speed from those who had received only the psychoeducational intervention by that time.

At 10 weeks, the group who had crossed over from the psychoeducational to the self-regulation training showed significant gains on the attention and EF and the memory domain scores, as well as on all subdomain scores for both domains (Novakovic-Agopian et al., 2011). Processing speed scores did not change from 5 to 10 weeks. The group who completed self-regulation training in the first 5 weeks of the study maintained scores over weeks 5 to 10 and showed a boost in scores at 10 weeks on the attention and EF domain and on one subdomain (Novakovic-Agopian et al.). A separate analysis of neuropsychological results for the subset of 12 participants who completed neuroimaging yielded generally consistent results, as would be expected (Chen et al., 2011).

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In order to increase ecological validity and to gain a better understanding of the participants' performance in real-life situations, the researchers administered a functional measure (the Multiple Errands Task) and a self-report questionnaire (the Goal Processing Questionnaire [GPQ]; Novakovic-Agopian et al., 2011). Although the trend did not reach statistical significance, participants tended to make fewer errors on the Multiple Errands Task after self-regulation training, whether that training occurred in the first or last 5 weeks of the study. Responses to the self-report questionnaire indicated that participants experienced better EF in daily life after self-regulation training (Novokovic-Agopian et al.).

The researchers designed the fMRI aspect of this study to assess the hypothesis that neuroimaging of participants after the self-regulating training would show a more coherent pattern in the dorsolateral prefrontal and in extrastriate regions when participants were focusing on task-relevant stimuli (Chen et al., 2011). In other words, after self-regulation training based on goal management and problem solving, the researchers expected that the modulation or attunement of brain activation in these regions would increase. As in the studies of neuropsychological performance, the researchers compared changes both within and across participants at baseline, five weeks, and ten weeks. The prefrontal region was targeted for study because of evidence indicating this area is involved in attention control; the extrastriate region was chosen because the task participants performed during imaging required attention to visual stimuli. The task was a selective attention 1-back task in which participants saw 10 images of faces and 10 of scenes in a pseudorandom order. In one condition participants were asked to hold in mind images of scenes and press a button when a new scene

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appeared to indicate whether that scene matched or did not match the last scene shown. In the other condition participants performed the same task but attended to faces rather than scenes. There were five blocks of 20 stimuli for each condition on each of the three occasions of neuroimaging. The researchers intended the cognitive task to simulate real-world situations in which people must process an ongoing barrage of stimuli, some goal relevant and some not. As they expected, the researchers did not find a significant difference in accuracy of matches on the cognitive task following the psychoeducational versus the self-regulation intervention. In preliminary processing, the researchers mapped the dorsolateral prefrontal and extrastriate regions in each of the 12 participants who underwent neuroimaging (Chen et al.).

To look at modulation of brain activity, the researchers input patterns of fMRI responses for trials in four of the five blocks for each condition (the training blocks) into a pattern classification program (Chen et al., 2011). The program output was a typical pattern of neural activity for each individual participant for each of the stimulus categories, that is, scenes and faces, for each task condition. In the remaining fifth block (the test block) for each condition, the similarity of the participant's neural activity on a given trial to the activity for the relevant category on the training blocks was calculated. The similarity of the participant's neural activity on a given trial of the test block to brain activation in response to stimuli in the irrelevant category in the training blocks also was calculated. The discrepancy between these two similarity values for any trial was calculated and referred to as a *certainty value* (Chen et al., p. 1546). The difference between certainty values on trials involving the relevant category and the certainty values on trials involving the irrelevant category also was calculated and labeled as the *relevant*

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to non-relevant differential (Chen et al., p. 1547). The larger this differential the more attuned or modulated the neural response was presumed to be to whether a given stimulus was relevant or irrelevant to the task at that time. Hence the relevant to non-relevant differential score on each neuroimaging occasion served as the main indicator of neural modulation with a larger differential in the positive direction indicating a greater relative deployment of attention to relevant versus irrelevant stimuli, hence, greater selectivity in attention (Chen et al.).

For the extrastriate region, the researchers concluded that there was evidence that most participants showed gains in the differential score in a positive direction after self-regulation training (Chen et al., 2011). On average, increases in the differential score in a positive direction were significantly greater after the self-regulation intervention than after the psychoeducation intervention. Thus, there was support for the hypothesis that fMRI results would indicate greater attunement of brain activity to task or goal relevant dimensions after self-regulation training (Chen et al.).

For the dorsolateral prefrontal region, there was no clear support for the hypothesis of greater modulation after self-regulation training as indexed by a larger relevant to non-relevant differential in the positive direction (Chen et al., 2011). Overall, the self-regulation intervention did not result in gains in differential scores larger than seen following the psychoeducation intervention. Following the self-regulation training, unexpected individual variability was seen. This variability was noted only following self-regulation training and was associated with a given participant's differential score on neuroimaging before the self-regulation intervention. Lower differential scores on neuroimaging before self-regulation training predicted larger gains in a positive direction

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after the intervention, while higher differential scores pre-intervention were associated with bigger changes in a negative direction. The researchers noted that these results are consistent with the idea that there are individual differences in the changes in brain activity that support improvement in attention and that an individual's status before intervention has an effect on the changes seen after intervention (Chen et al.).

Bertens, Kessels, Fiorenzato, Boelen, and Fasotti (2015) were also interested in GMT as a cognitive intervention for brain-injured individuals with EF difficulties and sought to optimize this approach by adding an errorless learning (EL) component. EL is an approach in which participants learn new tasks while errors are prevented. Bertens et al. noted that, due to the nature of EFs, the capacity of individuals with EF difficulties to learn and execute new tasks while also monitoring and correcting errors may be more limited when compared to individuals with no EF difficulties. Sixty brain-injured individuals with EF difficulties were randomly assigned to either a GMT and EL group (GMT-EL) or a standard GMT group. Each group received eight one-hour sessions of GMT over four weeks. The GMT-EL group was actively guided by the trainer to avoid errors, whereas the training of the GMT only group was based on the regular trial-and-error approach. Everyday task performance and goal attainment scaling for two goals (set by the participants at the second GMT session) were significantly higher in the GMT-EL group than in the GMT only group. The authors concluded that the avoidance of errors during GMT adds to the beneficial effect of this intervention.

All of these GMT studies mentioned so far focused on the alleviation of EF difficulties in individuals who had sustained a brain injury. Various sample sizes, research designs, and adaptations of GMT sessions were investigated and generally

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showed significant improvements on a variety of EF measures. While these studies demonstrated the suitability of GMT in these populations, other researchers set out to investigate the effectiveness of GMT in other populations of people who also struggle with EF skills. Healthy older adults, for example, have been included in GMT studies conducted by Levine et al. (2007) and van Hooren et al. (2007).

Goal management training with other populations. Levine et al. (2007) investigated the effectiveness of a modified version of GMT in a study in which 46 healthy older adults were recruited. Participants were divided into an Early Training Group (ETG, $N = 26$), that began the program immediately after the pre-training assessment, and a Late Training Group (LTG, $N = 20$), that began the program three months later. The intervention was divided into three components that each lasted four weeks, namely GMT, memory training, and psychosocial training. The sessions occurred weekly for three hours each, resulting in 12 sessions in total. Additionally, each participant discussed personal goals and concerns with the trainer individually on three occasions. Each session included in-class exercises and homework assignments. To measure the effectiveness of their intervention, Levine et al. (2007) developed *Simulated Real Life Tasks* (SRLTs) that consisted of paper-and-pencil tasks. These tasks included a main goal as well as several subgoals, and focused on problems that may be particularly difficult for individuals with EF difficulties, such as setting up a carpool schedule. More specifically, these were tasks that included planning, problem-solving, and self-monitoring capabilities. Participants' performance on these tasks was given an overall score and specifically rated on the following variables: "orientation, task strategy, engagement, and checking/error correction" (Levine et al., p. 146). In addition,

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participants filled out the DEX to measure their subjective experience with their EF difficulties. Participants in the ETG were assessed before and after their training, as well as at follow-up six months after their training ended. Participants in the LTG were assessed on two occasions before the training (once at the same time as the ETG pre-training assessment, and once before their own training) and at follow-up six months after their training. Due to technical reasons, no assessment of SRLTs was performed in the LTG immediately after their training. Levine et al.'s results showed that the intervention was successful in improving participants' performance on the SRLTs. That is, overall performance of the ETG significantly improved from the pre-training to post-training assessment, specifically in terms of task strategy, checking, and engagement behaviours. Furthermore, the ETG sustained the improvements in task strategy and checking behaviours at the follow-up assessment. Performance of the LTG did not significantly change between the two pre-training assessments, but significantly improved after they received the intervention in terms of overall score, and specifically in checking behaviour. Analysis of the DEX scores indicated that neither group showed significant changes immediately after the intervention. That being said, however, significantly lower scores were obtained in both groups at the follow-up assessment. Levine et al. hypothesized that this delay might reflect a longer period of time needed for real-life changes to become established.

Van Hooren et al. (2007) investigated the utility of another adapted version of GMT in a study of 69 healthy older adults. Participants were randomly assigned to either a GMT group, who received an intervention, or a wait list control group, who did not receive an intervention and had no contact with the researchers. The GMT involved a

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combination of GMT and psychoeducation, which focused on teaching participants about cognitive functions and how these functions relate to everyday behaviour and problems. Up to seven individuals were included in each GMT group. These participants were seen twice per week for 60 to 90 minutes, for a total of 12 times. The groups were structured to be interactive in that participants were encouraged to share their struggles with EFs and the emotional implications of their struggles. Homework assignments were given and reviewed each week. Both groups were assessed twice before the GMT group received the training in order to reduce practice effects, once immediately after the GMT group received the training, and once at a seven-week follow-up. Van Hooren et al. administered several measures to both groups, including the Stroop Colour Word Test to measure inhibition capabilities, four subtests of the Groningen Intelligence Test that were used as an IQ estimate, and the Mini-Mental State Examination. Questionnaires administered included the CFQ, the Symptom-Check-List 90 (SCL-90), a questionnaire initially designed by Jolles et al. (1995, as cited by van Hooren et al., 2007) to assess annoyance and worry related to EF difficulties, and a questionnaire designed to assess the ability to manage EF difficulties in everyday life. The results showed that after receiving the training, participants in the GMT group reported less annoyance with, and better management of their EF difficulties, as well as improvements in their ability to make and follow a plan, less distractibility, and better ability to evaluate the demands of a specific task than the control group. No significant changes in standardized measures were observed - a finding that may be explained by the relatively strong performance on EF measures at the pre-training assessment. At a follow-up assessment, participants in the

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GMT condition reported overall less anxiety than before GMT, as well as when compared to the control group (van Hooren et al.).

Other populations that have been proposed to struggle with EF skills are those who experience certain types of mental health problems, such as bipolar disorder (Dixon, Kravariti, Frith, Murray, & McGuire, 2004) and depression (Stordal et al., 2004). Previous studies have examined the effects of GMT on people with alcohol and substance abuse problems (Alfonso, Caracuel, Delgado-Pastor, and Verdejo-García, 2011) and schizophrenia (Levaux et al. 2011).

Alfonso et al. (2011) conducted a study that aimed to improve the executive and decision-making functions in abstinent polysubstance abusers in a Spanish community. The participants were assigned to an experimental or a control group, and matched according to various socio-demographic variables (that is, age, gender, educational level, and hand dominance), drug of choice, amount and frequency of substance use, as well as age of onset of substance use. Both groups received 14 sessions (twice per week) of 90 minutes. The experimental group received a combination of standard community treatment, GMT, and Mindfulness training, whereas the control group received standard community treatment only. The standard community treatment consisted of the psychotherapeutic intervention that is typically provided by community resources. Results indicated that after treatment, participants in the experimental group performed significantly better than the control group on the Letter Number Sequencing (LNS) task, the Stroop test, and the Iowa Gambling Task. However, no significant differences between the groups were observed on the other measures, namely the Digit Span, Arithmetic, Trail Making Test, Zoo Map, and Key Search tasks. Alfonso et al. (2011)

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concluded that the combination of GMT and Mindfulness training is a valuable addition to the standard community treatment as it positively affected participants' working memory (that is, LNS), selective attention/response inhibition (that is, the Stroop test), and decision-making skills (that is, the Iowa Gambling Task), which in turn are predictors of treatment outcome and relapse in addiction treatment (Passetti, Clark, Mehta, Joyce, & King, 2008). They noted that the failure of the experimental group to show significant change on certain measures of EFs may be due to participants' impairment in more basic skills necessary to succeed on those tasks. More specifically, they noted that several tasks included visual-spatial skills that have been shown to be affected in alcohol abusers (Fein, Torres, Price, & Di Sclafani, 2006).

Levaux et al. (2012) used an adapted version of GMT with a 39-year-old man with schizophrenia and applied it in a real-life setting. According to the authors, many individuals with schizophrenia exhibit difficulties in goal-directed behaviour. They noted that GMT involves the training of processes that can be applied in a variety of domains and situations. That is, the different factors involved in GMT, such as focusing attention, defining and solving the problem, and monitoring one's behaviour and progress towards the goal, are thought to generalize to different situations that are not specifically trained during the intervention. The individual who participated in their study showed EF difficulties in a variety of domestic tasks, especially with the organization and goal attainment of tasks in situations that were new or required multitasking. Further, the individual was described as having efficient working memory, attentional, and intellectual capacities. The GMT consisted of 16 bi-weekly sessions that lasted 90 minutes and took place at the participant's home. The intervention was based on Levine

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et al. (2000) and included several adaptations. More specifically, Levaux et al. added a psychoeducation session, included more training sessions, and the intervention took place in a different context than outlined in Levine et al. (2000). Levaux et al. defined three stages of the intervention. The first stage was psychoeducational and focused on learning the GM steps. In stage two, GM principles were practiced on pencil-and-paper tasks. Lastly, stage three involved the training of the GM principles with real-life tasks. Quantitative and qualitative measures of activities of daily living (ADLs) were used to assess the effects of the intervention. Meal preparation, as a task the individual specifically struggled with, was included in the intervention, whereas washing was used as a measure of the generalization of the effects as it constituted a non-trained but familiar task. To further investigate the generalization effects of GMT, a non-trained and non-familiar task (that is, meeting preparation) was also included. Furthermore, three laboratory SRLTs, along with several questionnaires that addressed the participant's levels of anxiety, self-esteem, and clinical symptoms were included. Results of this study indicated an improved performance on two planning tasks (Tower of London and the 6 Elements Test), one inhibition task (Hayling Test), two of the paper-and-pencil tasks (significant results for grouping and proofreading), and two ADL tasks (meal preparation and meeting preparation), as well as a significant increase on the qualitative measure of self-esteem.

In addition to normal older adults, patients with brain injuries, and patients with mental health disorders, patients with medical conditions may prove to be of interest to GMT researchers. Various illnesses have been associated with EF difficulties, such as vascular diseases, hypertension, as well as respiratory and cardiac illnesses (please see

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Schillerstrom, Horton, & Royall, 2005 for a review). The first researchers to utilize GMT with a population living with a medical condition, more specifically spina bifida (a neurodevelopmental condition associated with EF difficulties) were Stubberud, Langenbahn, Levine, Stanghelle, and Schanke (2013, 2014). They sampled 38 Norwegian individuals with spina bifida and randomly assigned them into a GMT group ($N = 24$) and a wait-list control group ($N = 14$). Training took place in groups with up to six participants. The GMT group was taught GM strategies and received mindfulness training with in-group discussions and exercises to facilitate learning. Participants in this group were seen on three occasions during a three-day inpatient intervention, each separated by a one-month stay at home. During the first and third intervention period, participants were seen for six hours, and during the second intervention period, participants were seen for nine hours. A variety of neuropsychological measures were reported in Stubberud et al. (2013), including the Conners' Continuous Performance Test – Second Edition (CPT-II), Color-Word Interference Test (D-KEFS), Trail Making Test – conditions four (switching) and five (motor speed) (D-KEFS), Tower Test (D-KEFS), and the Hotel Task (see Manly et al., 2002). Participants were assessed three times in total, once before the intervention, once immediately after the final training session, and once after six months. The results of this study showed that participants in the GMT group significantly improved their performance on the Hotel Task and the CPT-II at the post-intervention and follow-up assessments when compared to their baseline assessment, as well as when compared to the control group. Their overall performance on the Tower Test improved significantly at the follow-up assessment but not at the post-intervention assessment, although there was a significant improvement in terms of their mean time to

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perform the first move and their rule violations at the post-intervention assessment. Furthermore, the GMT groups' performance significantly improved at the post-intervention and follow-up assessment on the Trail Making Test – condition four and the Color-Word Interference Test, which measure inhibition and switching capabilities; however, these improvements were not significant when compared to the control group. No significant change was found for the Trail Making Test – condition five (which measures motor speed).

Stubberud et al. (2014, 2015) reported results of the same study (that is, Stubberud et al., 2013) but focused on self-report measures of EF difficulties in one study (Stubberud et al., 2014) and on self-report measures of emotional and physical health in the other (Stubberud et al., 2015). The EF self-report measures given to the participants included the DEX (self and informant version), CFQ, and Behaviour Rating Inventory of Executive Function – Adult Version (BRIEF-A; self and other-rated version). For these measures, significant changes were found in the GMT groups' ratings on the DEX-self at the post-intervention and follow-up assessments, and on the CFQ at the follow-up assessment when compared to their baseline ratings and when compared to the control group. In addition, the self-rating version of the BRIEF-A indicated significantly less EF difficulties for the GMT group than the control group at the follow-up assessment. The participants' informants' ratings on the DEX and BRIEF-A did not significantly change after the intervention. Lastly, participants in the GMT group were verbally asked to rate their level of satisfaction with the intervention (ranging from "very dissatisfied" to "very satisfied"), and to report whether the intervention helped them with their GM skills in everyday life ("yes" or "no"). All of the participants were "very satisfied" with the

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intervention, and 96% reported that it helped them in their daily lives. Stubberud et al. (2014) concluded that this intervention was successful in ameliorating some of the EF difficulties in individuals with spina bifida.

To assess participants' emotional and physical health, Stubberud et al. (2015) included the Hopkins Symptom Checklist 25 (HSCL-25) as a self-report measure of depressive and anxiety symptoms, the Short-Form 36 health survey version 2 (SF-36) as a self-report measure of mental and physical health, and the General Coping Questionnaire (GCQ) as a self-report measure of general coping style that differentiates between task-focused, emotion-focused, and avoidant coping styles. In addition, they inspected the DEX Positive Affect and Negative Affect subscales, which were combined into an Emotional Regulation Index. Again, these measures were administered to the participants on three occasions: at the baseline assessment, post-intervention assessment, and at a six-month follow-up assessment. Results showed significant improvement in the GMT group compared to the wait-list control group on the HSCL-25 at the post-intervention and follow-up assessment, as well as significant improvements on the SF-36 and the emotion regulation subscales of the DEX at the post-intervention assessment. Furthermore, there was a significant increase in task-focused coping style with a significant decrease in avoidant coping style in the GMT group after the intervention. These results were indicative of a significant improvement in GMT participants' perceived emotional health and coping style when compared to a control group.

Overall, previous research has demonstrated the potential of GMT interventions in a variety of populations. Many mental health or medical conditions exist that are associated with EF difficulties (for example, Schillerstrom et al., 2005), and researchers

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are just beginning to explore which of these populations may benefit from GMT. That being said, previous studies allow for cautious optimism in that significant improvement of EF skills or alleviation of EF difficulties in individuals is frequently reported. More research is warranted to identify suitable populations and optimize the GMT intervention.

A systematic review of the effectiveness of GMT interventions with brain-injured individuals by Krasny-Pacini et al. (2014) was one step in this direction as they set out to determine whether GMT improves EF difficulties, who the most appropriate participants for this intervention are, how often and for how long the intervention should be administered, and what the best format for the intervention is. Twelve studies that were published by December 2011 were included in this review. Four of these specifically addressed the effectiveness of the GMT model, and eight consisted of rehabilitation studies.

In particular, Krasny-Pacini and colleagues found that GMT is most effective when combined with other EF interventions (for example, problem-solving therapy or utilization of external cues). They further noted that, although several studies have demonstrated the effectiveness of GMT on different measures, most studies did not include an assessment measure of the effectiveness of GMT in everyday life activities, and thus the effectiveness of GMT has not been well-established. In addition, they concluded that training sessions are ideally conducted several times per week, each session lasting 1.5 hours or longer. Finally, Krasny-Pacini et al. recommended use of "external cueing or prompting" in order to remind participants of the "application of GMT strategies in everyday situations" (p. 114). This recommendation was largely based on the study conducted by Fish et al. (2007).

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Past research on GMT has provided support for the effectiveness of this intervention with a variety of populations and formats and has demonstrated diverse beneficial effects, as outlined above and in Appendix A. In order to adapt this intervention for undergraduate students, it was necessary to review the literature on effective delivery of GMT in abbreviated formats and on practical considerations for educational training design in undergraduates in general.

Modification of Goal Management Training for Undergraduate Students

To adapt GMT to undergraduates, I considered the literature relevant to intervention design for an undergraduate setting and I consulted with an educational specialist at the University of Windsor. Additionally, I conducted a pilot study designed to shed light on undergraduate preferences and relevance of GMT to undergraduate concerns. In particular, the number and length of sessions, types of cues used, and modality for contact were of interest for the review.

Relevant literature and experience suggested that the relatively long intervention period of the original version of GMT (that is, nine two-hour sessions, Levine et al., 2012a) would be a potential problem when offering it to university students. According to L. Prada, who was in charge of the *Skills To Enhance Personal Success* (S.T.E.P.S., provided by the University of Windsor Student Disability Services), workshops that are being offered to undergraduate students are of a short duration (that is, 50 minutes) in order to facilitate students' attendance as they are often hesitant to commit to workshops that cover multiple dates (L. Prada, personal communication, February 25, 2014).

Reducing the number of GMT sessions and overall length of GMT also was desirable to conserve statistical power in this small sample longitudinal study. Attrition

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in longitudinal studies is oftentimes a concern (Little, 1995) and “loss of participants in different phases of data collection may affect the validity of results obtained in longitudinal studies” (Ahern & Le Brocque, 2005, p. 54).

The possibility of shortening GMT successfully has been demonstrated by at least two studies. Fish et al. (2007) utilized one 30-minute session followed by text-message reminders and Levine et al. (2000) utilized a single one-hour GMT session. In areas outside GMT, single-session interventions have also shown significant results. For example, a single session focusing on the alcohol consumption of 217 college students significantly decreased their alcohol expectancies and consumption immediately after the intervention and at a one-month follow-up assessment (Lau-Barraco & Dunn, 2008). A single session was also utilized by Rausch, Gramling, and Auerbach (2006) who investigated the effectiveness of a single session of either meditation, progressive muscle relaxation (PMR), or simply resting (as the control group) with 387 undergraduate students. Their results showed that participants who practiced meditation or PMR were significantly more successful in decreasing their negative response to a stressor, and recovered more quickly after being exposed to a stressor compared to the control group.

A potential drawback of offering a single session to participants, instead of several sessions that span a number of weeks, is that participants do not have the opportunity to benefit from the repeated exposures to GMT over time. Offering intervention sessions over an extended period of time allows participants to practice their GM skills in session and apply these skills in their everyday lives. In addition, the original GMT protocol allows for regular practice at home through weekly homework assignments. With that being said, other research has shown that a variety of modalities

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that do not require participants to attend a session in person can be beneficial for interventions. For example, Dietrich, Shipherd, Gershgoren, Filho and Basevitch (2012) used Facebook to provide 45 university student soccer players with weekly consulting sessions. The researchers posted common strategies used in applied sport psychology and relevant questions on a weekly basis. They concluded that Facebook is a practical and inexpensive tool that is helpful in improving the sense of unity among students and consultants.

Cues have also been shown to be important in intervention studies and in the general habit formation of certain behaviours, when there is no direct contact with the researcher. For example, Lally and Gardner (2013) discussed the importance of contextual cues (for example, "going for a walk after breakfast", p. S140, where breakfast served as the cue) in promoting healthy behaviour (in this case, going for a walk). They noted that repeating the wanted behaviour when a cue is encountered is essential for habit formation. The authors used the *Self-Report Habit Index* (SRHI; developed by Verplanken & Orbell, 2003), a measure that assesses the acquisition of a habit, and found that habit formation occurs in the form of an asymptotic curve, in that "initial repetitions caused large increases in automaticity, but with each new repetition, automaticity gains reduced until the behaviour reached its limit of automaticity" (p. S141). In a similar study, conducted by Lally, van Jaarsveld, Potts, and Wardle (2010), it was found that it took a median time of 66 days to reach nearly perfect habit formation with great individual variation, ranging from 18 to 254 days.

A study by Ingersoll et al. (2013) provides an example of an intervention study that utilized text-message cues. Ingersoll et al. used a bidirectional text-messaging

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system with 31 HIV participants who struggled with medication adherence and substance abuse. Participants attended an initial interview session individually or as part of a focus group. Over a three-month period, participants received daily reminders and queries about their mood, substance use, and medication adherence. They were prompted to reply to these text-messages and received automated feedback based on their response. Although data about the effectiveness of this intervention was not reported, it was found that this text-message tool is a feasible addition to standard interventions in this population. Participants' response rates were between 64 and 69%, depending on the focus of the query, and overall more positive than negative. Moreover, participants responded positively emotionally to this intervention as they felt that they were being cared for.

Further, Bock, Heron, Jennings, Magee, and Morrow (2012) asked 21 young adults who quit smoking to participate in a two-hour focus group. This focus group consisted of questions and discussions about their opinions and preferences related to a text-message intervention tool designed to facilitate smoking cessation. Participants showed interest in such an intervention. They made several suggestions for improvement, which were to provide more variation in the content of the text-messages (for example, facts, coping strategies, and encouragement), and to include other social networking means (for example, Facebook) to communicate with each other. These ideas were applied to the modified GMT in the current study.

The studies reviewed above looked at a variety of formats of delivering the GMT workshop. In particular, the number of sessions varied, as did ways of communicating with participants in between sessions. These studies provided grounds for the view that a

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single workshop session of several hours would be a suitable format for an undergraduate student population. The reviewed studies suggest that communication between the researcher and the participants after the GMT workshop is important, but the best format of such contact remained unclear.

Consequently, a pilot study was conducted to determine undergraduates' preference for communication with the researcher, as well as their concerns about executive functioning (Carstens, 2013). Thirty-five undergraduate students with self-reported EF difficulties participated in this study. They completed one questionnaire that was designed to address the research questions noted above.

Participants were asked to rate their preferred means to be contacted by the researcher among email, phone, text-messages, and a Facebook forum. Twenty-three reported email as their preferred method. Four participants chose text-messages as their preferred means of communication, and 12 of them chose it as their second preference (Carstens, 2013).

Thus, for the current study, email and text-messages were chosen as a means of communication to facilitate practice and habit formation in participants with regards to the application of GM principles on a day-to-day basis. This contact with the researcher served as cues for the participants, and therefore this study addressed this limitation outlined by Krasny-Pacini et al. (2014).

This pilot study also surveyed participants' most common academic concerns (Carstens, 2013). Out of a list of possible academic difficulties (including writing essays, time-management, initiating assignments, studying for exams, reading course materials, retaining attention, and organizing one's course material), time-management was ranked

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as most difficult, and retaining attention was ranked as second most difficult by the participants in the pilot study (Carstens, 2013). These difficulties were in accordance with what the GMT workshop was designed to address. Consequently, these findings supported the idea that GMT would be of interest for this population.

Overall, review, consultation, and a pilot study (Carstens, 2013) led to a modified abbreviated version of GMT designed to be suitable for undergraduate students. The number of sessions and total length of the workshop were reduced in order to increase the likelihood that participants would enter and complete all phases of the study. During the workshop, the researcher and research assistant gave examples of application of GMT to situations typical of undergraduate life. Finally, the researcher provided cues in the form of emails and text-messages in the weeks following the workshop session to offset somewhat the disadvantages associated with only a single abbreviated exposure to GMT. A control group (separately recruited and not randomly assigned) was used to assess the effects of repeated exposures to neuropsychological measures and repeated contacts with the researcher.

Summary of the Literature Review

Several studies have documented the success of GMT in increasing participants' EF skills and in increasing their utilization of GM strategies in daily life (for example, Levine et al., 2007). The motivational effects of goals on performance have also been well established in the literature (for example, Pajares, 1996). Furthermore, it has been documented that academic self-efficacy and self-regulatory mechanisms (for example, self-monitoring and goal setting) are linked (for example, Bandura & Wood, 1989), as well as academic self-efficacy and cognitive processes (for example, Devonport & Lane,

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2006; Pintrich, 2000). Lastly, research suggests that self-efficacy may be increased by interventions, such as providing modeling and guided mastery exercises (Wiedenfeld et al., 1990).

Previously reviewed studies (Bock et al, 2012; Dietrich et al., 2012; Ingersoll et al., 2013; pilot study) demonstrate the suitability of providing information, or contact with the researcher, through a variety of modalities that are not in-person. Such contact with participants is beneficial in the generalization or transfer of the intervention effects over time. Through these modalities, the participants may continue to benefit through the effects of distributed learning and practice of skills.

Furthermore, past research with GMT has used interventions modified in a variety of aspects, such as length and focus of the intervention. The present study examined a different abbreviation and modification of GMT and was the first specifically aimed at undergraduates with attentional and EF complaints. Moreover, there is a lack of studies in the literature regarding the effectiveness of an abbreviated GMT regardless of the population that is being targeted (Krasny-Pacini et al., 2014).

Given the suggestion that GMT may be more beneficial in groups with milder EF difficulties (Krasny-Pacini et al., 2014), undergraduates may be an ideal target population. Moreover, the current literature also lacks research that examines the causal relationship between goal setting and self-monitoring on undergraduate students' academic self-efficacy. Although it has been reported that higher academic self-efficacy is related to more challenging goals, a stronger level of commitment, motivation, and attainment of these goals, as well as more adaptive learning habits, it remains unclear whether higher academic self-efficacy leads students to utilize more adaptive strategies

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(many of which represent EF skills), whether students who have learned to utilize these EF skills develop a higher level of academic self-efficacy, or how these two factors influence each other.

As there are specific aspects of goals that influence the positive effects, it is important to educate students about strategies to successfully set goals and adapt these strategies if necessary. Doing so may increase the students' beliefs in their ability to achieve certain goals, and thus succeed in their academic work or in the university setting in general (for example, Hsieh et al., 2007). As mentioned before, these beliefs relate to one's self-efficacy, aspects of which may be boosted by GMT.

Finally, literature review, consultation at this institution, and a pilot study informed modifications of the GMT design for this study with undergraduates at the University of Windsor. Specifically, this background work suggested that a single four-hour session was the most viable way to deliver the GMT workshop, and that text-messages and emails were the most appropriate formats for cues.

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CHAPTER 3

THE PRESENT RESEARCH

To date, GMT has not been studied with undergraduate students. The present study aimed to address this gap in the literature. As noted above, there is no consensus definition of EFs, although common elements are included in most definitions. For the purpose of this study the following EFs were chosen as the focus: participants' inhibition, switching, response generation and set-maintainence abilities (the latter often measured with fluency tasks), as well as working memory capabilities. In addition, this study examined two important possible effects of the GMT workshop on participants' academic achievement, namely their academic self-efficacy and sessional GPA.

In order to address potential problems of enrolment and attrition, this study involved two separately recruited groups of undergraduate students with self-reported EF difficulties. One group underwent an abbreviated version of GMT and one group did not undergo any version of GMT, as described in more detail in the Method section. Each group was assessed a total of three times; once within three weeks before the GMT group received the GMT workshop (the baseline assessment), once within three weeks after the GMT group received the GMT workshop (the first follow-up assessment), as well as once three months after the first follow-up assessment. This design made it possible to compare the two groups on a number of standardized EF measures and self-report questionnaires that addressed EF difficulties and academic self-efficacy beliefs in everyday life, and thus to determine the effectiveness of the GMT workshop in an undergraduate population. It is noteworthy that by including EF performance measures as well as self-report questionnaires, this study followed the recommendation outlined by

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Krasny-Pacini et al. (2014) that EF difficulties should be addressed both in objective and subjective ways.

The purpose of this study was not only to address the research question of whether GMT with students would increase their EF skills, but also to look at the question of whether teaching students goal-management strategies would affect their level of academic self-efficacy. As noted above, decreasing students' attrition rate is one of the leading challenges faced by many post-secondary institutions. Thus, a second purpose of this study was to examine the effects of an educational intervention that potentially relieves some academic stress often faced by students, as well as possibly increasing their academic self-efficacy. This in itself is predicted to have numerous positive effects on the students' well-being.

Study Hypotheses

Hypothesis 1. Because academic self-efficacy is related to one's problem-solving ability and cognitive functioning (for example, Bandura, 1997; Krueger & Dickson, 1994), it was hypothesized that there would be a positive correlation between participants' academic self-efficacy and their performance on EF measures during their baseline assessment. Similarly, as academic self-efficacy and EFs are related to academic performance (for example, Wood & Locke, 1987; Zimmerman et al., 1992), it was hypothesized that participants' self-reported level of academic self-efficacy and their performance on EF measures would be positively correlated with their academic performance.

Hypothesis 2. It has been suggested in the literature that participants who have undergone GMT experience a decrease in their subjective experience of EF difficulties as

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their performance on EF measures improves (for example, Levine et al., 2007). These findings indicate that individuals who demonstrate higher performances on EF measures may experience fewer difficulties with attention and EFs in their day-to-day lives. Therefore, it was hypothesized that participants' initial degree of self-reported EF difficulties would be negatively correlated with their overall performance on EF measures during the baseline assessment.

Hypothesis 3. The literature indicates that GMT is an effective intervention for improving performances on tasks that are designed to measure EFs (for example, Alfonso et al., 2011; Levine et al., 2011). Thus, it was hypothesized that the adapted version of GMT in this study would improve participants' performance on EF measures. More specifically, it was hypothesized that participants in the GMT group would perform significantly better on the EF measures after they had received the GMT workshop (that is, there would be an improvement in performance from their baseline assessment to their first follow-up assessment) and that this improvement would be significantly greater relative to a control group who did not undergo the GMT workshop. As there was ongoing contact between the researcher and the GMT participants in the time period between the first follow-up assessment and the second follow-up assessment three months after the first follow-up assessment, which involved emails and text-message reminders of the GMT principles and practice tasks, it was hypothesized that GMT participants would habitualize the use of their GM strategies over time, and thus show further improvements on EF measures at the second follow-up assessment, beyond the positive changes that might be seen in the control group.

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The contact between the first and second follow-up assessment between the control group and the researcher was unrelated to any GMT strategies. Thus, it was hypothesized that there would be no significant improvement in their performance on EF measures between these assessments other than that attributable to practice effects, nonspecific developmental effects, and the possible motivational effects of ongoing contact with the researcher.

Hypothesis 4. Different cognitive processes (for example, visualization) have been shown to positively affect one's academic self-efficacy beliefs. As the literature suggests a positive relationship between performance on EF measures and academic self-efficacy, it was hypothesized that increasing participants' EF skills (as specific cognitive processes) through GMT would increase the participants' academic self-efficacy beliefs. More specifically, it was hypothesized that there would be a significant increase in participants' academic self-efficacy beliefs after receiving GMT (that is, from the baseline to the first follow-up assessment) relative to the control group. Similarly to hypothesis 3, due to ongoing contact between the researcher and the GMT group that involved GMT related principles and reminders to use the GM strategies, it was hypothesized that GMT participants' academic self-efficacy would further improve at the second follow-up assessment. Again, the contact between the control group and the researcher during that time was unrelated to GMT. Therefore, the improvement in self-efficacy of GMT group participants was hypothesized to be significantly greater than any improvements in self-efficacy of control group participants.

Hypothesis 5. Several studies in the literature have reported a significant decrease in participants' subjective rates of EF difficulties after the GMT intervention

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(for example, Levine et al., 2007; van Hooren et al., 2007). This implies that individuals who have received GMT tend to be aware of their changes in EFs in day-to-day situations. As GMT was designed to increase individual's GM skills, it was hypothesized that GMT participants in this study would experience a significant increase in their perception of the degree to which they exhibit these skills on day-to-day tasks after the intervention. Their perceived increase in GM skills was further hypothesized to be significantly greater than any increase observed in the control group. Again, because of the continued contact between the GMT participants and the researcher between the first and second follow-up assessment, it was hypothesized that there would be a significant increase in perceived GM skills of GMT participants during that time. Similarly to the hypotheses stated above, it was hypothesized that there would be no significant change in the control group in perceived skills from the first to second follow-up assessment.

Hypothesis 6. As GMT was hypothesized to decrease EF difficulties as measured with standardized tests, it was also hypothesized that there would be a significant decrease in self-reported EF difficulties in the GMT group after the GMT workshop. This decrease was further hypothesized to be significantly greater than any changes observed in the control group. In addition, the GMT participants' self-reported EF difficulties were hypothesized to further significantly decrease between the first and second follow-up assessment, whereas no significant decrease was hypothesized to occur in the control group between these assessments.

Hypothesis 7. The literature suggests that there is a positive relationship between academic self-efficacy and academic achievement (for example, Gore, 2006; Pajares, 1996). As GMT was designed to increase EF and GM skills (Levine et al., 2012a), and

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as it was hypothesized to increase academic self-efficacy (see hypothesis 4), it was further hypothesized that it would also improve participants' academic achievement. That is, it was hypothesized that GMT participants would show a more significant improvement in their grades after receiving the intervention than participants in the control group. For this, participants' sessional semester GPA before they enrolled in this study was compared to the sessional semester GPA in which they had completed the baseline, first follow-up assessment, and, for one group, the GMT intervention. Thus, the effect of GMT on participants' academic achievement was determined by the change in their grades from their baseline assessment to their second follow-up assessment.

Hypothesis 8. Because participants in the GMT group were provided with cues to utilize the GMT strategies over time, and because cues have been shown to be an important aspect in habit-formation (for example, Lally & Gardner, 2013), it was hypothesized that there would be an increase in GMT group participants' habit of utilizing the GMT strategies over time. As mentioned by Lally and Gardner, habit formation tends to occur in the form of an asymptote; therefore, it was hypothesized that there would be a great increase in habit-formation at first with less increase later in time, thus following a non-linear trend. Through the weekly surveys that were included in the emails to the GMT group participants, and which inquired about their habit formation, this variable was assessed regularly between the first and second follow-up assessment. This hypothesis only pertained to the GMT group.

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CHAPTER 4

DESIGN AND METHODOLOGY

Participants

Fifty undergraduate students at the University of Windsor entered this study and 35 completed all assessments (see below for complete demographic information). They had never been diagnosed with a learning disorder, were 18 years of age or older, were fluent in English, did not have any uncorrected vision or hearing problems, planned to be enrolled to study at the University of Windsor in the following semester, had a cell phone, and reported experiencing some EF difficulties. EF difficulties were described as difficulties focusing attention, controlling and regulating distractions, or working towards goals. If participants reported "yes" on a screening question given to the Psychology Participant Pool (that is, "Do you have difficulties focusing attention and/or controlling/regulating distractions and/or working towards goals?"), they were allowed to take part in this study. Participants filled out a second screening questionnaire just before the consent procedure in order to verify that they met all requirements before they began the baseline assessment.

According to Cohen (1988), a partial η^2 of .25 constitutes a moderate effect size. The online research tool *G-Power* (see Faul, Erdfelder, Lang, & Buchner, 2007) was used to calculate the number of participants needed for adequate power for this study. For a *Repeated Measure Analysis of Variance* (RM ANOVA) with a within-between interaction (henceforth referred to as a mixed factorial ANOVA), two groups, a minimum power of .8, a moderate effect size, and three measurements, a minimum of 28 participants in total was needed. As noted above, 50 participants were recruited for this

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study and 35 completed all assessments. Thus, the number of participants who completed all assessments exceeded the calculated number of participants needed for sufficient power.

The control group was chosen to be compared to the GMT group in order to take into account practice effects, non-specific developmental changes, and effects of contact with the researcher over the period of the study. Except for the four-hour GMT workshop, the amount of contact between participants in both groups was the same. A wait-list control group was not chosen because the expectation of receiving the GMT intervention at a future date may have altered the participants' self-report measures of their skills and difficulties. The reasons for non-randomized assignment to the two groups and the advantages and disadvantages thereof are further discussed below.

Participants in both groups were recruited through the Psychology Participant Pool, although advertisements for the two groups differed. More specifically, following the recommendations made by the Psychology Participant Pool coordinator, the advertisement for the GMT group indicated that participants would be asked to attend a workshop and complete assessments at three points in time. Once participants signed up for the study, they were sent an email by the researcher that included detailed information about the procedure of the study, and were given the opportunity to withdraw. This procedure targeted individuals motivated to improve their GM skills.

The advertisement for the control group simply indicated that participants would undergo three assessments. See Appendix B for the advertisements for both groups and the second screening questionnaire used to verify that participants met eligibility criteria.

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It is possible that participants in the GMT and control group differed in various aspects, such as level of motivation, since participants in the former group were asked to sign up only if they intended to complete the GMT, while there was no expectation of attendance at a workshop for the control group. Randomization of participants into the two groups was not feasible for this project, as it would have significantly extended the timeline of the study. Although this may appear as a limitation, it may actually not be as the recruitment process for the GMT group ensured, to the extent possible, that it would capture individuals for whom it was intended, whereas the recruitment process for the control group ensured, again to the extent possible, that the two groups matched for EF difficulties. As noted above, initial recruitment materials provided to the GMT group included information about the GMT workshop and only limited information about the complete design of the study. Following this, participants were asked to continue only if they were interested in attending all parts of the study. This may have ensured that participants in the GMT group were at least partially internally motivated to attend the workshop. It is noteworthy that only one potential participant dropped out of the GMT group prior to any assessment, based on the information that was provided in the recruitment email. In addition, the contact with the researcher was matched to both groups, to the extent possible. That is, participants in both groups attended three assessment sessions, and received weekly emails and text messages. Thus, the only difference in exposure to the researcher was the one four-hour GMT workshop that only the GMT groups received.

Participants were asked to give written informed consent. For their voluntary participation they received either 1.5 Psychology Participant Pool credits per assessment

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session (if they were enrolled in at least one eligible course) or monetary compensation. More specifically, participants not in the Participant Pool in a given semester received $5 for participating in the baseline assessment, $10 for participating in the first follow-up assessment, and $15 for participating in the second follow-up assessment. Compensation for participation (either monetary or Psychology Participant Pool credits) was granted after each assessment.

Furthermore, participants in the GMT group were provided with refreshments during the GMT session and were entered into a draw to win one of two $20 gift certificates for Tim Horton's Restaurants. The draw took place immediately after the GMT intervention. In addition, participants in the GMT group were entered into a draw for one out of two $20 vouchers for the Cineplex Movie Theaters for every weekly survey they filled out. This draw took place before the second follow-up assessment.

Participants in both groups were only allowed to complete the first follow-up assessment if they completed the baseline assessment. In addition, GMT group participants were only allowed to complete the first follow-up assessment if they completed the GMT intervention. Similarly, participants had to complete the first follow-up assessment in order to complete the second.

Procedure and Design

All participants underwent a baseline assessment that took approximately 90 minutes to complete. Within three weeks after the baseline assessment, the GMT group received the GMT intervention (see Table 1). The GMT group was offered a total of six times, with the number of participants ranging from 2 to 5. The full GMT program consists of nine modules that each takes approximately two hours to run (Levine et al.,

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2012a). This study involved an abbreviated version that ran approximately four hours in one single session for reasons described above. In order to do so, certain modules, or parts of the modules, were omitted (see below).

The main focus of the intervention in the present study was on specific techniques participants could use to alter their GM skills (e.g., Levine et al, 2007, 2011). GMT was designed to facilitate awareness to the task at hand, setting goals and splitting these up into smaller, more manageable ones, and monitoring one's thoughts and behaviours towards the goals. Students often experience difficulties in these areas, as they often struggle to manage their time, to study for exams, or to avoid feeling overwhelmed by assignments.

The core components of the GMT are reflected in the "Stop-State-Split-Check" cycle (that is, stopping what one is doing and reverting one's attention back to the task at hand, state one's goal, split the task into subtasks, and check or monitor one's behaviour) with the purpose to help individuals become more aware of what they are doing and when they begin to get off track in their tasks (Levine et al., 2012a). After a short introduction of the GMT program, as well as a definition of specific concepts, such as being on "automatic pilot" (Levine et al., 2012a, p. 37), the program began with module four of the GMT manual. Module four, as well as modules six through nine, map onto the core components of the GMT as they describe this cycle ("Stop-State-Split-Check"), and were thus the focus of the four-hour intervention. The modules are structured so that they build upon one another, each adding to this cycle and providing an opportunity for the students to practice the skills during the session.

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Additional aspects of each module that were omitted included the review of the last session at the beginning of each module and the review of the homework assignment that participants typically complete between sessions in the original full-length GMT program. Furthermore, the GMT manual includes several in-session exercises that are designed to practice the skills introduced in the session. Although the same skill is typically practiced through several exercises, due to the time limitations the overall number of in-session exercises was reduced. That is, similarly to the original intervention, participants were able to practice the skills learned, albeit through fewer exercises during the session.

Furthermore, concepts and exercises that are not directly associated with the "Stop-State-Split-Check" cycle were omitted, such as a body scan. These aspects were introduced to the students in weekly emails sent to them by the researcher. More specifically, they received regular emails describing these concepts and techniques, as well as suggested homework assignments that they could review in their GMT workbook. In order to ensure that participants did their homework, participants were offered a reward of $10 if they brought the workbook to the second follow-up assessment and if it was evident that they completed the homework assignments. However, only one participant brought the workbook to the second follow-up assessment. Homework assignments included practicing present-mindedness by utilizing the body scan exercise and breathing exercise and by charting their mental slips and their use of the "Stop-State-Split-Check" cycle. See Appendix C for an overview of the emails and text-messages sent to the participants.

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In summary, during the four-hour intervention students received an abbreviated version of the GMT program that included all the core GMT principles (that is, the "Stop-State-Split-Check" cycle). In addition, components and exercises that were omitted in the four-hour workshop were reviewed in the weekly emails sent to participants.

Within three weeks after the GMT group received the intervention, both groups underwent the first follow-up assessment. This assessment was identical to the baseline assessment, with the exception of the "Feedback Questionnaire 1" that was given to the GMT participants only. During the time period between the first follow-up assessment and the second follow up-assessment, the researcher contacted the participants in the GMT group via email once a week to provide them with additional information, to direct them to specific exercises in the GMT workbook, to inquire about any specific difficulties they were experiencing, and to refer them to an online survey (FluidSurvey) where they were asked to fill out the *Self-Report Behavioural Automaticity Index* (see the SRBAI below). None of the participants chose to disclose any difficulties they were experiencing related to the GMT. In addition, participants in the GMT group received text-messages three times per week on a variable schedule. These text-messages included a reminder message of the GM concept (that is, the "Stop-State-Split-Check" cycle) and prompted them to consider what they were doing at that very moment, and whether they were using the GM principles. Text-messages were chosen because they were the most likely means of communication to be received immediately by the participants.

Lastly, all participants underwent a second follow-up assessment approximately three months after the first follow-up assessment. Again, this assessment was identical to

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the previous ones, with the exception of "Feedback Questionnaire 2" given only to GMT participants. Because the control group did not receive the GMT intervention, any improvements in their performance measures were likely due to practice effects on these measures or nonspecific developmental changes. Thus, any changes in the GMT group that differ from those found in the control group are in addition to these effects.

The participants provided informed consent to the researcher before each assessment and then a research assistant assessed each participant on an individual basis. This way, the examiners were blinded to the group membership of each participant, and thus examiner bias could be ruled out. Research assistants were two graduate students in the psychology department and four undergraduate students. They either already had received training in the administration of the WAIS-IV or received this training from the researcher. Research assistants were trained in the administration of the D-KEFS and the questionnaires by the researcher. See Figure 1 and Table 1 for an overview of the procedure.

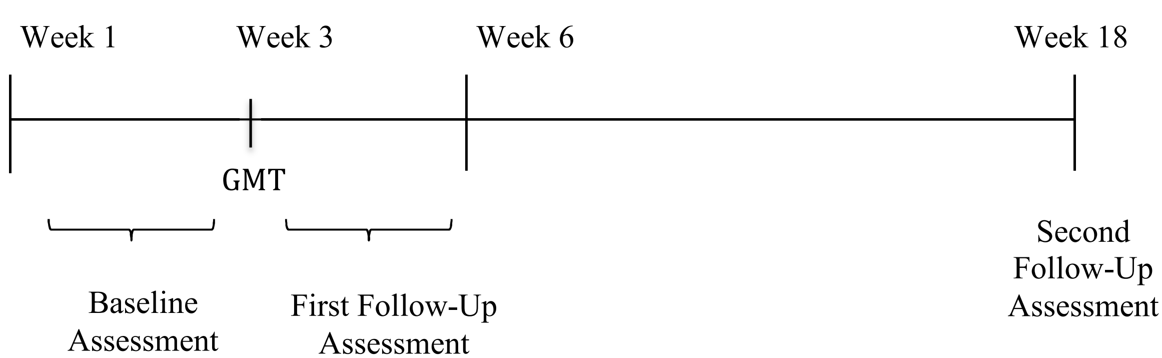

Figure 1. Timeline of the present study.

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Table 1. *Overview of the Assessment and Intervention Schedule*

Time Period	GMT Group	Control Group
Within three weeks before GMT intervention	Baseline assessment	Baseline assessment
	GMT intervention	
Within three weeks after GMT intervention	First follow-up assessment	First follow-up assessment
Between first and second follow-up assessment	Continuing contact with the researcher through emails and text-messages; weekly Self-Report Behavioural Automaticity Index (SRBAI) scores	Continuing contact with the researcher through emails and text-messages
Approximately three months after the second follow-up assessment	Second follow-up assessment	Second follow-up assessment

Materials

Goal management training. Participants in the GMT group underwent one four-hour intervention session. The GMT intervention was based on the *Goal Management Training Trainer's Manual* (Levine et al., 2012a). This manual provided the researcher with a CD that included slides to illustrate and facilitate understanding of the GMT principles, as well as audio of the breathing exercise and breath focus exercise. Several of these slides provided on the CD were utilized during the intervention session. The slides and anecdotal examples of GMT concepts (such as absentmindedness) discussed

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during the workshop were adapted to undergraduate students' challenges to facilitate the transfer of learned skills to their day-to-day lives. For example, in teaching the concept of splitting a complex task up into subtasks, the original example in the GMT Manual (that is, cooking an extravagant meal) was changed to an example thought to be more relevant to students (that is, writing an essay).

During the GMT workshop, participants were also given the *Goal Management Training Workbook* (Levine, Manly, & Robertson, 2012b) to take home. This workbook consisted of nine chapters that were organized according to the modules and included several homework assignments to which participants were referred to via weekly email after the first follow-up assessment. These homework assignments are described in Appendix C. In these emails, participants were also provided with a link to the online SRBAI survey (see below), which they were asked to fill out each week. Lastly, this group received three text-messages per week sent on a variable schedule that included a reminder to use GMT principles.

Control group. The control group did not undergo the GMT intervention, and was not given any materials. Participants in this group were assessed on the same measures and within the same timeframe (that is, the baseline assessment within three weeks before the GMT group received their intervention, the first follow-up assessment within three weeks after the GMT group received their intervention, and the second follow-up assessment three months after the first follow-up assessment) as the GMT group, with the exception of both Feedback Questionnaires (1 and 2) and the SRBAI. The researcher also sent one email and three text-messages per week that included trivia information in order to control for the amount of contact with her.

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Performance measures.

Selected subtests of the Delis-Kaplan Executive Function System (D-KEFS). The D-KEFS spans an age range from 8 to 89 years and was designed to measure fundamental, as well as higher-level cognitive skills. It was standardized on a sample (based on the 2000 U.S. Census) of 1750 non-clinical individuals that was stratified in regards to “age, sex, race/ethnicity, years of education, and geographic region” (Homack, Lee, & Riccio, 2005, p. 603). Originally, it was designed for administrations in schools because it serves to complement other, more traditional intelligence and achievement tests often used in these settings (Delis, Kaplan, & Kramer, 2001). It consists of nine standardized tests including the Trail Making Test, Verbal Fluency Test, Design Fluency Test, Color-Word Interference Test, Sorting Test, Twenty Questions Test, Word Context Test, Tower Test, and Proverb Test. Swanson (2005) noted that the correlation between the D-KEFS tests is relatively low, indicating that each test measures a unique aspect of EFs. The administrator can be flexible in choosing which test to administer, as each test can be administered individually (Swanson, 2005).

Although internal consistency measures across the subtests are relatively low, it has been noted that this should not be taken as a serious drawback of the D-KEFS as EFs are made up of complex processes that are difficult to measure (Shunk, Davis, & Dean, 2006). Delis et al. (2001) note that variability in individual’s performances is expected to be relatively high due to this complexity of cognitive processes involved in EFs.

The tests that were chosen for this study (see below) are subtests of pre-existing clinical or experimental scales. According to Delis et al. (2001) and Swanson (2005), their validity has been well-established in several research studies that have been

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conducted over the past five decades (see Delis, Kramer, Kaplan, & Holdnack, 2004, for a list of validity studies of the D-KEFS). Swanson (2005) concluded her review of the D-KEFS with a statement regarding the suitability of the D-KEFS as a clinical or research tool, expressing that it is "an excellent choice of instruments for the measurement of executive functioning" (p.127). Similarly, Shunk et al. (2006) conclude their review by stating that the D-KEFS is "the most thorough and precise comprehensive battery used to measure individual executive functioning" (p. 278). The subtests that were chosen for this study (that is, Tower Test, Trail Making Test – Condition 4, Verbal Fluency, and Color-Word Interference – Condition 3 and 4) have been included in various GMT research studies in the past and are thought to be sensitive to changes in EFs following GMT (see Appendix A). They are described in detail below and constitute part of the EF performance measures for this study.

It is important to note that some researchers have stated that behavioural observations and rating scales of executive dysfunction (indirect assessment measures) are superior to assessment tools such as the D-KEFS (direct assessment measures) in the detection of such impairment (for example, Barkley, 2012). Recent research, for example by Follmer and Stefanou (2014), has explored these different viewpoints. They investigated the correlations between direct and indirect measures (that is, the D-KEFS and BRIEF) and found that there is little correlation between the two. They stated that each type of measure, direct and indirect, provides unique contributions in the assessment of EFs. For this reason, this study also included an indirect measure (that is, the BRIEF-A), which is discussed below.

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Tower Test. On this test, participants were required to move up to five disks of different sizes on three pegs to build a target tower while following certain rules. This test was designed to measure several EFs, including spatial planning, rule learning, spatial problem solving, inhibition of impulsive responses, inhibition of perseverative responses, as well as the ability to establish/maintain cognitive set. In order to succeed on this task, one taps into visual attention and visual-spatial skills. For this study, performance on this test served as an indication of participants' inhibition skills. The test-retest reliability coefficient for the Tower Test Total Achievement Score is .44 (Delis et al., 2001; Swanson, 2005). Delis et al. (2001) also looked at the mean difference in scaled scores of 101 participants who were assessed twice, once at baseline and once 25 days later, and reported a mean increase of 1.31 on this subtask.

Trail Making Test (condition 4 – number-letter switching). On this task, the participant was presented with a piece of paper with numbers and letters on it. The participant was required to draw a line, switching between numbers (in ascending order) and letters (in alphabetical order). They were asked to do this as fast as possible without making any mistakes. The completion time served as the measure of their performance on this task. This visual-motor sequencing task assesses one's flexibility in thinking and impulsivity. Condition four was designed as a higher-level condition, requiring the participant to inhibit impulsive responses and remain flexible in their problem-solving approach and switching of sets. For this study, performance on this test (that is, completion time) served as an indication of participants' switching capabilities. Test-retest reliability coefficient for the scaled score for this condition is .38 (Delis et al.,

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2001; Swanson, 2005). Here, Delis et al. (2001) reported a mean increase of .9 standard scores between a baseline assessment and a follow-up assessment 25 days later.

Verbal Fluency. The verbal fluency subtest of the D-KEFS consists of three separate conditions. In the Letter Fluency condition, participants were asked to name as many words as they could in 60 seconds that begin with a certain letter. The second condition, that is the Category Fluency condition, required individuals to name as many words as they could in 60 seconds that fit into a certain category (for example, animals). Lastly, in the Switching Fluency condition participants were asked to switch between two categories (that is, fruits and pieces of furniture), again naming as many words as they could in 60 seconds. Switching between the categories requires more cognitive resources and flexibility. This test was designed to assess an individual's word generation capabilities "in an effortful, phonemic format (Letter Fluency), from overlearned concepts (Category Fluency), and while simultaneously switching between overlearned concepts (Category Switching)" (Delis et al., 2001, p. 22). For this study, participants' performance on the Letter and Category tasks served as an indication of their fluency capabilities, whereas performance on the Category Switching task served as an indication of their switching capabilities. Test-retest reliability coefficient of the Total Responses scaled scores for Letter Fluency is .8, for Category Fluency is .79, and for Switching Fluency is .52 (Delis et al., 2001; Swanson, 2005). Delis et al. (2001) reported a mean increase in scaled scores of .48 for Letter Fluency, of .47 for Category Fluency, and of .01 for Switching Fluency among participants who were assessed 25 days apart.

Color Word Interference – Inhibition. On this test, participants were required to name the ink colour of colour words as fast as they could without making any mistakes.

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The main EF measured by this test was inhibition, as participants needed to inhibit the more automatic response of reading the colour word in order to succeed on this task. Similarly to the Tower Test, performance on this task served as an indication of participants' inhibition skills. The test-retest reliability coefficient for the Total Time to Complete standard score of this condition is .75 (Delis et al., 2001; Swanson, 2005). Here, Delis et al. (2001) reported a mean increase of 1.02 scaled scores in participants who were assessed at baseline and 25 days later.

Color Word Interference – Switching. In this condition, the participant was required to switch back and forth between naming the colour of ink a word was printed in and reading the colour word. It was designed to measure both inhibition and cognitive flexibility. Similarly to the Trails Condition 4 task, performance on this task served as an indication of participants' switching capabilities. The test-retest reliability coefficient for the Total Time to Complete standard score of this condition is .65 (Delis et al., 2001; Swanson, 2005). The mean increase of scaled scores when assessed 25 days apart was 1.07 (Delis et al., 2001).

Selected subtests of the Wechsler Adult Intelligence Scale – 4th Edition (WAIS-IV). The WAIS-IV is a clinical tool designed to assess intelligence in adults ranging from age 16 to 90. The standardization sample included 2200 individuals who were stratified (based on 2010 US Census) in regards to their geographical region, gender, years of education, and race/ethnicity (Benson, Hulac, & Kranzler, 2010). The WAIS-IV consists of ten core tests and five supplementary tests that address a variety of cognitive functions. These subtests can be used to comprise composite scores in specific areas of functioning, namely Verbal Comprehension, Perceptual Reasoning, Working

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Memory, and Processing Speed. Additionally, it yields a Full Scale IQ score, which is a composite score of overall cognitive functioning. The reliability and validity of the WAIS-IV have been well established in the literature and are considered to be good (Wechsler, 2008a). The subtests that were chosen for this study constitute part of the EF performance measures (that is, Digit Span and Letter-Number Sequencing as measures of participants' working memory capabilities) as well as performance measures that are not directly linked to EFs (that is, Symbol Search and Coding as measures of participants' processing speed). They are described in detail below.

Digit Span. This test is part of the Working Memory Index on the WAIS-IV. Here, participants were asked to listen to and repeat an increasing sequence of numbers. This task consists of three conditions, namely Digit Span Forward, Backwards, and Sequencing. In the first condition, participants were required to hold in mind and repeat the sequence of numbers as stated by the administrator. In the Backwards condition, participants needed to hold the numbers in mind, mentally manipulate them, and repeat the sequence in reverse order. In the Sequence condition, participants needed to hold the numbers read by the examiner in mind, mentally manipulate them, and repeat them in ascending order. The Backwards condition is more complex than the Forward condition, as the order of the numbers provided to the participant needs to be changed. Similarly, the Sequencing condition is more complex than the Backwards condition, as participants need to hold the numbers in mind while determining the correct sequence to repeat them. This test is designed to assess an individual's auditory working memory, attention, and auditory sequential processing. For this study, performance on this task served as an indication of participants' working memory capabilities. The reliability coefficient for

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this subtest's total scaled score is .93 (Wechsler, 2008a). Estevis, Basso, and Combs (2012) assessed the increase in 54 participants' scaled scores between a baseline and either a three- or six-months follow-up assessment due to practice effect as .5. Similarly, Wechsler (2008b) looked at the mean increase in scaled scores in 298 participants between a baseline and follow-up assessment 22 days later and reported an increase of .6.

Letter-Number Sequencing (LNS). The LNS test is a supplemental subtest of the WAIS-IV Working Memory Index. It can only be administered to participants between 16 and 69 years of age. For this task, a sequence of letters and numbers were read to the participant by the examiner. The participants were instructed to put the sequence in order, repeating the numbers first, in ascending order, followed by the letters, in alphabetical order. To succeed on this task, participants needed to remember the sequence that was read to them and hold it in their memory while mentally manipulating it into the correct order. As with the Digit Span test, this test is designed to assess an individual's auditory working memory, attention, and auditory sequential processing capabilities, albeit with numbers and letters. As for the Digit Span task, participants' performance on this task served as an indication of their working memory capabilities. The reliability coefficient for this subtest total scaled score is .88 (Wechsler, 2008a). Estevis et al. (2012) reported that practice effects resulted in an increase of .3 on this subtest's scaled score (that is, between a baseline assessment and a follow-up assessment either three or six months later). Similarly, Wechsler (2008b) indicated a mean increase in scaled scores of .4 when assessed 22 days apart.

Coding. This is a subtest of the WAIS-IV Processing Speed Index. On this task, participants were presented with a piece of paper and a pencil. On the top of the paper

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are boxes that are split in half, with a number in the top part and a special mark in the bottom part. The numbers range from 1 to 9 with each number having a particular mark associated. Below these demonstration items are more boxes that are split in half. These boxes have a number in the top part but are missing the special mark in the bottom part. The participant is instructed to fill in as many of the corresponding special marks as they can in two minutes time. It is used to assess participants' processing speed and short-term visual memory. The reliability coefficient for this subtest total scaled score is .86 (Wechsler, 2008a). Further, scores have been reported to increase between a baseline and either a three- or six-months follow-up assessment as a result of practice by a scaled score of 1.1 (Estevis et al., 2012). Wechsler indicated a somewhat lower mean increase in participants' scaled scores over time (that is, 22 days), which was .6.

Symbol Search. This test is also a subtest of the WAIS-IV Processing Speed Index. Participants are provided with a booklet that contains several pages of symbols. More specifically, there are two target symbols on the left-hand side and non-target symbols next to them. If one of the target symbols matches one of the non-target symbols, they are asked to draw a line through the non-target symbol. If neither target symbol matches any of the non-target symbols, they are asked to draw a line through a "NO" box that is placed next to the non-target symbols. The participants are instructed to do so for as many symbols as they can in two minutes. The reliability coefficient for this subtest total scaled score is .81 (Wechsler, 2008a). The practice effect on this subtest between a baseline and either a three- or six-months assessment was reported to be a mean increase of 2.2 scaled scores (Estevis et al., 2012). In contrast, and again lower than the mean increase found by Estevis et al., Wechsler (2008b) indicated a mean

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increase on this subtask of .9 in scaled scores between assessments that were 22 days apart.

Based on Novakovic-Agopian et al. (2011), participants' processing speed was not hypothesized to increase as a result of GMT. Coding and Symbol Search were included in this research study as control measures that should not indicate any change after GMT. The scaled scores for Symbol Search and Coding were averaged for each participant to form a Processing Speed Domain scaled score used as a dependent variable in some supplementary analyses.

Self-report measures.

Behavior Rating Inventory of Executive Functions – Adult Version (BRIEF-A). The BRIEF-A was chosen as a standardized behaviour self-rating inventory. It consists of numerous scales that address different aspects of EFs, including Inhibit, Shift, Emotional Control, Self-Monitor (all part of the Behavior Regulation Index [BRI]), as well as Initiate, Working Memory, Plan/Organize, Organization of Materials, and Task Monitor (all part of the Metacognitive Index [MI]; Roth, Isquith, & Gioia, 2005). The Global Executive Composite (GEC) represents the summary score of the BRIEF-A. For this study, the researcher used the GEC as an overall score of participants' self-reported EF difficulties.

Self-Efficacy for Learning Form – Abbreviated Version (SELF-A). This is a 19-item self-report measure of students' self-efficacy in several areas of academic functioning. Students are asked to rate their confidence of being able to perform certain academic tasks on a scale from 0 (definitely cannot do it) to 100 (definitely can do it). Students' self-efficacy beliefs regarding their self-regulatory learning processes have

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been shown to be related to their academic performances, as well as their motivation to perform well in university (Zimmerman & Kitsantas, 2007). The reliability and validity of the SELF-A was investigated in 223 college students by Zimmerman and Kitsantas (2007). Their results showed that this is a reliable and valid measure when assessing students' self-efficacy for learning. More specifically, the reliability coefficient was .97. Furthermore, the correlation between the SELF-A and participants' grades in an educational psychology course was $r = .58$, and adding the SELF-A to Scholastic Aptitude Test (SAT) scores when attempting to predict students' quality of homework and course grades resulted in significantly more accurate predictions (with an increase of 22% and 24% of the variance in outcomes attributable to the SELF-A). For each assessment in this study, participants' total raw scores on the SELF-A were divided by 19 to get their average rating on the scale of 0 to 100. Hereafter, this average rating will be referred to as participants' SELF-A total score. This measure was included to gain a better understanding of students' subjective academic self-efficacy and any changes they may experience in their self-efficacy related to academic tasks as a result of the GMT program. See Appendix D for the SELF-A.

Robert Morris Attention Scale (RMAS). The RMAS is a five-item self-report measure of general attention. On this scale, participants are asked to read five statements related to their attention and rate their agreement with each of these statements from 'strongly agree' to 'strongly disagree'. Each rating is converted to a score from 1 to 5, where higher scores indicate more difficulties with attention. For this study, participants' total raw scores were used.

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The criterion validity of the RMAS is good and its test-retest reliability has been reported to be .81 (Kelly, 2009). More specifically, other measures of attention are correlated with it, including the Differential Attentional Processes Inventory, the Self-Regulation Scale, and the Digit Span Forward test (WAIS - Revised). Social desirability has not been shown to correlate with the RMAS. The RMAS was included in this study as a measure of self-reported attentional difficulties, as attention is a construct associated with overall EFs. See Appendix E for the RMAS.

Goal Management Training Questionnaire - Self (GMTQ-S). The GMTQ is a self-report questionnaire designed by Levine et al. (2012a) to evaluate the effectiveness of GMT. It consists of 34 questions that address the severity of problems individuals often face. The provided scale ranges from 0 (no problem at all) to 10 (a very major problem). Similarly to the SELF-A, for each assessment in this study, participants' total raw scores on the GMTQ-S were divided by 34 to get their average rating on the scale from 0 to 10. Hereafter, this average rating will be referred to as participants' GMTQ-S total score. This questionnaire was administered to determine any subjective changes in the participants' GM skills.

Background questionnaire. Participants were asked to fill out a short background questionnaire to determine their demographics (including age, academic level, major, gender, a previous diagnosis of Attention Deficit Hyperactivity Disorder [ADHD], and how many courses they were enrolled in), their previous sessional GPA, their goal for that semester's sessional GPA, and any academic concerns or difficulties on academic tasks. It was also used as a measure of their experiences of EF difficulties, and to what degree they experienced these difficulties. More specifically, three questions

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addressed these concerns on which participants were asked to describe them and rate their severity. In addition, the participants were asked to rank several academic concerns and how these applied to them on a scale from 1 to 5. See Appendix F for this questionnaire.

Feedback questionnaires. Two feedback questionnaires that slightly differ in content were given to the GMT participants. Feedback Questionnaire 1 (see Appendix G) was administered to the GMT group during the first follow-up assessment, and Feedback Questionnaire 2 (see Appendix H) was administered to the GMT group during the second follow-up assessment. These questionnaires were developed by the researcher to gather information about the participants' subjective experience of the intervention. More specifically, it served to determine the usefulness of the intervention in general, and the usefulness of each part specifically, as experienced by the participants. In order to remind the participants of the contents of the homework assignments, which they were asked to rate on Feedback Questionnaire 2 during the second follow-up assessment, a one-page summary of each homework assignment was provided.

Self-Report Behavioural Automaticity Index (SRBAI). This four-item index served as a measure of participants' progress in habit formation in terms of their utilization of the GMT strategies. The weekly emails they received from the researcher included a link to an online survey of the SRBAI. Previous research has suggested that automaticity is the most crucial element in the relationship between habit and behaviour (see Gardner, 2012). The SRBAI was thus developed as an automaticity subscale of the SRHI to capture this element. Gardner, Abraham, Lally, and de Brujin (2012) set out to identify the SRHI items that best reflect automaticity by analyzing the consistency of

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seven researchers' ratings of item content. The four items that make up the SRBAI can be seen in Appendix I. Gardner et al. found that the SRBAI was a reliable measure (with α coefficient ranging from .68 to .97) that correlated strongly with the SRHI (r = .92) and habit-behaviour (r = .41). This measure was included in the study to track participants' habit formation of GM skills over time (more specifically, between the first and second follow-up assessments).

Other measure.

Grade Point Average (GPA). In addition to the performance and self-report measures described above, participants' sessional GPA was recorded on two occasions. That is, their GPA of the semester before they enrolled in this study was recorded during the baseline assessment, and their GPA of the semester in which they were enrolled in this study was recorded during the second follow-up assessment. Collection of participants' sessional GPA at those points in time was included in this study to determine whether academic performance differed depending on group membership in this study. In general, statistics of University of Windsor full-time students' average GPA indicate a slight increase over year one (that is, 66.7 in Spring 2013, 67.6 in Fall 2013, and 67.1 in Winter 2014). A small drop occurred at the beginning of year two when the average was 66.2 in Spring 2014, followed by 70 in Fall 2014 and 69 in Winter 2015. In year three, students' average GPA was 70.2 in Spring 2015, 71.7 in Fall 2015, and 69.7 in Winter 2015 (R. Nease, personal communication, April 28, 2016). Overall, students' GPA trend over the first three years at the University (that is, from Spring 2013 to Winter 2015) indicates little variation in year one with a small decline into year two. This was followed by a small but steady increase into year three and a further drop at the

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end of year three. When the sessional GPA averages are taken together for each year, there is a small but steady incline from 67.13 in the first year to 68.4 in the second year, and then to 70.53 in the third year.

Table 2

Order of Assessment Measure Administration in Baseline and Follow-up Sessions

- WAIS-IV subtests
  - Digit Span
  - Symbol Search
  - Letter-Number Sequencing
  - Coding
- D-KEFS subtests
  - Trail Making Test – Condition 4
  - Verbal Fluency
  - Colour Word Interference – Inhibition, Switching
  - Tower Test
- Background Questionnaire
- GMTQ-S
- RMAS
- SELF-A
- BRIEF-A
- GPA (only at the baseline and second follow-up assessment)
- Feedback Questionnaire 1 (given to GMT participants only at the first follow-up assessment)
- Feedback Questionnaire 2 (given to GMT participants only at the second follow-up assessment)

Note. WAIS-IV = Wechsler Adult Intelligence Scale – Fourth Edition; D-KEFS = Delis-Kaplan Executive Function System; GMTQ-S = Goal Management Training Questionnaire – Self; RMAS = Robert Morris Attention Scale; BRIEF-A = Behavioral Rating Inventory of Executive Functions – Adult Version; GPA = Grade Point Average.

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CHAPTER 5
ANALYSIS OF RESULTS

Preliminary Analyses

Fifty participants completed the baseline assessment (original sample), 38 participants completed the first-follow-up assessment, and 35 participants completed the second follow-up assessment (final sample). As noted earlier, participants were only eligible for this study at the next time point if they had completed all prior assessments and, for those in the GMT group, if they had completed the GMT workshop. The reason for drop out of the 15 participants is not known, as there was no further contact between them and the researcher. Information on the distribution of participants in each group at each time point is presented in Table 3. Most analyses were performed on the final sample of 35 participants.

Table 3. *Overview of Number of Participants in each Group at each Assessment*

	GMT group	Control group
Baseline assessment	27	23
GMT workshop	20	N/A
First follow-up assessment	18	20
Second follow-up assessment	16	19

Before any statistical analyses were performed in order to investigate the hypotheses, an overall EF Skill Score (EFSS) was calculated for each participant after each assessment. All of the EF measures in this study have been hypothesized to be sensitive to GMT in the various research studies described before (see Appendix A).

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Thus, the standard scores of each participant's D-KEFS subtests and WAIS-IV Working Memory subtests (as working memory has been described as an EF) contributed to the overall EFSS. The reason for this was to establish an overall measure of participants' performance on the EF measures. In order to do so, the average of the standard scores of each EF performance measure was determined. In addition to an overall EF domain score, similarly to Novakovic-Agopian et al. (2011), the following subdomain scores were calculated by averaging the participants' standard scores on the related performance tests: working memory, inhibition, switching, and fluency. Table 4 and Figure 2 below illustrates which measures contributed to each EF domain score. As the D-KEFS does not provide Canadian-based norms, all standard scores in this study are calculated by reference to U.S.-based norms in order to allow for intra-study comparisons of test results (Delis et al., 2001; Wechsler, 2008a).

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Table 4. *Subtests that make up each Executive Functioning Subdomain assessed*

Subdomain	EF Performance Measure
Working Memory	WAIS-IV Digit Span
	WAIS-IV Letter-Number Sequencing
Inhibition	D-KEFS Tower Test
	D-KEFS Colour-Word Interference – Inhibition
Switching	D-KEFS Verbal Fluency – Switching
	D-KEFS Trail Making Test – Condition 4
	D-KEFS Colour Word Interference - Switching
Fluency	D-KEFS Verbal Fluency – Semantic
	D-KEFS Verbal Fluency – Phonemic

Note. WAIS-IV = Wechsler Adult Intelligence Scale – Fourth Edition; D-KEFS = Delis-Kaplan Executive Function System.

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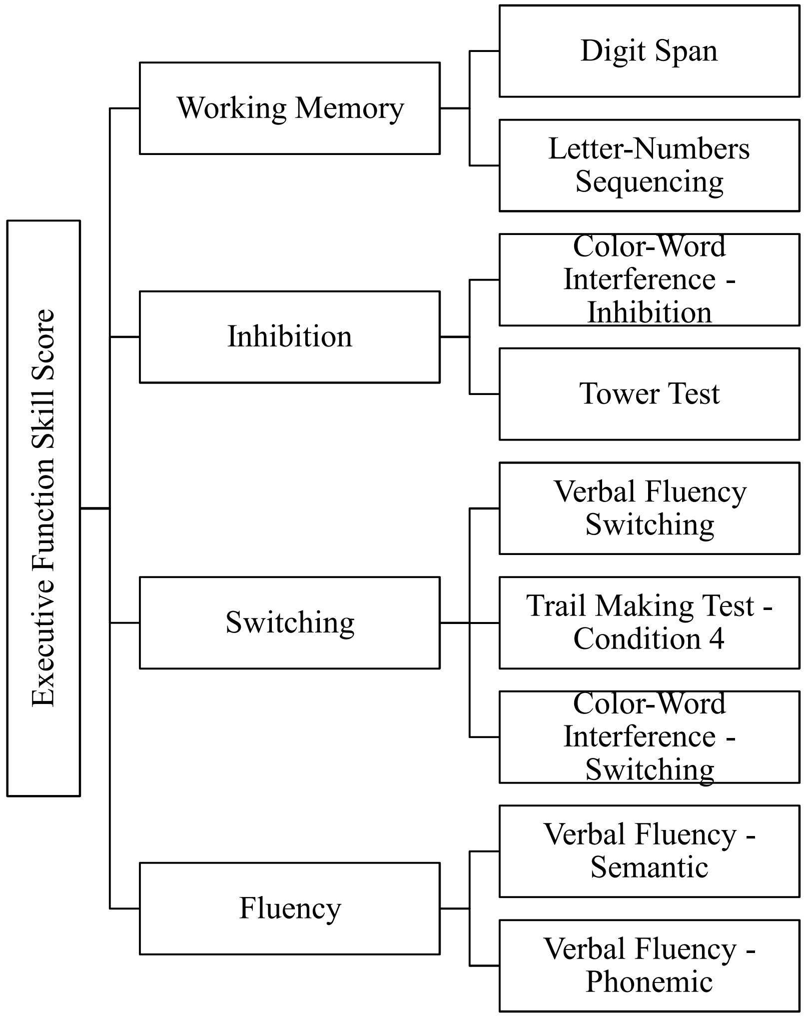

Figure 2. Illustration of subtests that make up each subdomain, and overall Executive Function Skills Score.

In addition to the EF subdomains described above, another subdomain score was calculated that was not directly indicated as an EF measure. For this, two measures of participants' processing speed (that is, the WAIS-IV Symbol Search and Coding subtests) were averaged in order to create the processing speed subdomain score.

Outliers. All variables of the baseline assessment were analyzed for outliers that were more than three standard deviations from the mean. For two variables, the working

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memory and inhibition domain scores, there was one score three standard deviations above the mean at the baseline assessment. Further, at the first follow-up assessment, an outlier existed for the working memory domain score. No outliers existed at the second follow-up assessment. Each subsequent analysis for which any of these scores was used to test the hypotheses was performed with and without the outliers, with no significant changes in the results. For that reason, all outliers were maintained in the data set.

Background variables. Participants in the original sample of 50 ranged in age from 18 to 39 (M = 21.68, SD = 3.56). Most students were psychology majors (52%; single- or double-major) and in the second or third year of their degree (33.3% and 31.4%, respectively). Twelve participants in the sample were males and 38 were females. For the 35 participants who completed all three assessments, the age range was 18 to 39 (M = 21.23, SD = 3.80), with most of these students being psychology majors (47%; single- or double-major). As above, most students were in their second or third year of their degree (42.9% and 28.6%, respectively). Of these 35 participants, 9 were males and 26 were females.

Assumptions. Use of a mixed factorial design is based on meeting several assumptions. The first is the assumption of independence of observations. The assumption of independence of observations was met, as each participant's scores were independent of the other participants' scores in the sample. The research assistants who collected the data for this study were blinded to participants' group membership and tested each participant on a one-on-one basis.

Second is the assumption of a normal distribution. Skewness and kurtosis values were analyzed for the final sample. Skewness values between -2 and 2, and kurtosis

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values between -3 and 3 are consistent with a normal distribution. No skewness values fell outside of this range. However, the working memory domain values for kurtosis of the baseline and first follow-up assessment were above 3 (that is 6.46 and 3.33, respectively), and thus indicated a violation of the normal distribution. That being said, mixed factorial ANOVAs are generally robust against violations (Field, 2009). As noted above, the inclusion of outliers did not affect the results of this study. The fact that outliers were not influential on the results also indicates that the extreme values for kurtosis for the working memory domain did not require procedures to control for violation of the assumption of a normal distribution.

The assumption of sphericity was tested in the final sample for all dependent variables with the *Mauchley's Test of Sphericity*. Here, analyses of four dependent variables indicated that the variances of the differences between measures were not equal, and thus violate this assumption (namely, GEC t-scores, RMAS total raw scores, GMTQ-S total scores, and working memory domain). For these violations, the Huynh-Feldt corrections were considered (GEC t-score $\varepsilon = .90$, RMAS $\varepsilon = .91$, GMTQ-S $\varepsilon = .82$, and working memory domain $\varepsilon = .89$). The values for ε were relatively close to 1, and thus indicate that the violations of sphericity were not severe. Nonetheless, in these instances the multivariate results of mixed factorial ANOVAs are considered to be more powerful than univariate results of mixed factorial ANOVAs (Field, 1998), and thus the former was used to analyze and interpret the data for these four dependent variables.

The assumption of homogeneity of variance in the final sample was assessed with the *Levene's Test.* These analyses indicated significant ($p < .05$) heterogeneity of variance across groups for RMAS total raw scores measured at the baseline and first

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follow-up assessment, as well as for the working memory domain measured at the first follow-up assessment. That being said, mixed factorial ANOVAs are assumed to be robust against violation of the assumption of homogeneity of variance if the group sizes are relatively equal, which is the case for this study.

Lastly, the assumption of homogeneity of covariance in the final sample was assessed with the *Box's M Test*. Results were non-significant for all variables, indicating that this assumption was not violated. Overall, mixed factorial ANOVAs were considered an appropriate method to analyze the data.

Study Hypotheses

Before the hypotheses of this study were investigated, several analyses were performed to ensure that the GMT and control group did not differ significantly on certain characteristics (that is, their age, year in the program, previous sessional GPA, the number of courses they were enrolled in, and whether they had been diagnosed with ADHD), or on the range of time that passed between the baseline assessment and the first follow-up assessment, as well as between the first follow-up assessment and the second follow-up assessment. In addition, participants' baseline measures of self-reported attention and EF difficulties, GM skills, and academic self-efficacy and baseline performance on EF measures were compared for the two groups

For the first part of this investigation, independent *t* tests were performed on four of the three respective descriptive measures (that is, previous sessional GPA and number of courses they were enrolled in) for the original sample. Whether the two groups differed in the number of participants who had previously been diagnosed with ADHD was explored with a *chi-square* analysis. Next, the days that passed between each

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assessment in both groups for all participants who came to that assessment was analyzed with independent *t* tests. Lastly, for the original sample the baseline scores of the two groups on the RMAS (total raw scores), BRIEF-A (for which the GEC-scores were used and converted into *t*-scores), EFSS, GMTQ-S (total scores), and SELF-A (total scores) were also investigated with independent *t*-tests.

Table 5 and 6 below summarize these statistics. None were significant at the $p <$ .05 level. Thus, although the participants of the two groups were not randomly assigned, they did not differ significantly in terms of their characteristics, the amount of time that passed between their assessments, the levels of EF or attentional difficulty they experienced, or their performance on EF measures. Thus, subsequent analyses were warranted to explore the hypotheses.

Table 5. *Descriptive Statistics for Age, Year in Program, Previous Sessional GPA, Number of Courses, Previous Diagnoses of ADHD, and Time between Baseline and First Follow-Up Assessment, and First Follow-Up and Second Follow-Up Assessment (in Days) for the Original Sample*

Group	Age[a] *M (SD)*	Year in Program[a] *M (SD)*	GPA[a] *M (SD)*	Courses[a] *M (SD)*	ADHD[a] (*N*)	Baseline-first follow-up in days[b] *M (SD)*	First-second follow-up in days[c] *M (SD)*
GMT	21.33 (2.56)	2.89 (1.01)	64.20 (13.25)	4.00 (1.21)	4	18.56 (6.96)	109.00 (9.93)
Control	22.09 (4.49)	2.57 (1.04)	67.76 (9.00)	3.39 (1.78)	5	18.10 (6.03)	106.39 (8.16)

[a]GMT group $N = 27$, control group $N = 23$. [b]GMT group $N = 18$, control group $N = 20$. [c]GMT group $N = 16$, control group $N = 19$.

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Table 6. *Descriptive Statistics of Each Group's Baseline Robert Morris Attention Scale (RMAS) Total Raw Scores, Global Executive Composite (GEC) t-scores, Executive Function Skill Score (EFSS), Goal Management Training Questionnaire – Self (GMTQ-S) Total Scores, and Self-Efficacy for Learning Form – Abbreviated (SELF-A) Total Scores for the Original Sample*

Group	RMAS *M (SD)*	GEC t-score *M (SD)*	EFSS[a] *M (SD)*	GMTQ-S *M (SD)*	SELF-A *M (SD)*
GMT	20.04 (2.95)	66.41 (9.64)	10.24 (1.53)	6.33 (1.73)	54.05 (14.93)
Control	19.57 (2.39)	64.83 (9.03)	9.88 (1.80)	6.18 (1.50)	54.90 (14.85)

Note. GMT group $N = 27$, control group $N = 23$
[a]Based on scaled scores with $M = 10$ and $SD = 3$.

The same six independent sample *t* tests (that is, age, year in the program, GPA, number of courses, time between assessment 1 and 2, and time between assessment 2 and 3) and *chi square* analysis (that is, whether or not participants had previously been diagnosed with ADHD) also were completed for the final sample, the 35 participants who completed all three assessments. As above, none of the analyses were significant ($p >$ .05), indicating that the two groups did not differ at baseline on these variables. Tables 7 and 8 below summarize these statistics for the final sample.

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Table 7. *Descriptive Statistics for Age, Year in Program, Previous Sessional GPA, Number of Courses, Previous Diagnoses of ADHD, and Time between Baseline and First Follow-Up Assessment, and First Follow-Up and Second Follow-Up Assessment (in Days) for the Final Sample*

Group	Age *M (SD)*	Year in Program *M (SD)*	GPA *M (SD)*	Courses *M (SD)*	ADHD *(N)*	Baseline-first follow-up in days *M (SD)*	First-second follow-up in days *M (SD)*
GMT	20.06 (1.12)	2.38 (0.81)	63.64 (12.51)	4.06 (1.18)	2	19.00 (6.81)	109.00 (9.93)
Control	22.21 (4.89)	2.53 (1.12)	67.22 (9.75)	3.47 (1.81)	5	17.95 (6.16)	106.39 (8.16)

Note. GMT group $N = 16$, control group $N = 19$.

Table 8. *Descriptive Statistics of Each Group's Baseline Robert Morris Attention Scale (RMAS) Total Raw Scores, Global Executive Composite (GEC) t-scores, Executive Function Skill Score (EFSS), Goal Management Training Questionnaire – Self (GMTQ-S) Total Scores, and Self-Efficacy for Learning Form – Abbreviated (SELF-A) Total Scores for the Final Sample*

Group	RMAS *M (SD)*	GEC t-score *M (SD)*	EFSS[a] *M (SD)*	GMTQ-S *M (SD)*	SELF-A *M (SD)*
GMT	19.81 (3.29)	65.81 (10.38)	9.74 (1.58)	6.47 (1.68)	54.23 (13.67)
Control	19.95 (1.90)	66.16 (9.22)	10.03 (1.93)	6.37 (1.56)	53.94 (13.39)

Note. GMT group $N = 16$, control group $N = 19$.
[a]Based on scaled scores with $M = 10$ and $SD = 3$.

Hypothesis 1. The first hypothesis stated that there would be a positive association between participants' baseline assessment of academic self-efficacy and their baseline assessment of EF measures. To examine this hypothesis, participants' baseline

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assessment SELF-A total scores and their baseline assessment EFSS were illustrated in a scatterplot (see Figure 3 below). As the relationship appeared to be linear, a one-tailed pearson *r* correlational analysis was performed. The results of this analysis were not significant ($r(48) = -.05$, $p = .37$, $N = 50$), indicating that there was no significant relationship between the baseline SELF-A total scores and EFSS in the original sample.

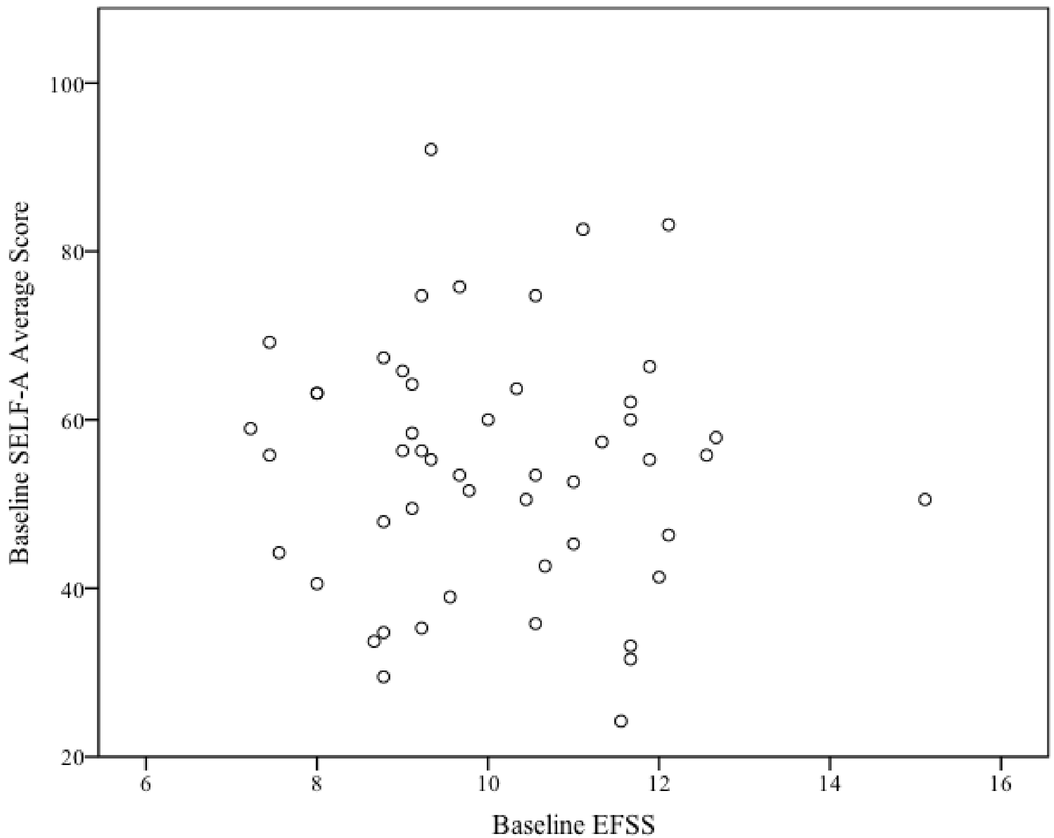

Figure 3. Scatterplot of participants' total Self-Efficacy for Learning Form – Abbreviated (SELF-A) total scores and Executive Function Skill Scores (EFSSs) at baseline assessment for the original sample ($N = 50$).

Hypothesis 1 also stated that participants' self-reported level of academic self-efficacy and their performance on EF measures would be positively correlated with their academic performance. To analyze this, participants' baseline GPA and SELF-A total scores, as well as their baseline GPA and EFSS were graphed in scatterplots (see Figure 4

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and 5 below). As both scatterplots appeared to be linear, two one-tailed pearson *r* correlational analyses were performed. Similarly to the previous findings, no significant correlations were found between students' baseline GPA and SELF-A total scores ($r(48) = -.01$, $p = .47$, $N = 50$) or between their baseline GPA and EFSS ($r(48) = -.14$, $p = .16$, $N = 50$), and thus this hypothesis was not supported.

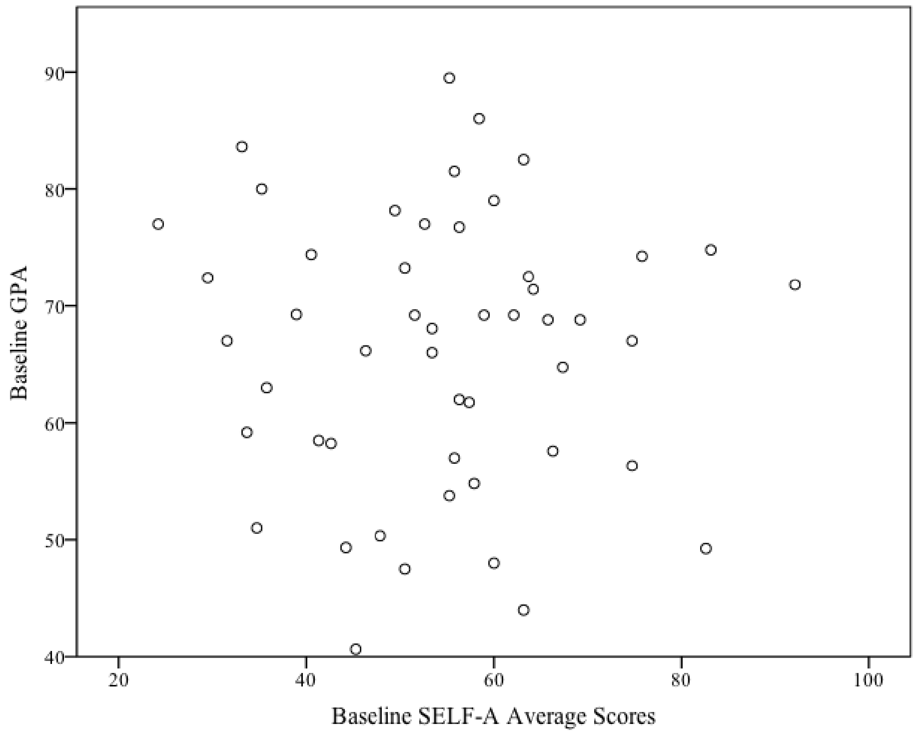

Figure 4. Scatterplot of participants' GPA and total Self-Efficacy for Learning Form – Abbreviated (SELF-A) total scores at baseline assessment for the original sample ($N = 50$).

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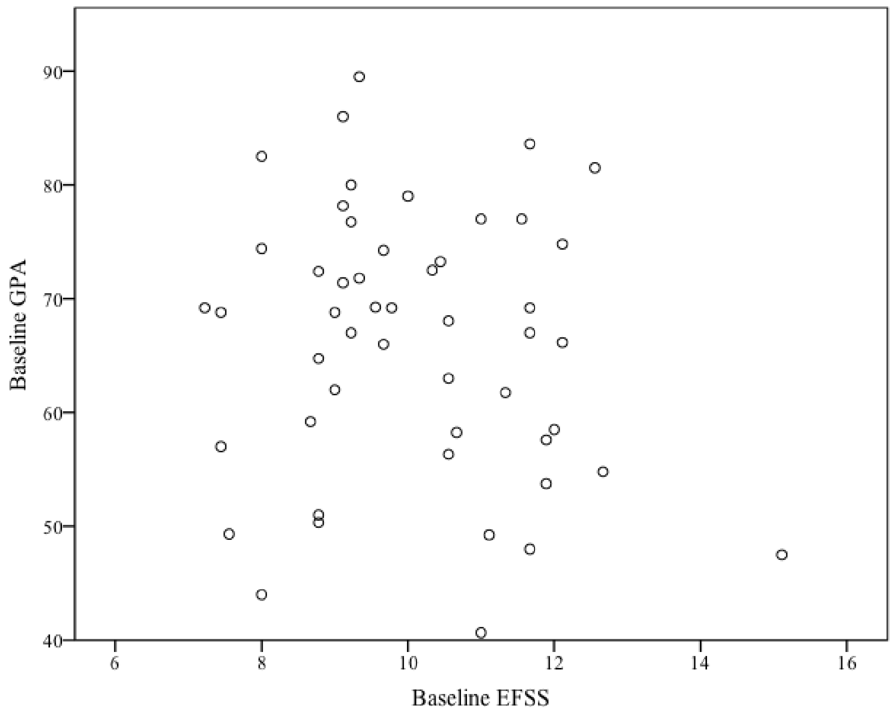

Figure 5. Scatterplot of all participants' GPA and Executive Function Skill Scores (EFSSs) at baseline assessment for the original sample ($N = 50$).

Hypothesis 2. Hypothesis two stated that there would be a negative relation between participants' self-reported attention and EF difficulties, and their performance on the EF measures at the baseline assessment. Similarly to hypothesis one, the participants' baseline EFSS and their BRIEF-A (that is, GEC-*t*-scores), as well as their baseline EFSS and their RMAS total raw scores were illustrated in separate scatterplots (see Figure 6 and 7 below).

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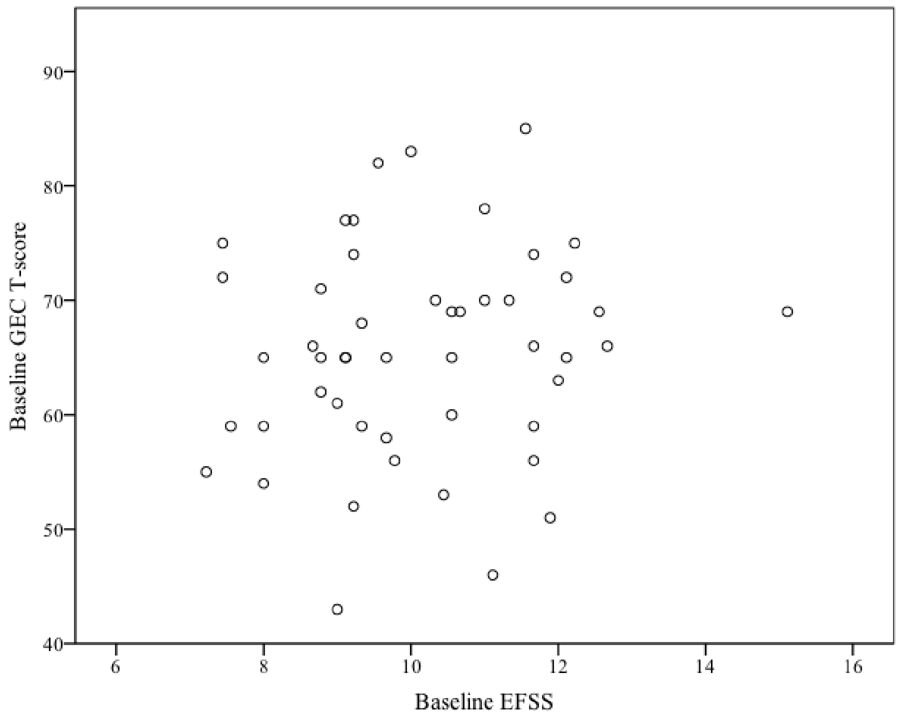

Figure 6. Scatterplot of participants' baseline Global Executive Composite (GEC) t-scores and Executive Function Skill Scores (EFSSs; $N = 50$) in the original sample.

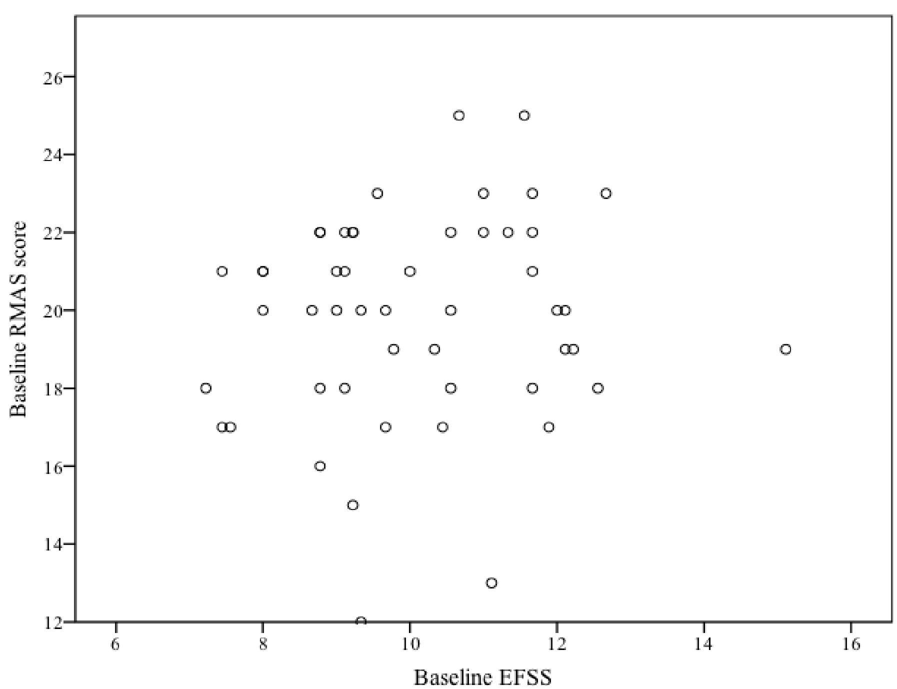

Figure 7. Scatterplot of participants' baseline Robert Morris Attention Scale (RMAS) total raw scores and Executive Function Skill Scores (EFSSs; $N = 50$) in the original sample.

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The relationships between the GEC *t*-scores and EFSS scores appeared to be linear, and thus a one-tailed Pearson *r* correlational analysis was conducted. The results of this analysis were not significant ($r(48)= .13$ $p = .19$, $N = 50$), indicating that there was no significant relationship between the amount of self-reported EF difficulties and participants' performance on EF measures. Similarly, the relationship between the RMAS total raw scores and EFSS also appeared to be linear, and thus another one-tailed pearson *r* correlational analysis was conducted. This analysis showed results that were also non-significant ($r(48) = .12$, $p = .21$, $N = 50$), and thus this hypothesis was not supported. Overall, participants' performance on EF measures at the baseline assessment was not significantly related to the amount of EF or attentional difficulties they reported.

Hypothesis 3. Hypothesis 3 suggested that there would be a significant increase in GMT participants' performance after they had received the GMT workshop on EF measures over time (that is, from the baseline assessment to the first follow-up assessment and to the second follow-up assessment), and that this increase would be significantly greater than any changes observed in the performance of the control group. As the control group did not receive an intervention, any change in this group was assumed to be due to practice effects, effects of contact with the researcher, or non-specific developmental changes.

To investigate this hypothesis, a total of five two-by-three mixed factorial ANOVAs were performed on data from the final sample. These statistical analyses investigated the difference on EF performance measures between the two groups (that is, GMT and control group), as well as within the same group (that is, from the baseline assessment to the first follow-up assessment and to the second follow-up assessment).

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More specifically, one mixed factorial ANOVA was performed using the overall EFSS, and four more mixed factorial ANOVAs were performed using the four domain scores as separate dependent variables (that is, working memory, switching, inhibition, and fluency). Table 9 shows significant main effects for time of assessments for EFSS, working memory, switching, inhibition, and fluency ($p < .05$ and $N = 35$), but no significant main effect for group membership for these domains ($p > .05$ and $N = 35$). In addition, no significant interaction effect between group and time was observed for these domains ($p > .05$ and $N = 35$), and thus no post-hoc analyses were performed. Please see Table 10 for a summary of scores by group and time of assessment.

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Table 9. *Results of the Mixed Factorial ANOVAs of Executive Function Skill Score (EFSS) and Executive Function Domains in the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
EFSS	2, 66	61.01	.00	.65
Working Memory	2, 32	5.45	.01	.25
Switching	2, 66	13.37	.00	.31
Inhibition	2, 66	19.53	.00	.37
Fluency	2, 66	18.04	.00	.35
Main Effect for Group				
EFSS	1, 33	.21	.65	.01
Working Memory	1, 33	1.08	.31	.03
Switching	1, 33	.66	.42	.02
Inhibition	1, 33	.07	.79	.00
Fluency	1, 33	.03	.86	.00
Interaction Effect Time*Group				
EFSS	2, 66	.97	.38	.03
Working Memory	2, 32	1.47	.25	.08
Switching	2, 66	.62	.54	.02
Inhibition	2, 66	1.58	.21	.05
Fluency	2, 66	1.04	.36	.03

Note. GMT group $N = 16$, control group $N = 19$.

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Table 10. *Mean and Standard Deviation Scores of Executive Function Skill Scores (EFSS) and Executive Function Domains by Time of Assessment for the Final Sample (N = 35)*

	Group	Mean	*SD*
EFSS			
Baseline	GMT	9.74	1.58
	Control	10.03	1.93
First Follow-Up	GMT	10.98	1.77
	Control	11.08	1.94
Second Follow-Up	GMT	10.83	1.63
	Control	11.26	1.84
Working Memory			
Baseline	GMT	8.75	1.68
	Control	9.39	2.44
First Follow-Up	GMT	9.31	1.28
	Control	9.74	2.42
Second Follow-Up	GMT	9.44	2.24
	Control	10.53	2.54
Switching			
Baseline	GMT	9.56	2.32
	Control	9.86	1.92
First Follow-Up	GMT	10.52	2.63
	Control	11.11	2.14
Second Follow-Up	GMT	10.35	2.32
	Control	11.16	1.83
Inhibition			
Baseline	GMT	10.41	1.84
	Control	10.47	1.56
First Follow-Up	GMT	12.38	2.01
	Control	11.66	1.80
Second Follow-Up	GMT	11.88	1.36
	Control	12.13	1.79

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	Group	Mean	*SD*
Fluency			
Baseline	GMT	10.31	3.26
	Control	10.47	3.45
First Follow-Up	GMT	11.94	3.58
	Control	11.79	3.23
Second Follow-Up	GMT	11.88	3.30
	Control	11.29	3.34

Note. GMT group $N = 16$, control group $N = 19$. The subdomain scores are averages of scaled scores *(M=10, SD=3)* on the following subtasks: Working Memory: Digit Span and Letter-Number Sequencing; Switching: Verbal Fluency – Switching, Trail Making Test – Condition 4, and Color-Word Interference – Switching; Inhibition: Tower Test, Color-Word Interference – Inhibition; Fluency: Verbal Fluency – Semantic and Verbal Fluency – Phonemic. The Executive Function Skill Score is the average of the scaled scores on all of those subtasks. Scaled scores have a mean of 10 and a standard deviation of 3.

Additional mixed factorial ANOVAs were completed with all individual performance measures. The results of these analyses show significant main effects for time for most performance measures (that is, for Digit Span, Color-Word Interference – Inhibition as well as Switching, Tower Test, Trail Making Test – Condition 4, Verbal Fluency Phonemic as well as Semantic, Symbol Search, and Coding. Again, no significant main effects were found for group membership on any of these measures ($p > .05$). Further, no significant effects for group membership over time were found on either performance measures ($p > .05$), with the exception of Symbol Search ($F(2, 66) = 3.82$, $p = .03$) and Coding ($F(2, 66) = 3.46$, $p = .04$). The results of all analyses can also be seen in Appendix L.

Hypothesis 4. This hypothesis predicted that there would be a significant increase in the GMT participants' self-reported levels of academic self-efficacy after the GMT workshop (that is, from the baseline to the first follow-up assessment and to the second follow-up assessment), and that this increase would be significantly greater than

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any changes found in the self-reports of the control group. The statistical analysis used to investigate this hypothesis was also a two-by-three mixed factorial ANOVA using participants' SELF-A total scores of the final sample. This analysis explored the change in the score of self-efficacy over time, and whether the changes in the two groups differed.

As can be seen in Table 11, there was a significant increase in participants' self-efficacy scores over time ($p = .03$, $N = 35$), but no significant difference in the changes of SELF-A total scores across time between the two groups. Thus, no further post-hoc analyses were performed.

Table 11. *Results of the Mixed Factorial ANOVA of Self-Efficacy for Learning – Abbreviated (SELF-A) Total Scores, and Mean and Standard Deviations at each Time of Assessment for the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
SELF-A	2, 66	3.71	.03	.10
Main Effect for Group				
SELF-A	1, 33	.02	.88	.00
Interaction Effect Time*Group				
SELF-A	2, 66	.12	.88	.00
		Group	Mean	*SD*
Baseline		GMT	54.23	13.67
		Control	53.95	13.39
First Follow-Up		GMT	54.59	16.52
		Control	56.14	11.25
Second Follow-Up		GMT	58.63	13.27
		Control	59.22	11.53

Note. GMT group $N = 16$, control group $N = 19$.

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Hypothesis 5. Hypothesis 5 predicted that there would be a significant increase in the self-reported GM skills of the GMT group over time (that is, from the baseline assessment to the first follow-up assessment and to the second follow-up assessment), and that this increase would be significantly greater than any self-reported changes found in the control group. Again, a two-by-three mixed factorial ANOVA served to analyze the data in the final sample by determining the groups' changes in their GMTQ-S total scores.

Results of this analysis yielded a significant reduction in overall scores over time, indicating a decrease in self-reported GM skills difficulties. A significant difference in the pattern of changes in self-reported difficulties was also observed between the GMT and control group over time (see Table 12). As can be seen in Figure 8, on an absolute basis the GMT group reported less GM difficulties at the first follow-up assessment compared to baseline, whereas the control group reported more such difficulties. Thus, hypothesis 5 was partially supported.

Furthermore, a significant within-subject quadratic contrast was found ($p < .05$), indicating a significant difference in the change of direction of reported difficulties in the control group, with an initial increase in reported GM difficulties at the first follow-up assessment, followed by a decrease in reported GM difficulties at the second follow-up assessment.

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Table 12. *Results of the Mixed Factorial ANOVA of Goal Management Training – Self (GMTQ-S) Total Scores, and Mean and Standard Deviations at each Time of Assessment in the Final Sample*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
GMTQ-S	2, 32	4.55	.02	.22
Main Effect for Group				
GMTQ-S	1, 33	.76	.39	.02
Interaction Effect Time*Group				
GMTQ-S	2, 32	3.40	.05	.18

	Group	Mean	*SD*
Baseline	GMT	6.47	1.68
	Control	6.37	1.56
First Follow-Up Assessment	GMT	5.82	1.76
	Control	6.72	1.59
Second Follow-Up Assessment	GMT	5.28	2.01
	Control	5.74	1.46

Note. GMT group $N = 16$, control group $N = 19$.

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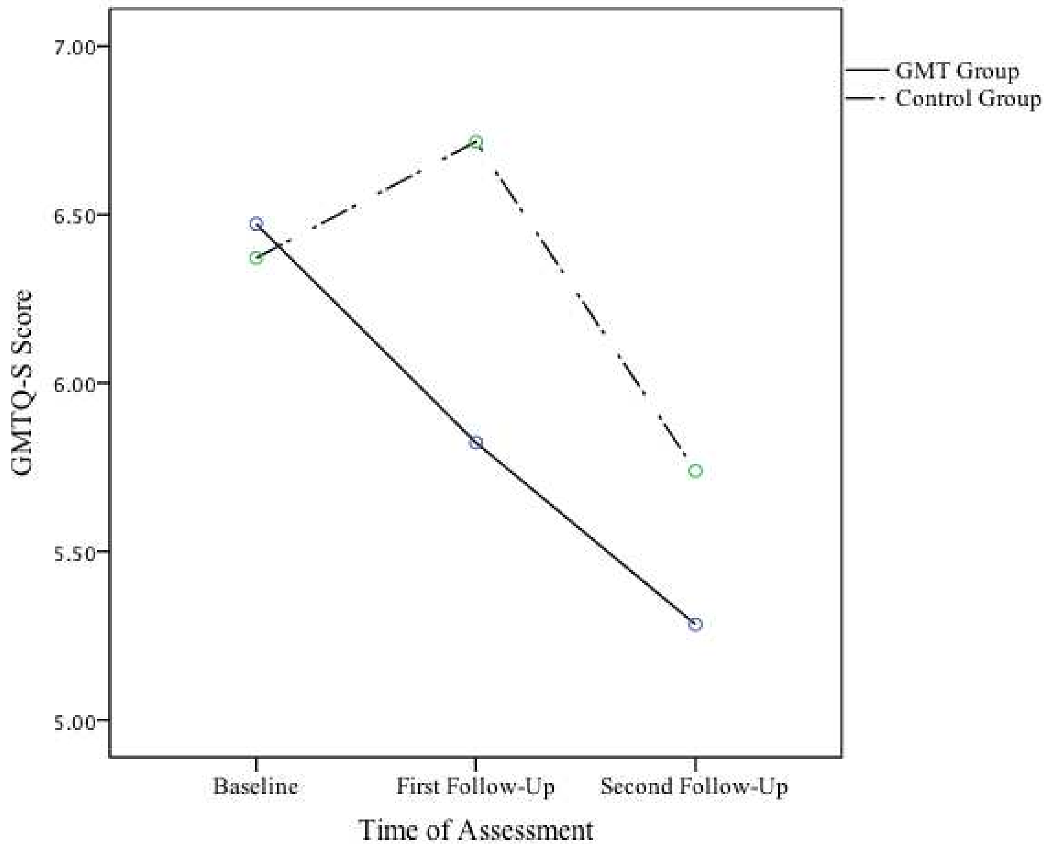

Figure 8. Linear graph of participants' GMTQ-S total scores over time by group membership for the final sample (GMT group $N = 16$, control group $N = 19$).

A post-hoc analysis was performed to investigate the differences between the groups on each of the assessments. More specifically, three two-by-two mixed factorial ANOVAs were conducted to investigate the difference in GMTQ-S total scores between the two groups between two specific points in time (that is, the change in scores between the baseline and first follow-up assessment, between the baseline and second-follow-up assessment, and between the first and second follow-up assessment). As the type of analysis was changed from a two-by-three mixed factorial ANOVA to a two-by-two mixed factorial ANOVA, a separate G-Power analysis was performed to identify the number of participants needed for sufficient power. This analysis yielded that for a RM

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ANOVA with a within-between interaction and two groups (again, henceforth referred to as a mixed factorial ANOVA), a power of .8, a moderate effect size, and two measurements, 34 participants would be needed. The final sample included 35 participants, and thus enough data was collected to continue the analyses.

The results of these analyses showed that there was no significant decrease in reported GMTQ-S total scores over time for the final sample as a whole between baseline and first follow-up assessment; however, there was a significant difference in the pattern of change in GMTQ-S total scores between these two assessments between the GMT and control groups. More specifically, while the GMTQ-S total scores of the GMT group decreased, they increased for the control group (see Table 11). Thus, participants who received the GMT workshop reported significantly less GM skill difficulties at the first follow-up assessment compared to the baseline assessment than did participants who did not receive the GMT. Results further showed an overall significant decrease in GMTQ-S total scores across groups between the baseline assessment and second follow-up assessment, as well as between the first and second follow-up assessment ($p < .05$), with no significant difference between the two groups (see Table 13). Thus, the difference between groups seen at the first follow-up assessment was not sustained at the second follow-up assessment.

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Table 13. *Results of the Post-Hoc Mixed Factorial ANOVAs of Goal Management Training – Self (GMTQ-S) Total Scores, and Mean and Standard Deviations in Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
GMTQ-S (Baseline to First Follow-Up Assessment)				
Main Effect for Time	1, 33	.58	.45	.02
Main Effect for Group	1, 33	.58	.45	.02
Interaction Effect Time*Group	1, 33	6.20	.02	.16
GMTQ-S (Baseline to Second Follow-Up Assessment)				
Main Effect for Time	1, 33	7.79	.01	.19
Main Effect for Group	1, 33	.15	.71	.00
Interaction Effect Time*Group	1, 33	.73	.40	.02
GMTQ-S (First to Second Follow-Up Assessment)				
Main Effect for Time	1, 33	8.89	.01	.21
Main Effect for Group	1, 33	1.70	.20	.05
Interaction Effect Time*Group	1, 33	.74	.40	.02

Note. GMT group $N = 16$, control group $N = 19$.

Hypothesis 6. This hypothesis stated that there would be a significant decrease in GMT participants' self-reported attentional and EF difficulties after they had received the GMT workshop and over time. This decrease was further hypothesized to be significantly greater than any decrease found in the control group. Two two-by-three

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mixed factorial ANOVAs were used to investigate this hypothesis, using the RMAS total raw scores and the BRIEF-A scores (more specifically, the GEC t-scores).

First, the mixed factorial ANOVA of the participants' RMAS total raw scores was conducted. These results indicated a significant decrease in RMAS total raw scores across groups over time but no significant difference between the groups overall, or between the groups over time (see Table 14).

Table 14. *Results of the Mixed Factorial ANOVA of Robert Morris Attention Scale (RMAS) Total Raw Scores, and Mean and Standard Deviations at each Time of Assessment for the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
RMAS	2, 32	5.69	.01	.26
Main Effect for Group				
RMAS	1, 33	.17	.68	.01
Interaction Effect Time*Group				
RMAS	2, 32	.21	.82	.01

	Group	Mean	*SD*
Baseline	GMT	19.81	3.29
	Control	19.95	1.90
First Follow-Up Assessment	GMT	19.56	3.41
	Control	19.74	2.62
Second Follow-Up Assessment	GMT	17.81	3.76
	Control	18.58	2.95

Note. GMT group $N = 16$, control group $N = 19$.

To explore the second part of this hypothesis (that is, changes in reported EF difficulties), a two-by-three mixed factorial ANOVA was conducted with participants

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GEC t-scores. Again, results showed a main effect in that EF difficulties decreased for both groups over time. No significant effect was observed for group membership, as well as no significant difference between the groups over time (see Table 15).

Table 15. *Results of the Mixed Factorial ANOVA of Global Executive Composite (GEC) t-scores, and Mean and Standard Deviations at each Time of Assessment in the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
GEC t-score	2, 32	5.05	.01	.24
Main Effect for Group				
GEC t-score	1, 33	.08	.78	.00
Interaction Effect Time*Group				
GEC t-score	2, 32	.20	.82	.01
	Group	Mean	*SD*	
Baseline	GMT	65.81	10.38	
	Control	66.16	9.22	
First Follow-Up Assessment	GMT	65.00	11.76	
	Control	65.42	10.95	
Second Follow-Up Assessment	GMT	60.56	8.31	
	Control	62.58	11.57	

Note. GMT group $N = 16$, control group $N = 19$. Based on t-scores with $M = 50$ and $SD = 10$.

Overall, the results showed that there was a significant decrease of participants' attentional and EF difficulties; however, no significant difference was found between the two groups overall, or between the two groups over time. Thus, this hypothesis was not supported.

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Hypothesis 7. Hypothesis 7 stated that there would be an improvement in GMT participants' academic performance as measured by the intervention effects on their grades, and that this improvement would be greater than any changes found in the control group. To investigate whether this hypothesis was supported by the results, the change in participants' grades of the semester before and after participation in this study were analyzed. More specifically, their sessional GPA collected at the baseline assessment was compared to their sessional GPA collected at the second follow-up assessment to determine whether the change in grades from these points in time was significant within each group, as well as whether any such changes found were dependent on group membership. This hypothesis was investigated with another two-by-two mixed factorial ANOVA. As for the post-hoc analyses performed for hypothesis 5, the number of participants needed for sufficient power of this analysis was 34. The results of this analysis showed an overall significant increase in sessional GPA among participants, but no significant main effect for group membership or significant difference between the GMT and control group (see Table 16 and Figure 9).

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Table 16. *Results of the Mixed Factorial ANOVA for Sessional GPA, and Mean and Standard Deviation for Sessional GPA at Baseline and Second Follow-Up Assessment for the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
GPA	1, 33	8.22	.01	.20
Main Effect for Group				
GPA	1, 33	1.82	.19	.05
Interaction Effect Time*Group				
GPA	1, 33	.07	.79	.00

	Group	Mean	*SD*
Baseline	GMT	63.64	12.51
	Control	67.22	9.75
Second Follow-Up Assessment	GMT	68.28	9.09
	Control	72.81	9.73

Note. GMT group *N* = 16, control group *N* = 19.

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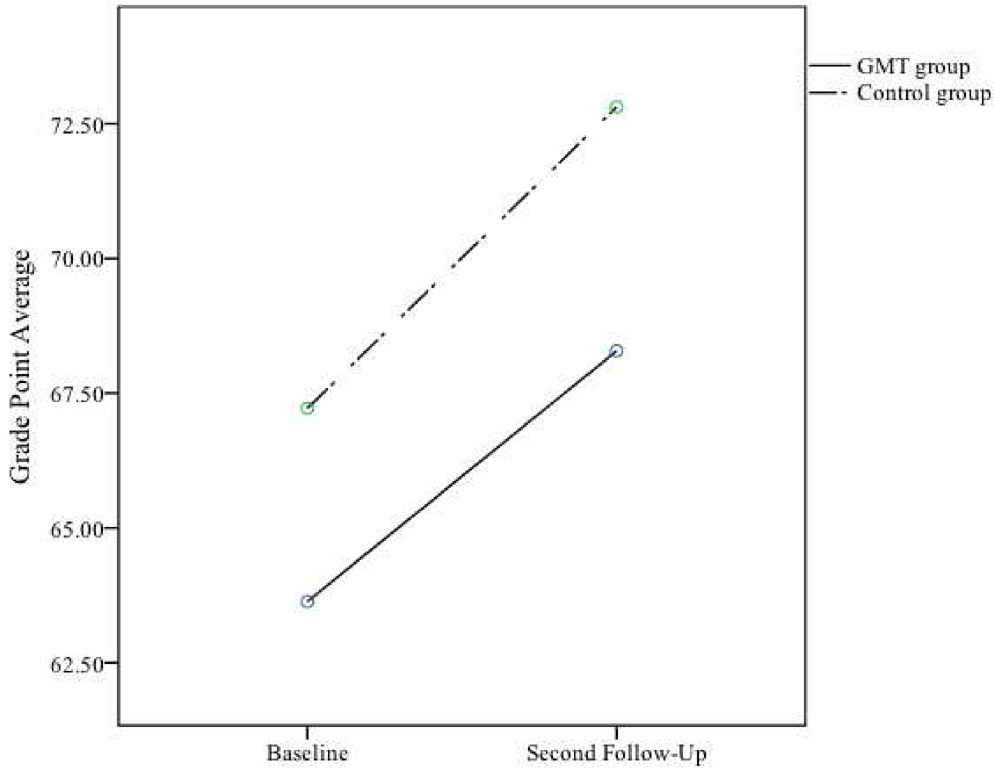

Figure 9. Linear graph of participants' GPA over time by group membership for the final sample (GMT group $N = 16$, control group $N = 19$).

Hypothesis 8. It was hypothesized that participants in the GMT group would acquire the habit of using the GMT strategies in their daily life following a non-linear pattern, with a greater increase of habit acquisition (as measured by the SRBAI) initially, and lesser increase of habit formation over time. Participants in the GMT group filled out the SRBAI on an irregular basis (see Table 17 below), with ratings ranging from 0 to 20. To examine this hypothesis, the average of all participants' ratings for a given week was calculated and depicted in a linear graph. One can see in Table 17 and Figure 10 that the reported GMT habit acquisition of participants remained relatively stable over the 12 weeks between the first and second follow-up. No non-linear trend was detected in the data and thus this hypothesis was not supported.

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Table 17. *Weekly Average Self-Report Behavioural Automaticity Index (SRBAI) Ratings and Number of GMT Group Participants Contributing Ratings for the Week*

Week	1	2	3	4	5	6	7	8	9	10	11	12
N	8	8	10	12	4	7	6	7	8	7	4	8
Average SRBAI Score	13.25	11.13	12.70	12.00	11.25	13.14	13.17	13.14	14.14	14.38	14.29	14.38

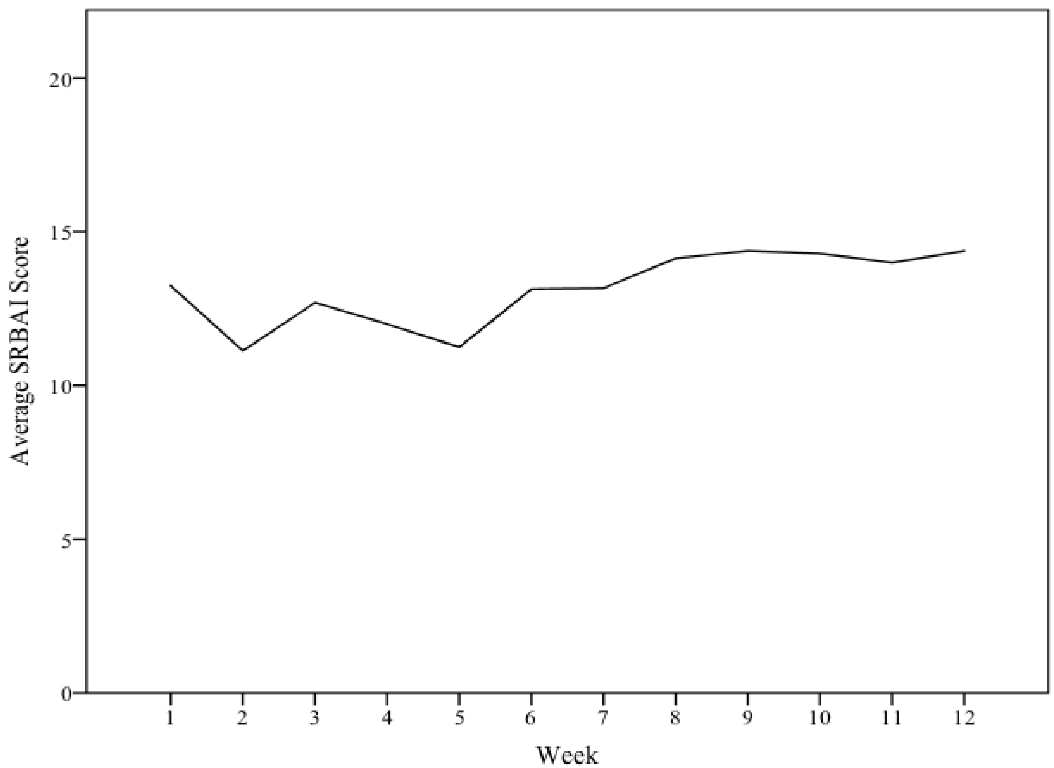

Figure 10. Linear graph of GMT group participants' average Self-Report Behavioural Automaticity Index (SRBAI) scores at each week between the first and second follow-up assessment. As listed in Table 15, number of ratings per week ranged from 4 to 12.

To analyze the data further and to determine whether participants acquired the GM strategies over time, the reported SRBAI score of the first and last four weeks were compared using an independent sample *t* test. For this, the 12 weeks were divided into three intervals of four weeks each (that is, weeks one through four, weeks five through

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eight, and weeks nine through 12). Each rating submitted by the participants was entered as a separate score for all intervals. Next, using an independent sample *t* test, scores recorded within weeks one through four were compared to scores recorded within weeks nine through twelve. SRBAI scores in the first 4-week interval in fact are not independent of those in the last 4 weeks, since all GMT group participants were encouraged to provide SRBAI ratings each week. Use of the independent sample *t* test therefore provides a conservative test of the hypothesis.

This analysis indicated significant results ($p = .02$) in that scores collected during weeks one through four after the GMT workshop (that is, $M = 12.47$, $SD = 3.01$) were significantly lower than scores collected during weeks nine through twelve after the GMT workshop (that is, $M = 14.77$, $SD = 3.57$). These results suggest a significant increase in GM skill acquisition over time, and one can see in Figure 11 a linear trend of this acquisition.

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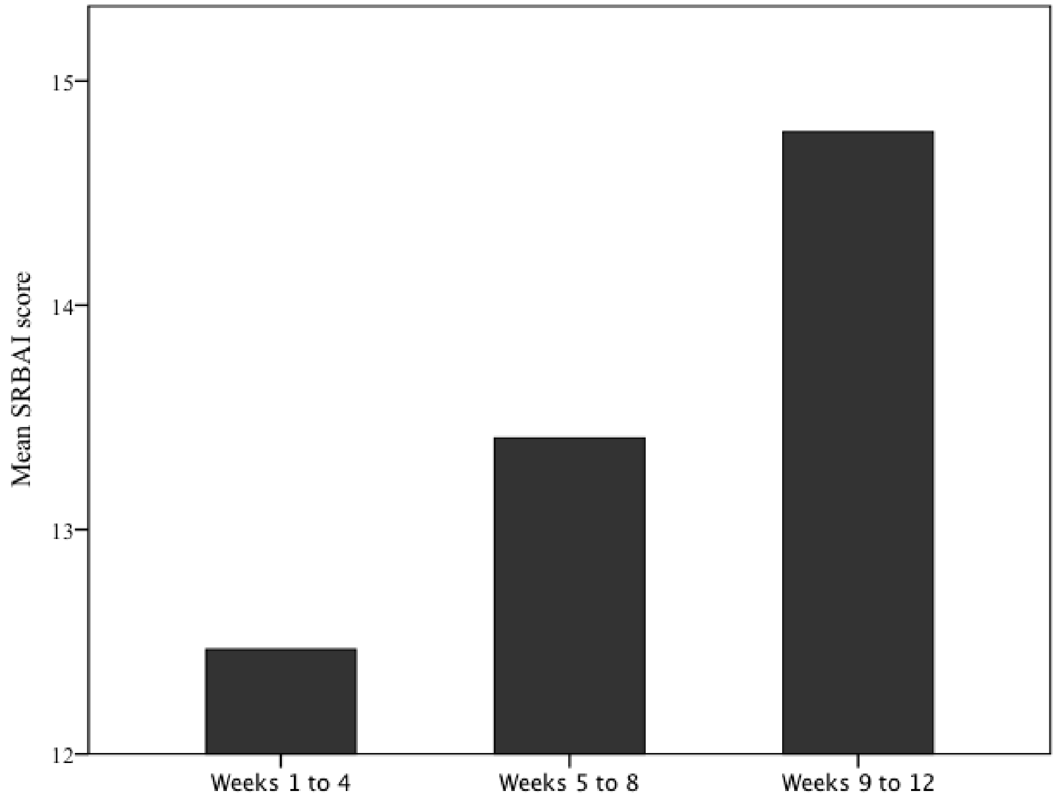

Figure 11. Bar graph of mean SRBAI scores for each of the three four-week intervals. Number of GMT participants contributing ratings each week is listed in Table 15.

Supplementary Analyses

Several analyses not directly linked to a specific hypothesis were performed to investigate and understand the data more completely. The purpose of the following analyses was to discover any treatment effect of the GMT intervention and to facilitate future hypothesis generation in this area.

Processing speed subdomain. The research design included an assessment of processing speed in order to tap a domain not directly linked to EFs. A two-by-three mixed factorial ANOVA was conducted to investigate any changes in performances over time by group. As can be seen in Table 18 and Figure 12, participants' scores increased

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significantly over time, as well as significantly more within the GMT group than in the control group.

Table 18. *Results of the Mixed Factorial ANOVA of Processing Speed Scores, and Mean and Standard Deviations at each Time of Assessment for the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
Processing Speed	2, 66	61.17	.00	.68
Main Effect for Group				
Processing Speed	1, 33	.84	.37	.03
Interaction Effect Time*Group				
Processing Speed	2, 66	5.74	.01	.15

	Group	Mean	*SD*
Baseline	GMT	10.88	2.37
	Control	10.71	2.30
First Follow-Up Assessment	GMT	12.97	2.70
	Control	12.45	2.87
Second Follow-Up Assessment	GMT	14.16	2.63
	Control	12.53	2.66

Note. GMT group $N = 16$, control group $N = 19$. The Processing Speed scores are averages of scaled scores on Symbol Search and Coding subtests. Scaled scores have a mean of 10 and a standard deviation of 3.

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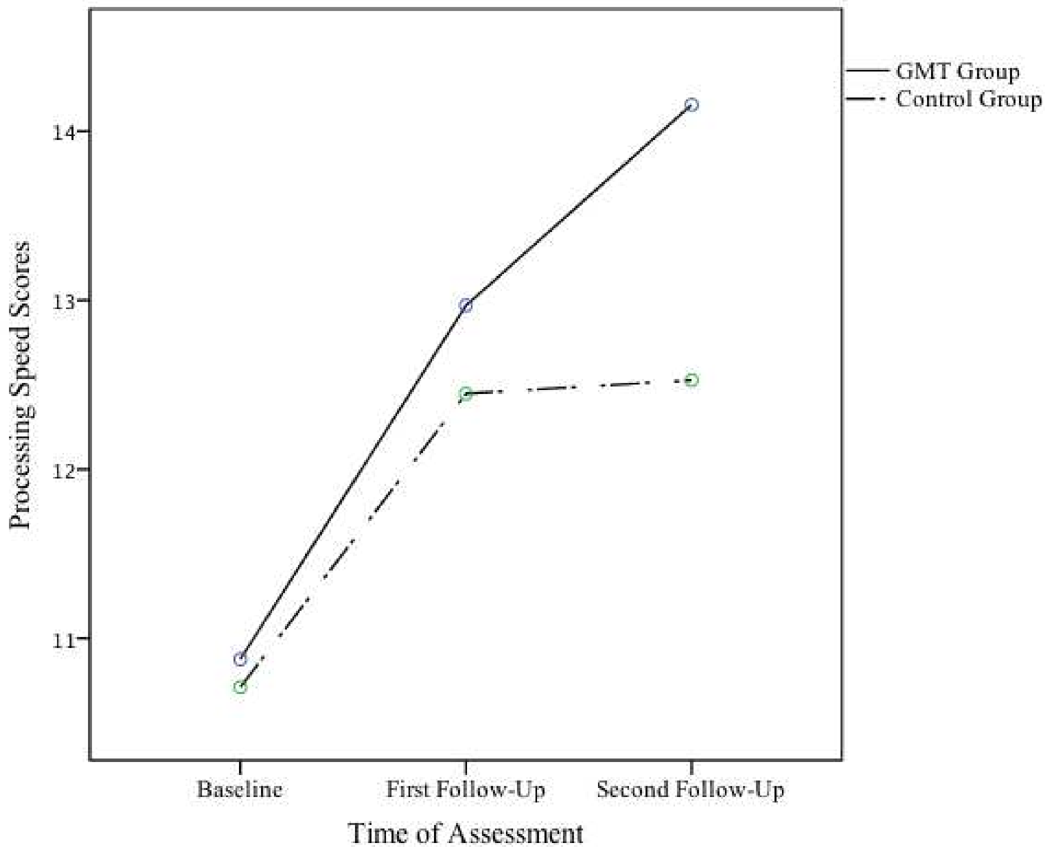

Figure 12. Linear graph of participants' processing speed scores over time by group membership for the final sample (GMT group $N = 16$, control group $N = 19$).

A post-hoc analysis was performed to determine the points in time at which changes differed between groups. As can be seen in Table 19, across groups, participants' overall processing speed scores increased between each time of assessment. Further, the GMT group participants' scores increased significantly more than the control group participants' scores between the baseline and second follow-up assessment, as well as between the first and second follow-up assessment.

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Table 19. *Results of the Mixed Factorial ANOVAs of Processing Speed Subdomain Scores for the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Processing Speed (Baseline to First Follow-Up Assessment)				
Main Effect for Time	1, 33	63.73	.00	.67
Main Effect for Group	1, 33	.17	.69	.01
Interaction Effect Time*Group	1, 33	.59	.45	.02
Processing Speed (Baseline to Second Follow-Up Assessment)				
Main Effect for Time	1, 33	101.19	.00	.75
Main Effect for Group	1, 33	1.24	.27	.04
Interaction Effect Time*Group	1, 33	8.37	.01	.20
Processing Speed (First to Second Follow-Up Assessment)				
Main Effect for Time	1, 33	11.62	.00	.26
Main Effect for Group	1, 33	1.41	.24	.04
Interaction Effect Time*Group	1, 33	8.90	.01	.21

Note. GMT group $N = 16$, control group $N = 19$.

To further analyze the processing speed subdomain scores, the two WAIS-IV measures that made up this subdomain were separately analyzed using two-by-three mixed factorial ANOVAs. These results showed that both Symbol Search and Coding subtests showed a significant increase in scaled scores across groups over time (Symbol Search: $F(2, 66) = 60.84$, $p < .01$; Coding: $F(2, 66) = 21.21$, $p < .01$), as well as a

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significant difference between the two groups over time (Symbol Search: $F(2, 66) = 3.82$, $p = .03$, partial $\eta^2 = .10$, $N = 35$; Coding: $F(2, 66) = 3.46$ $p = .04$, partial $\eta^2 = .10$, $N = 35$). However, no significant main effect for group membership was observed for either subtask ($p > .05$).

The increase in participants' scores may be higher than what would be expected on the basis of practice effects. As noted before, reliability coefficients of both the Coding and Symbol Search subtasks are relatively high (that is, .86 and .81, respectively; Wechsler, 2008a). Further, Estevis et al. (2012) found that a mean increase of 1.1 for the Coding subtest scaled score and 2.2 for the Symbol Search subtest scaled score occurred between a baseline assessment and either a three- or six-months follow-up assessment. In addition, Wechsler (2008b) found that a mean increase of .6 for the Coding subtest scaled score and .9 for the Symbol Search subtest scaled score occurred between a baseline assessment and a follow-up assessment 22 days later. Taken together (that is, calculating the average increase of the Coding and Processing Speed subtasks), the mean increase observed in Estevis et al.'s study results in 1.65, and the mean increase observed in Wechsler's study results in .75. It is important to note that participants in both of those studies were only assessed twice, whereas participants in this study were assessed three times. Nevertheless, it is interesting to see that the mean increase observed between the baseline and second follow-up assessment in the processing speed subdomain mean scores of the control group in this study, which was 1.82, is similar to the increase reported by Estevis et al. However, the mean increase between these times of assessments in the GMT group was 3.28, which is almost twice as high. Thus, practice effects alone likely do not explain the difference in scores between the two groups.

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Multicollinearity among dependent variables. A multicollinearity analysis among all dependent variables at the baseline assessment was conducted with multiple pearson *r* correlational analyses for the original sample ($N = 50$). As shown in table 20 below, several measures were significantly correlated. More specifically, there was a significant relationship between the RMAS total raw scores, the SELF-A total scores, the GMTQ-S total scores, and the GEC t-scores. Results also showed several significant correlations among the performance measures across the different subdomains assessed (that is, working memory, fluency, inhibition, switching, and processing speed).

BRIEF-A indices and subdomains. For hypothesis six, the relationship between self-reported EF difficulties (as measured by BRIEF-A GEC t-scores) and group membership was analyzed over time. As stated above, no significant difference between the GMT and control group was found in terms of self-report. As the GEC of the BRIEF-A represents an overall measure of EF difficulties, and in itself is derived from scores on two indices (that is, the Metacognitive Index [MI] and the Behavioral Regulation Index [BRI]), which in turn are comprised of several subdomains (see Tables 20A and 20B), a supplementary in-depth analysis of the relationship between group membership and each index and subdomains was performed. More specifically, one two-by-three mixed factorial ANOVA was performed for each index (that is, the MI and BRI), which yielded a significant decrease in scores of both indices among all participants over time ($p \leq .01$ for both), but no significant difference in scores between groups ($p > .05$). Following this, nine two-by-three mixed factorial ANOVAs were conducted to examine each subdomain. Of these, the subdomains of Task Monitor, Initiate, Working Memory, and Organization of Materials yielded a significant decrease across groups over time ($p <$

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.05), but no subdomain yielded significant effects for group membership and difficulties over time (see Table 21 below for details).

Table 20A. *Results of Pearson r Correlational Analyses Among the Dependent Variables at Baseline- Part A*

		RMAS Total Raw	SELF-A Total	GMTQ-S Total	GEC t-score	Digit Span	Symbol Search	Coding
RMAS Total Raw	*r*	1	-.47**	.57**	.55**	.19	-.06	-.18
SELF-A Total	*r*	-.47**	1	-.33*	-.29*	-.23	-.06	.21
GMTQ-S Total	*r*	.57**	-.33*	1	.62**	.05	-.06	-.19
GEC t-score	*r*	.55**	-.29*	.62**	1	.20	-.10	-.12
Digit Span	*r*	.19	-.23	.05	.20	1	.09	.10
Symbol Search	*r*	-.06	-.06	-.06	-.10	.09	1	.49**
Coding	*r*	-.18	.21	-.19	-.12	.10	.49**	1
LNS	*r*	.05	-.09	.10	.12	.63**	-.01	.01
Phonemic Fluency	*r*	-.02	.13	-.09	.10	.41**	.17	.46**
Semantic Fluency	*r*	-.04	.04	-.29*	.03	.13	.08	.32*
Switching Fluency	*r*	.17	.01	.07	.10	.04	-.05	.06
Trails Condition 4	*r*	.25	-.19	.13	.13	.45**	.18	.30*
CW Cond. 3	*r*	.02	-.06	-.15	-.15	.47**	.26	.42**
CW Cond. 4	*r*	.03	.09	-.12	.03	.35*	.32*	.40**
Tower Test	*r*	.05	-.12	-.11	.02	.07	-.15	-.05

Note: N = 50. CW Cond. = Color-Word Condition. LNS – Letter-Number Sequencing.
* significant at $p \leq .05$. ** significant at $p \leq .01$.

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Table 20B. *Results of Pearson r Correlational Analyses Among the Dependent Variables at Baseline- Part B*

		LNS	Phonemic Fluency	Semantic Fluency	Switching Fluency	Trails 4	CW Cond. 3	CW Cond. 4	Tower Test
RMAS Total Raw	*r*	.05	-.02	-.04	.17	.25	.02	.03	.05
SELF-A Total	*r*	-.09	.13	.04	.01	-.19	-.06	.09	-.12
GMTQ-S Total	*r*	.10	-.09	$-.29^{*}$	.07	.13	-.09	-.12	-.11
GEC t-score	*r*	.12	.10	.03	.10	.13	-.15	.03	.02
Digit Span	*r*	$.63^{**}$	$.41^{**}$	.13	.04	$.45^{**}$	$.47^{**}$	$.35^{*}$	.07
Symbol Search	*r*	-.01	.17	.08	-.05	.18	.26	$.32^{*}$	-.15
Coding	*r*	.01	$.46^{**}$	$.32^{*}$	.06	$.30^{*}$	$.42^{**}$	$.40^{**}$	-.05
LNS	*r*	1	$.35^{*}$	$.31^{*}$	.26	$.44^{**}$	$.33^{*}$	$.47^{**}$	$.28^{*}$
Phonemic Fluency	*r*	$.35^{*}$	1	$.54^{**}$	.25	.20	.24	$.34^{*}$	.09
Semantic Fluency	*r*	$.31^{*}$	$.54^{**}$	1	$.53^{**}$	.17	.14	$.34^{*}$	.28
Switching Fluency	*r*	.26	.25	$.53^{**}$	1	.06	.02	$.29^{*}$	.05
Trails Condition 4	*r*	$.44^{**}$	.20	.17	.06	1	.20	$.28^{*}$	.13
CW Cond. 3	*r*	$.33^{*}$	.24	.14	.02	.20	1	$.59^{**}$	.04
CW Cond. 4	*r*	$.47^{**}$	$.34^{*}$	$.34^{*}$	$.29^{*}$	$.28^{*}$	$.59^{**}$	1	.12
Tower Test	*r*	$.28^{*}$	.09	.28	.05	.13	.04	.12	1

Note: N = 50. CW Cond. = Color-Word Condition. LNS – Letter-Number Sequencing.
* significant at $p \leq .05$. ** significant at $p \leq .01$.

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Table 21. *Results of the Mixed Factorial ANOVAs of BRIEF-A Indices and Subdomains in the Final Sample (N = 35)*

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
Behavior Regulation Index	2, 66	8.03	.00	.20
Inhibit	2, 66	1.94	.15	.06
Shift	2, 66	2.97	.06	.08
Emotional Control	2, 66	2.92	.06	.08
Self-Monitor	2, 66	2.92	.06	.08
Metacognitive Index	2, 66	11.73	.00	.26
Task-Monitor	2, 66	6.79	.00	.17
Initiate	2, 66	7.38	.00	.18
Working Memory	2, 66	8.77	.00	.21
Plan/Organize	2, 66	2.32	.11	.07
Organization of Materials	2, 66	3.69	.03	.10
Main Effect for Group				
Behavior Regulation Index	1, 33	.00	.99	.00
Inhibit	1, 33	.04	.85	.00
Shift	1, 33	.40	.53	.01
Emotional Control	1, 33	.04	.84	.00
Self-Monitor	1, 33	.03	.87	.00
Metacognitive Index	1, 33	.24	.63	.01
Task-Monitor	1, 33	.18	.67	.01
Initiate	1, 33	1.08	.31	.03
Working Memory	1, 33	.03	.86	.00
Plan/Organize	1, 33	.43	.52	.01
Organization of Materials	1, 33	3.16	.09	.09

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	df, df error	*F*	*p*	partial η^2
Interaction Effect Time*Group				
Behavior Regulation Index	2, 66	.75	.48	.02
Inhibit	2, 66	.50	.61	.02
Shift	2, 66	.18	.84	.01
Emotional Control	2, 66	.90	.41	.03
Self-Monitor	2, 66	1.88	.16	.05
Metacognitive Index	2, 66	.04	.96	.00
Task-Monitor	2, 66	.27	.77	.01
Initiate	2, 66	.17	.84	.01
Working Memory	2, 66	1.92	.15	.06
Plan/Organize	2, 66	.68	.51	.02
Organization of Materials	2, 66	.75	.48	.02

Note. GMT group *N* = 16, control group *N* = 19.

Feedback questionnaires. Participants' responses on the feedback questionnaires were also analyzed. The first five questions on both feedback questionnaires addressed participants' opinion regarding the usefulness of the GMT workshop strategies in their lives. They rated five statements on a scale from 1 (completely disagree) to 5 (completely agree). The mean response on these five questions on Feedback Questionnaire 1 was 20.39 (*SD* = 2.91, average of 4.08 per question, *N* = 18, range from 14 to 25) and on Feedback Questionnaire 2 was 20.31 (*SD* = 4.19, average of 4.06 per question, *N* = 16, range from 10 to 25). Overall, these responses indicate that participants rated the GMT workshop as useful for them. Participants also rated their experienced difficulties with each GMT component on four questions (that is, STOP, STATE, SPLIT, and CHECK) on a scale from 1 (no

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difficulties) to 5 (severe difficulties). Here, on Feedback Questionnaire 1, the mean response was 11.72 (*SD* = 4.64, average of 2.39 per question, *N* = 18, range from 4 to 21) and on Feedback Questionnaire 2 was 10.00 (*SD* = 4.23, average of 2.50 per question, *N* = 16, range from 4 to 20). Overall, participants appeared to experience some difficulties on different GMT components on a day-to-day basis. Lastly, participants rated the helpfulness of learning each GMT component on four questions on a scale from 1 (not helpful at all) to 5 (very helpful). On Feedback Questionnaire 1, the mean response on these four questions was 17.28 (*SD* = 2.59, average of 4.32 per question, *N* = 18, range from 10 to 20), and on Feedback Questionnaire 2, the mean response on these four questions was 16.44 (*SD* = 2.83, average of 4.11 per question, *N* = 16, range from 10 to 20). Overall, the GMT components were rated as helpful. The qualitative responses on Feedback Questionnaires 1 and 2 were recorded and can be seen in Appendix J.

Selective dropout. As mentioned before, the reasons participants dropped out of the research are not known. In order to determine whether participants who completed only one or two waves of assessment differed from participants who completed all three waves of assessment, independent sample *t* tests were performed on the baseline measures of the RMAS total raw scores, GMTQ-S total scores, GPA, GEC t-scores, SELF-A total scores, as well as the EFSSs and performance measure subdomains derived from the WAIS-IV and D-KEFS (that is, the working memory, inhibition, fluency, switching, and processing speed subdomains). No significant results were obtained on any of the analyses ($p > .05$), indicating that participants who did and did not drop out did not significantly differ in terms of their self-reported EF difficulties or academic self-

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efficacy, their academic performance (that is, their GPA), or their performance on EF or processing speed measures. Further independent *t* tests were performed to examine whether participants who completed only one or two waves of assessment differed from participants who completed all three waves of assessment in terms of their demographic information. More specifically, these analyses examined the differences in participants' age, year in the program, GPA, and the number of courses they were enrolled in at the baseline assessment. These analyses showed that participants who completed only one or two waves of assessment were significantly more advanced in their program ($M = 3.40$, $SD = 0.83$) than those who completed all three assessments ($M = 2.45$, $SD = 0.98$) ($t(48) = -3.26$, $p = .00$). Based on this information, it is possible that GMT may be more of interest, or more applicable to undergraduate students who are near the beginning of their academic career. All other *t* test analyses did not show significant differences ($p > .05$) between the two groups in terms of their other demographic information (that is, age, GPA, and number of courses). Please see Appendix L for more information.

Academic self-efficacy, executive functioning, and academic achievement. A one-tailed pearson *r* correlational analysis was performed to establish whether a relationship exists between participants' academic self-efficacy beliefs and their academic achievement. Interestingly, and in contrast to the literature, the correlation between the baseline SELF-A total scores and GPA was not significant ($r(48) = -.01$, $p = .47$, $N = 50$), indicating that the participants' self-efficacy beliefs for academic work was not related to the overall achievement. Baseline SELF-A total scores and anticipated GPA were also not significantly correlated ($r(48) = .06$, $p = .34$, $N = 50$), nor were the

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SELF-A total scores and anticipated GPA at the second follow-up assessment ($r(33) = .21$ $p = .11$, $N = 35$).

As participants' anticipation of their upcoming GPA can be argued as demonstrating an aspect of academic self-efficacy, the relation of anticipated GPA to performance on EF measures was also analyzed. Again, two one-tailed pearson *r* correlational analyses were performed. Results showed that the baseline performance on EF measures (EFSS) was not significantly correlated to the baseline anticipated GPA ($r(48)= .12$, $p = .20$, $N = 50$). However, at the second follow-up assessment, participants' EFSS was significantly correlated to their anticipated GPA ($r(33)= .33$, $p = .03$, $N = 35$).

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CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Overview

The purpose of this study was to determine whether a GMT protocol that was initially designed for individuals with severe EF difficulties due to brain injuries would benefit undergraduate students who are experiencing difficulties related to EFs and attention. Some undergraduates struggle to meet the academic demands placed upon them, albeit usually to a subclinical extent. For the present study, a published GMT approach (Levine et al., 2012a) was adapted to meet students' needs. That is, the initial intervention of nine two-hour sessions was abbreviated to one four-hour workshop. This workshop reviewed the same GM principles and included the same practice tasks as the original version, albeit in a shortened manner. All components of the original version that were not part of the abbreviated workshop of this study, nonetheless, were included in emails through reviews and homework practice exercises.

The sample for this study consisted of two separately recruited groups (not randomly assigned), one that received the GMT workshop and one that did not. These groups underwent a total of three 90-minute assessments (that is, the baseline assessment within three weeks before the GMT group received the workshop, the first follow-up assessment within three weeks after the GMT group received the workshop, and the second follow-up assessment three months after the first follow-up assessment). During these assessments, participants were tested on a one-on-one basis with a research assistant who was blinded to their group membership. Measures included several EF performance tasks (selected subtests of the WAIS-IV and DKEFS), GPA (measured at

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the baseline and second follow-up assessment) as a measure of academic achievement, as well as several self-report measures of EF, attentional, and GM difficulties, and academic self-efficacy. The two groups were compared on their performance on these measures over time. The following sections of this discussion will review the results in detail. That is, the relationship between participants' performance on EF measures and self-reported academic self-efficacy, as well as self-reported attentional and EF difficulties will be reviewed, followed by a discussion of the comparison of the two groups on all measures over time. This will be followed by a review of the results for the processing speed subdomain, and its relation to the concept of EFs. Finally, there will be a discussion of potential limitations of this study, as well as suggestions for future research and the practical implications of such research.

Baseline Self-Report and EF Performance Measures

This study investigated the relationship between participants' performance on EF measures and their self-reported academic self-efficacy, as well as attentional and EF difficulties. Based on the literature review, it was hypothesized that there would be a significant correlation between performance on EF measures and these self-report measures; however, in contrast to these hypotheses (that is, hypotheses 1 and 2), no significant relationship was found. These results indicate that participants' academic self-efficacy beliefs are not directly related to their performance on EF measures.

Similar to self-reported academic self-efficacy beliefs, self-reported attentional and EF difficulties were not significantly related to objective performance on standardized measures of EF at the baseline assessment. A possible explanation for these results is that the performance measures of EFs used in this study tap into aspects of EFs

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that differ from the aspects of EFs tapped into by the self-report measures used (that is, the BRIEF-A and the RMAS). In general, objective EF measures are often not considered to be very ecologically valid in that these measures may not translate directly to day-to-day capabilities (see, for example, Krasny-Pacini et al., 2014). The lack of consistent correspondence between performance and self-report measures is reflected in current diagnostic criteria. A diagnosis of ADHD, for example, does not require any data from objective measures, but rather relies on subjective data (as in, self-report questionnaires, or questionnaires completed by caregivers or teachers; American Psychiatric Association, 2013). As mentioned before, EFs are a very difficult construct to define and consist of several aspects (see Barkley, 2012). Thus, the tasks that contributed to the EFSS may have measured aspects of EFs that were not captured by the attentional and EF self-report measures used (that is, the RMAS and BRIEF-A).

Effectiveness of GMT

Before discussing the effectiveness of GMT, it is important to note that the analyses completed to investigate this research question only included the 35 participants who completed all three assessments. As the reasons for drop out of the remaining 15 participants are unknown, it is possible that the characteristics of the remaining sample differed in some ways from the characteristics of those who chose not to complete all assessments. Regardless, the collected data provide an adequate basis for interpretation of the results.

Hypotheses 3 focused on the effectiveness of GMT to improve performance on EF measures. As described above, there was a significant improvement in scores across groups over time for overall EF measures (that is, EFSS), as well as for each of the EF

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subdomains assessed (that is, working memory, inhibition, switching, and fluency). However, there was no significant difference in improvement between the two groups over time, or a significant difference between the two groups across time. The general increase in performances across groups may be due to practice effects alone. Particularly, the time period between the baseline and first follow-up assessment was relatively short (as both assessments occurred within a six week period), indicating that the familiarization of participants with the tasks and study procedure appears to have improved their performances. It is noteworthy that the effect sizes of this practice effect ranged from medium (partial $\eta^2 = .25$ for the working memory subdomain) to large (partial $\eta^2 = .65$ for the EFSS), accounting for a large proportion of the variance between the assessments over time.

A possible reason for the nonsignificant difference between the GMT and control group across the assessments may be the already adequate performance on EF measures at the baseline assessment. For example, the mean EFSS scores of the GMT and control group at the baseline assessment were 9.74 and 10.03, respectively, indicating an overall average performance. Thus, in order to indicate an improvement in performance, participants' scores would need to be above average. It is possible that individuals who have more severe EF difficulties, such as those who score below average on these measures during the baseline assessment, have more room for improvement and may thus be more likely to improve their EFs through GMT.

For hypothesis 4, it was predicted that participants' self-reported academic self-efficacy would improve significantly more in the GMT group over time, compared to the control group. Although there was an improvement in scores across groups over time, no

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difference in change between the two groups over time was found. As mentioned before, and in contrast to what was expected, participants' baseline SELF-A total scores were not significantly correlated to their GPA. This indicates that the SELF-A may not have been a valid measure to assess participants' academic self-efficacy in this study. Thus, it is possible that the strategies learned during the GMT workshop may have been reflected in changes for academic self-efficacy on a more appropriate measure of this construct.

Another approach that was used to determine the effectiveness of the GMT workshop was to look at participants' self-report ratings of difficulties with GM skills in their day-to-day lives (that is, in the analyses related to hypothesis 5). For this, a significant decrease in reported difficulties was observed across both groups over time. In addition, a significantly greater reduction in reported difficulties was noted in the GMT group over time, when compared to the control group. This analysis yielded an effect size of partial $\eta^2 = .18$, indicating that group membership alone accounted for 18% of the variance between the times of assessment. A post-hoc analysis showed that this interaction effect was significant between the baseline and first follow-up assessment. These results suggest that immediately after the GMT workshop GMT group participants reported significantly fewer difficulties with GM skills in their day-to-day lives than participants who did not receive the GMT workshop. However, this effect was not long-standing as there was no significant difference between the two groups at the second follow-up assessment three months later. It is possible that the timing of the assessments during the semester influenced these results. Specifically, the first follow-up assessment not only occurred immediately after the workshop, but it also occurred at the time when students were taking their midterm exams. As such, the increase in academic demands

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that likely occurred at that time may have exacerbated the GM challenges that students faced. However, as the GMT workshop equipped the GMT group participants with strategies to tackle exactly such challenges, this group may have felt more confident in their abilities to manage their goals. The nonsignificant difference in GM difficulties at the second follow-up assessment may also be explained by this, as that time fell at the beginning of the next semester, with presumably fewer challenges related to imminent exams.

Hypothesis 6 predicted that there would be a significantly greater decrease in self-reported attentional and EF difficulties over time within the GMT group when compared to the control group (measured with the RMAS total raw scores and BRIEF-A GEC t-scores, respectively). Analyses of both the RMAS total raw scores and GEC t-scores revealed no significant difference between the GMT and control group over time or across time. As mentioned before, the RMAS and BRIEF-A may not tap into the same EFs that are potentially improved by the GMT. That being said, there was a significant reduction of reported attentional and EF difficulties across groups over time. The effect sizes for these reductions were moderate for both measures (see Table 12 and 13). It is important to note that the overall mean of GEC t-scores reduced from a clinically significant level (that is, scores at or above 65) to a non-clinically significant level. More specifically, the mean GEC t-score at the baseline assessment decreased from 66.00 (*SD* = 9.62) to 61.66 (*SD* = 10.12) at the second follow-up assessment. These results raise the possibility that simply being exposed to questions that assess one's difficulty in these areas may be a factor in their reduction over time. Alternatively, it is possible that these changes reflect improved metacognition in students as they progress through university.

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This significant reduction, albeit not group-specific, is of clinical relevance to participants, and thus worthy of more exploration.

Examination of the BRIEF-A indices resulted in similar findings for the Metacognitive Index. Mean responses on this index also declined from an initially clinically significant level to a non-clinically significant level (see Table 19), regardless of group membership. Similarly, three subdomains of the Metacognitive Index followed this trend of scores, namely the Initiate, Plan/Organize, and Working Memory subdomains (see Table 19). Overall, all BRIEF-A domains scores that were above the cutoff score for clinical impairments at the baseline assessment reduced to non-clinical levels at the second follow-up assessment.

GMT was also hypothesized to increase participants' GPA over time (hypothesis 7); however, the change between the GMT and control group was not significantly different. That being said, there was an overall significant improvement across groups over time, indicating that participation in this study may have had a positive impact on participants' academic achievement. Results of this study indicated a mean increase of GPA of 4.64 for the GMT group and 5.59 for the control group, which is greater than the mean increase of full-time University of Windsor students in general. That is, between Spring 2013 and Winter 2015, the trend of undergraduate students' GPA showed a mean increase of 1.27 from year one to year two, and a mean increase of 2.13 from year two to year three (R. Nease, personal communication, April 28, 2016). A possible explanation for this difference in trend and significant increase in GPA of participants in this study is that they were confronted with questions about their academic self-efficacy, as well as attentional and EF difficulties, which may have increased their awareness of these

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experiences in their daily lives. An increased awareness could, in turn, have facilitated problem-solving when such difficulties were encountered.

In sum, the results of this study are generally not in accordance with previous findings. That is, several studies resulted in a significant increase in EF performance measures and self-report measures in participants who underwent GMT compared to a control group (for example, Novakovic-Agopian et al., 2011; Stubberud et al., 2013, 2014, 2015; see Appendix A for a comprehensive list). Although an overall positive trend was observed in this study across groups for all dependent variables, a difference between the GMT and control group over time was only found for self-reported GM skills difficulties in day-to-day lives between the baseline and first follow-up assessment. These contrasting findings to the previous literature may, in part, be understood in light of this study's limitations (see below).

Habit Acquisition

Previous research studies found that habits are typically acquired in the form in a non-linear fashion, with a higher increase of habit behaviours at the beginning and a lesser increase later on. Thus, the acquisition of GM strategies as habits in participants' day-to-day lives was hypothesized to follow this trend as well (that is, hypothesis 8). However, analyses of participants' weekly SRBAI scores indicate a small, linear increase in such habit acquisition over time, with a significant increase in habit formation between the first four weeks and the last four-weeks of the follow-up period. Given that participants received regular reminder text messages and review emails, it is likely that the regular exposure to GM strategies is related to this trend. Thus, establishing the habit

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of using GM strategies in students' everyday lives appears to be linked to regular exposure and practice over time.

Processing Speed Subdomain

Based on the study by Novakovic-Agopian et al. (2011), processing speed tasks were included in this study as a control measure, as these authors did not find an indication of improvement after participants underwent GMT, and typically processing speed is described as a component of scores on many executive functioning measures but not as an executive function. The findings of this study indicated an overall improvement in participants' processing speed across groups over time. In addition, and contrary to the findings of Novakovic-Agopian et al. (2011), results of this study showed a significant difference in the improvement between the two groups over time from the first follow-up to the second follow-up assessment. That is, participants in the GMT group improved significantly more on the processing speed measures than participants in the control group at this final point

Some researchers have argued that information processing speed is related to the EF construct. In fact, Anderson (2002) proposed that information processing speed is part of one of the core constructs in executive functioning. More specifically, information processing, which includes processing speed, efficiency, and fluency, was described as one of four main pillars of executive control, with the other three being attentional control, cognitive flexibility, and goal setting. He describes these four constructs as inter-related, yet "discrete functions that are likely to be related to specific frontal systems" (p. 73). In addition, Purcell (2010) found that the Processing Speed Index of the Wechsler Intelligence Scale for Children (fourth edition; WISC-IV)

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correlated significantly with the Executive Functioning Scale of the Behavioral Assessment System for Children - Second Edition in a sample of children referred for psychoeducational assessments. She noted that this relationship may be explained by the role of mental efficiency (as measured by processing speed tasks) in fluid reasoning, which is considered an aspect of EFs (see also Sattler, 2001). Although practice effects likely explain, in part, participants' improvement in processing speed, they do not account for the significantly better performance of GMT group participants when compared to control group participants at the second follow-up assessment. Given Anderson's model (2002), it is possible that this differential late gain in the GMT group reflects direct or nonspecific effects of their training in GM.

Qualitative Results

GMT group participants were given two feedback questionnaires, during the first and second follow-up assessments (Feedback Questionnaires 1 and 2). Both feedback questionnaires inquired about the usefulness of the workshop in helping GMT group participants improve their GM strategies in their day-to-day lives, as well as the usefulness and difficulties they experienced with each stage of the GM strategies (that is, stop, state, split, and check). Both feedback questionnaires also included open-ended questions regarding what they liked and disliked about the workshop. Overall, the responses on both feedback questionnaires were similar. That is, participants rated the overall workshop as useful to them. Similarly, the components of GMT were rated as helpful with participants' ratings ranging from none to some difficulties on the questionnaire. In terms of responses to the open-ended questions (which can be seen in Appendix J), participants particularly liked the interactive nature of the workshop, the

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tasks that were used to practice the GMT components, and the strategies designed to teach them to be more present-minded. On the other hand, participants disliked the length of the workshop and the homework assignments.

Methodological Limitations

Several limitations are noteworthy for this study. First, participants' overall average performances on the WAIS-IV and DKEFS measures at the baseline assessment were already adequate, with most scores being in the average range or higher. Thus, the high baseline scores on these measures may have hindered the possibility of significant improvement in scores, as it can be more challenging to improve past the average range, when compared to improving past the low average or borderline range.

The relatively small sample size is another limitation of this study. Several measures approached significant differences between the GMT group and control group, but the power of the statistical analyses used was too small to detect an effect. It is possible that Type II errors were being committed based on the small sample size.

Further, the sample only included undergraduate students and may thus not be generalizable to other young adults. It is unknown whether the abbreviated format and adaptations would be suitable for other populations who have subclinical levels of EF difficulties.

Two limitations of this study may provide hypotheses for further investigation. First, the participants in this study were not randomly assigned to groups. Rather, participants in the GMT group were recruited separately and were asked to confirm their appointment for the baseline assessment only if they intended to complete the entire study protocol. This procedure was chosen to increase the possibility of a more engaged

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GMT group than if participants were randomly assigned to the GMT versus the control group. Nonetheless, non-randomization is a limitation of this study. Second, the participants in the GMT group and control group had an overall different experience in this study. That is, only the GMT group received the GMT workshop, and thus experienced a closer interaction and potentially better-established rapport with the researcher. This potentially increased the possibility of a placebo effect in the GMT group, in that GMT participants inadvertently may have altered their performances or self-reports based on their perception of implied expectations by the research team to do so. Further assessment of GMT in an undergraduate population with self-reported attentional difficulties should consider the impact of initial participant commitment to GMT and of placebo factors involved in contact with the workshop leader.

Regardless of the possible role of placebo effect in this study and effects due to repeated contact with the research team, it is significant that there was an overall trend for improved EF performance and self-reports across time in both groups. Thus, simply participating in this study (in either group) was associated with positive changes in EF skills, self-reported difficulties with such skills, academic self-efficacy, and GPA. To some degree the changes seen on performance measures may reflect practice effects, but practice effects do not explain the changes on self-report indices and GPA. As the changes in GPA do not appear to be typical of undergraduates at this university, further research is needed to determine whether these changes stem from repeated exposure to the measures or reflect positive effects of participating in this study regardless of group assignment.

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Future Research and Practical Implications

This study was the first to apply an adapted version of Levine et al.'s (2012) GMT workshop to an undergraduate population with self-reported EF and attentional difficulties. Although most hypotheses were not supported by the data, certain trends were discovered. As mentioned above, one limitation of this study involved the high performance on baseline EF measures. Undergraduate students with more severe difficulties, for example determined through screening of EF measures, or students who are on academic probation may be more suitable for the GMT approach. That is, lower scores at the baseline assessment will likely provide more opportunity for growth of those EFs measured, which in turn may be reflected more clearly in the performance trend over time.

There is a wide range of other populations who may benefit from GMT. As EFs are developed over time and do not finish developing until one's mid- to late-20s (De Luca & Leventer, 2008), high school students or younger children may be examples of such populations. In particular, individuals who are vulnerable to EF difficulties could be targeted in future studies (such as, students with ADHD, learning disabilities, and academic challenges). Targeting younger participants who struggle with aspects of EFs may prevent some EF difficulties later in life, particularly as task demands tend to increase.

The students in this study were rewarded for their participation with either participant pool bonus points or money, which may also have been a limitation. An internally motivated sample of undergraduate students would be an important variation of this study. For example, incoming students who struggle with EFs or those who report

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being anxious or nervous about the upcoming academic demands may benefit from this GMT workshop. That being said, two points need to be considered. First, participants in the GMT group were minimally compensated for their participation in the GMT workshop itself. Instead of psychology pool participant points or money, they received refreshments during the workshop and had a chance to win a $20 gift card for Tim Horton's. Thus, with this limited compensation, it is reasonable to assume that GMT group participants were partially internally motivated. Second, a general improvement in self-report and performance measures occurred across groups, and may reflect benefit from simple exposure to EF measures. As mentioned before, simply being a participant in this study may have had a placebo effect on participants' performance and self-reports. Being observed, with an implied expectation to perform better and report fewer challenges ultimately may have led to the observed positive trend in results. If further research confirms the existence of this placebo effect, additional investigations could determine the critical components for the effect to occur, how long it persists over time, and whether there is an effect on dropout rates and degree completion.

Another important aspect of future research would be to provide the GMT workshop in a different format, as the current format represents only one possible abbreviation of the GMT intervention. For example, splitting the one four-hour session up into additional, shorter sessions may be helpful. The length of the one GMT session was indicated as one aspect that was disliked by several participants. Furthermore, covering the strategies and educational material in more detail, and over an extended period of time may allow for more internalization of the GM skills.

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The significant increase in GMT group participants' processing speed is another area of further investigation. As noted before, EFs continue to be difficult to define, and whether information processing speed can be considered part of these higher-level functions is not clear. This study, along with others (that is, Anderson, 2002 and Purcell, 2010), suggests that a link between EFs and processing speed exists. Thus, further investigation is warranted.

Finally, the lack of a significant correlation between participants' SELF-A total scores and their GPA poses another area of further investigation. The SELF-A is established in the literature as a valid and reliable measure of students' academic self-efficacy that relates to academic achievement (Zimmerman & Kitsantas, 2007). It is unclear why such a relationship between the SELF-A total scores and participants' GPA was not found in this study, and thus further investigation may shed light on the reasons that contributed to failure to find the expected association.

The practical implications of this research are two-fold. First, as mentioned before, dropout rates of universities are a significant concern. Many undergraduate students find themselves overwhelmed by the academic demands placed upon them while in university, and the GMT workshop is one approach that can potentially facilitate success. GMT strategies are focused on increasing efficiency and decreasing procrastination, which are difficulties noted by a high number of undergraduate students. By equipping these students with potential strategies that will aid them in their academic careers, dropout rates are likely to decrease.

The results of this study were overall not significant. However, as mentioned before, there was a trend towards improvement in all of the areas measured.

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Furthermore, the majority of the responses on the Feedback Questionnaire 1 and 2 were very positive, indicating that, at least on a subjective level, the GMT workshop was helpful for participants. Increasing our knowledge about the optimal format of and population for this intervention will be invaluable to undergraduate students and university institutions. If successful, the effects of this training may not only have an impact on participants' personal achievements, life-satisfaction, and academic achievement, but subsequently may also decrease the likelihood that students will drop out before degree completion. Thus, more research in this area is warranted.

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APPENDICES

Appendix A
Summary of Studies that Utilized GMT

Authors	N	Population	Groups	Time	Measures
Alfonso et al. (2011)	32 Group 1: 16 Group 2: 16	Outpatient, alcohol and polysubstance abusers	1) GMT & Mindfulness-based meditation and Standard Treatment 2) Standard Treatment	• 7 weeks • 2 sessions per week • 1.5 hours per session	WAIS-III (LNS [a], Arithmetic, DS); BADS (Zoo Map, Key Search); Stroop test [a]; Trail Making Test; Iowa Gambling Task [a]
Bertens et al. (2015)	60	Brain injured individuals	1) GMT and Errorless Learning 2) GMT only	• 8 1-hour sessions • 2 sessions per week	Everyday task performance[a]; Goal Attainment Scale[a]

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Authors	N	Population	Groups	Time	Measures
Chen et al. (2011) [c]	12 Group 1: 5 Group 2: 7	Brain injured individuals	1) Goals training intervention (GMT, mindfulness, attention, & problem-solving) 2) Education intervention	• 5 weeks - Switch intervention - 5 weeks • 10 x 2 hour sessions • 2 sessions per week • 3 x 1 hour individual sessions	fMRI; Attention & EF domain [a]: WAIS-III (LNS), auditory consonant trigrams, Digit-Vigilance Test, D-KEFS (Design & Verbal Fluency Switching, Color-Word Interference Tests – Inhibition & Inhibition/Switching), Trails B; Memory domain [a]: Hopkins Verbal Learning Test, Brief Visual Memory Test – Revised; Psychomotor speed domain: Trails A, Visual Attention Task
Fish et al. (2007)	20	Brain injured individuals	• GMT and randomized text-message alerts	• GMT: 1x 30 minutes	Prospective memory telephone task [a]

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Authors	N	Population	Groups	Time	Measures
Levaux et al. (2012)	1	Schizophrenia	• GMT • Psychoeducation	• 16 x 1.5 hour sessions • 2 sessions per week	Activities of daily living (meal preparation [b], washing, meeting preparation [b]); SRLTs; paper-and-pencil tasks [a]; questionnaires (anxiety, self-esteem [a], clinical symptoms); Tower of London [b]; 6 elements test [b]
Levine et al. (2000) Study #1	30 Group 1: 15 Group 2: 15	Brain injured individuals	1) GMT 2) Motor Skills Training	• 1 hour	Everyday paper-and-pencil tasks [a]
Levine et al. (2000) Study #2	1	Post-encephalitic individual	• GMT	• 5 x 1 hour sessions	Everyday paper-and-pencil tasks [b]; meal preparation [a]

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Authors	N	Population	Groups	Time	Measures
Levine et al. (2007)	46 Early training: 26 Late training: 20	Healthy older adults	• GMT • Memory training • Psychosocial training	• 12 x 3 hour sessions • 1 session per week • 3 individual sessions	SRLTs [a]; DEX [a] (sign. at follow-up)
Levine et al. (2011)	19 Group 1: 11 Group 2: 8	Brain injured individuals	1) GMT 2) Educational training	• 7 x 2 hour sessions • 1 session per week	SART [a]; D-KEFS Tower Test [a]; Hotel Task [a]; DEX; CFQ; self-designed questionnaire

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Authors	N	Population	Groups	Time	Measures
Novakovic-Agopian et al. (2011) [c]	16 Group 1: 8 Group 2: 8	Brain injured individuals	1) GMT – Psychoeducation 2) Psychoeducation - GMT	• GMT: o 10 x 2 hour group sessions o 3 x 1 hour individual sessions • Psychoeducation: o 1 x 2 hour session • 10 weeks in total	Working memory domain: Auditory Consonant Trigrams [a], WAIS-III LNS [a]; Mental flexibility domain: D-KEFS (Design Fluency Switching, Verbal Fluency Switching [a], Trails B [a]; Color-Word Interference Test Inhibition/Switching [a]); Sustained attention domain: timed Vigilance Test; Inhibition: Color-Word Interference Test Inhibition [a]; Memory: Hopkins Verbal Learning Test – Revised [a], Brief Visual Memory Test – Revised; Motor speed of processing: D-KEFS Trails A, Visual Attention Task (RT); Multiple Errands Task [a]; GPQ

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Authors	N	Population	Groups	Time	Measures
Schweizer et al. (2008)	1	Individual with right cerebellar hemorrhage	• GMT	• 7 x 2 hour sessions • 1 session per week	Revised-Strategy Application Test; Hotel Task; SART [b]; D-KEFS Tower Test[b]; DEX (self and informant[b]); CFQ
Stubberud et al. (2013, 2014, 2015)	38 Group 1: 24 Group 2: 14	Individuals with spina bifida	1) GMT and mindfulness 2) Wait-list control	• 1 x 6 hours • 1 x 9 hours • 1 x 6 hours • 1 month between each session	D-KEFS (Tower Test [a] [sign. at follow-up], Trail Making Test conditions 4 [a] & 5, Color-Word Interference Test [a]), CPT-II [a], Hotel Task [a]; DEX (self [a] and informant rating), CFQ [a] (sign. at follow-up), BRIEF-A (self [a] [sign. at follow-up] and other rating); HSCL-25 [a] (sign. at follow-up), DEX Positive Affect and Negative Affect subscales [a], SF-36 [a], GCQ [a]

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Authors	N	Population	1) Groups	• Time	Measures
Van Hooren et al. (2007)	69 Group 1: 38 Group 2: 31	Healthy older adults	2) GMT & Psychoeducation 3) Wait list control	• 60 – 90 minutes sessions • 6 weeks • 2 sessions per week (12 in total)	Stroop Colour Word Test; Groningen Intelligence Test; MMSE; CFQ; SCL-90 [a] (sign. for anxiety at follow-up); 2 self-designed questionnaires [a]

Note. BADS = Behavioural Assessment of the Dysexecutive Syndrome; BRIEF-A = Behaviour Rating Inventory of Executive Function – Adult Version; CFQ = Cognitive Failures Questionnaire; CPT-II: Conners' Continuous Performance Test – Second Edition; DEX = Dysexecutive Questionnaire; D-KEFS = Delis-Kaplan Executive Function System; DS = Digit Span; fMRI = functional Magnetic Resonance Imaging; GCQ = General Coping Questionnaire; GPQ = Goal Processing Questionnaire; HSCL-25 = Hopkins Symptom Checklist 25; LNS = Letter-Number Sequencing; MMSE = Mini-Mental State Examination; RT = reaction time; SART = Sustained Attention to Respond Task; SCL-90 = Symptom Checklist 90; SF-36 = Short-Form 36 health survey version 2; SRLT = Simulated Real Life Task; WAIS-III = Wechsler Adult Intelligence Scale – Third Edition.
[a]Statistically significant results at least at the level of $p < .05$. [b]Improved performance but without reported statistical significance. [c]These publications are reports of sub-studies within a larger research project. Data from 4 participants was only available for Novakovic-Agopian et al.

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Appendix B

Recruitment Advertisements

Psychology Participant Pool Advertisement:

GMT Group:

Description:

This study will contribute to my dissertation and will involve a Goal Management Training workshop that is hypothesized to improve students' academic self-efficacy and executive functioning. Executive functioning is an important skill when doing certain tasks, such as planning, setting goals and adapting them, or splitting a task up into subparts. This study will involve a total of three assessments, as well as a Goal Management Training workshop. Students who sign up for this study will be asked to participate in all parts of this study. Participation in this study will be compensated. Compensation will occur on a per-session basis. If you are interested in participating in this study, please sign up for it on the Participant Pool website. By signing up for this study, you are not obligated to participate. Once you sign up for the study, the researcher will email you all the details involved in this study (i.e., length and time-frame of the assessments and the workshop, as well as compensation details). If you continue to be interested at that point in time, the researcher will manually make an appointment for you.

Eligibility:

You have difficulties focusing attention and/or regulating distractions and/or working towards a goal; no diagnosis of a learning disorder; you own a cell phone and be able to receive text-messages; plan to be enrolled in the Summer 2015 semester

Email sent to participants who signed up for this study to provide more information:

"Thank you for your interest in this study. Below are some important details for you to know before making the decision whether or not to sign up for this study:

This study will contribute to my dissertation and will involve a Goal Management Training (GMT) workshop that is hypothesized to improve students' academic self-efficacy and executive functioning. Executive functioning is an important skill when doing certain tasks, such as planning, setting goals and adapting them, or splitting a task up into subparts.

This study includes three waves of assessments and one GMT workshop (described below). If you choose to participate, you will be manually enrolled in all parts of this study. Participation in this study will be compensated (see below).

The wave 1 assessment will be conducted between May 11th and May 28th, 2015. □The GMT workshop will take place on Friday, May 29th, 2015 from 10am to 2pm OR May 30th, 2015 from 12.30pm to 4.30pm at Chrysler Hall South 265A. You can choose on which of these dates you would like to participate. The wave 2 assessment will be conducted between June 1st and June 19th, 2015. The wave 3 assessment will be conducted between September 14th and October 2nd, 2015.

You are only eligible to participate in wave 2 or 3 if you have completed the GMT workshop.

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All assessments will take place at Chrysler Hall South 181. For the wave 1 and the wave 3 assessments, you are required to provide the researcher with a copy of the unofficial transcript of your previous full-time semester. If you forget to bring it to these specific assessments, you will be asked to print it out before you begin the assessment. A printer and paper will be available to you.

Each assessment includes self-report measures regarding your executive function and goal management skills, as well as a short background questionnaire and a feedback questionnaire (waves 2 and 3 only). You will also be assessed on your executive functioning skills by completing standardized measures. Each wave takes approximately 90 minutes of your time.

In addition to the waves, you will be asked to participate in one 4-hour GMT workshop that will take place in a group of up to 20 students. This workshop was designed to teach you goal-management strategies that are thought to help you manage your academic work and feel less overwhelmed by your responsibilities. Light refreshments will be provided during this workshop, and you will be entered into a draw to win one of two $20 Tim Horton's vouchers. No monetary compensation or participant pool credits will be granted for participation in this workshop.

Between waves 2 and 3, the researcher will send you one email and three text-messages per week to remind you of the strategies that were taught during the workshop and to provide you with homework exercises (included in a workbook that you will be provided with) that are aimed to help you use those strategies in your everyday life. You are not asked to respond to these emails or text-messages; however, if you are experiencing goal management relevant difficulties, you can share your concerns with your researcher who will attempt to help you. If you complete all the exercises and bring the workbook to the wave 3 assessment, you will receive $10. You will also be asked to fill out a very brief weekly survey (5 questions) on FluidSurvey. The link for these surveys will be included in the weekly emails. For each completed survey, your name will be entered into a draw for five $20 gift vouchers for a Cineplex Movie Theater. The winners of this draw will receive their vouchers in wave 3.

You have the option of being compensated with Psychology Participant Pool credits (if you are registered in the participant pool and you are registered in one or more eligible psychology courses) or with money. Compensation will occur on a per-session basis. If you choose to be compensated in Psychology Participant Pool credits, you will receive 1.5 bonus points for each of these waves of assessments. If you choose to be compensated with money, you will receive $5 for participation in the wave 1 assessment, $10 for participation in the wave 2 assessment, and $15 for participation in the wave 3 assessment of this study. You have the option to choose your compensation for each wave by letting the researcher know of your preference before completion of each assessment. You will be compensated after you completed the assessment.

I hope this information was helpful to you. Please let me know by email (XXX@uwindsor.ca) or phone (XXX-XXX-XXXX) if you have any questions and whether or not you decide if you would like to participate in this study. I will be more than happy to answer any questions you may have."

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Psychology Participant Pool Advertisement:
Control Group:
Description:
This study will contribute to my dissertation and includes three waves of assessments. Each assessment takes approximately 90 minutes of your time and participation in each wave will be compensated. You are currently being asked to sign up for wave 1 and 2. You will be manually enrolled in the wave 3 assessment. The wave 1 assessment will be conducted between May 11th and May 28th, 2015. The wave 2 assessment will be conducted between June 1st and June 19th, 2015. The wave 3 assessment will be conducted between September 14th and October 2nd, 2015. You are only eligible to participate in the wave 2 or wave 3 assessment if you have completed the wave 1 assessment. In each wave you will be asked to fill out self-report measures regarding your attention, executive function, and goal management skills, as well as a short background questionnaire. You will also be assessed on your executive functioning skills by completing standardized measures. Each wave will take approximately 90 minutes of your time. All assessments will take place at Chrysler Hall South 181. For the wave 1 and the wave 3 assessments, you are required to provide the researcher with a copy of the unofficial transcript of your previous full-time semester. If you forget to bring it to these specific assessments, you will be asked to print it out before you begin the assessment. A printer and paper will be available to you. Between waves 2 and 3, the researcher will send you one email and three text-messages per week that will include information about trivia. You are not asked to respond to these emails or text-messages. You will receive 1.5 bonus points for each assessment from the Psychology Participant Pool (if you are registered in the participant pool and you are registered in one or more eligible psychology courses). You will be compensated after you complete the assessment. Compensation will occur on a per-session basis.

Eligibility:
You have difficulties focusing attention and/or regulating distractions and/or working towards a goal; no diagnosis of a learning disorder; you own a cell phone and be able to receive text-messages; plan to be enrolled in Summer 2015 semester

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Screening questions given to participants before the baseline assessment:

1) Do you plan to be enrolled to study at the University of Windsor in the Summer 2015 semester?
   YES NO

2) Do you have a cell phone and are you willing to receive text messages?
   YES NO

3) Do you have difficulties focusing attention and/or controlling/regulating distractions and/or working towards goals?
   YES NO

4) Have you ever been diagnosed with a learning disorder?
   YES NO

5) Are you 18 years of age or older?
   YES NO

6) Are you fluent in English?
   YES NO

7) Do you have any uncorrected vision or hearing problems?
   YES NO

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Appendix C

Content of Emails and Text-Messages – Actual statements excluded because of copyrights

Emails:

Week 1:

- Description of concepts of absentmindedness and present-mindedness (and its importance).
- Examples of absentminded errors and reasons for such errors.
- Absentmindedness and present-mindedness monitoring worksheet (workbook module 1, pp. 11-16)

Week 2:

- Examples of what makes absentminded errors more/less likely to occur.
- Absentmindedness and present-mindedness monitoring worksheet (workbook module 2, pp. 15-17)
- Body scan (workbook module 2, pp. 11-13 & pp. 18-19)

Week 3:

- Review of the concept of the automatic pilot.
- Absentmindedness and present-mindedness monitoring worksheet (workbook module 3, pp. 11-12)
- Description of breathing exercise.
- Breathing exercise (workbook module 3, pp. 8-9 & 13-15) and Body scan exercise (workbook module 3, pp. 9 & 13-15).

Week 4:

- Absentmindedness and present-mindedness monitoring worksheet (workbook module 4, pp. 16-18)
- "Breath focus" (workbook module 4, pp. 11-14 & 21-26)
- Practice "stopping": Daily Stopping chart (workbook module 4, pp. 8 & 19-20)

Week 5:

- Review attention control (STOP!) and how distractions affect our "mental blackboard"
- Breathing exercise chart (workbook module 5, pp. 18-20)
- Slips & Successes monitoring chart (workbook module 5, pp. 21-27)

Week 6:

- Review of the mental blackboard (STATE your goal)
- Daily Stop!-State chart (workbook module 6, pp. 22-23 & 28-29)
- Breathing exercise (workbook module 6, pp. 24 & 30-31)
- Slips & Successes monitoring chart (workbook module 6, pp. 32-38)

Week 7:

- Review of goal conflict and decision-making.

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- Everyday Stop!-State chart (workbook module 7, pp. 28-30)
- Breathing exercise (workbook module 7, pp. 31-32)

Week 8:

- Review of the importance of splitting tasks into subtasks to avoid getting overwhelmed.
- Catalogue task (workbook module 7, pp. 22 & 24-27)
- Breathing exercise (workbook module 8, pp. 21 & 41-42)
- Everyday Stop-State chart (workbook module 8, pp. 20 & 38-40)

Week 9:

- Breathing exercise (copy of workbook module 8, pp. 21 & 41-42)
- Log Stop-State-Split Scenarios (workbook module 8, pp. 18-19 & 35-37)
- Wedding planning task (workbook module 8, pp. 11-13)

Week 10:

- Breathing exercise (copy of workbook module 8, pp. 21 & 41-42)
- Log Stop-State-Split Scenarios (copy of workbook module 8, pp. 18-19 & 35-37)
- Catalogue task (workbook module 8, pp. 25-30)

Week 11:

- Breathing exercise (copy of workbook module 8, pp. 21 & 41-42)
- Log Stop-State-Split Scenarios (copy of workbook module 8, pp. 18-19 & 35-37)
- Catalogue task (workbook module 8, pp. 31-34)

Week 12:

- Review of GMT strategies (workbook module 9, pp. 7-9 & 12-17)

Text-Messages:

Both groups, the GMT and control group received the same first text-message:
"Hello, this is Jenny, the researcher from the psychology study. This will be the number where future text-messages will come from. You do not need to reply to these messages. Have a good day!"

GMT group:
All text-messages after the first one included the following reminder to apply the GMT principles to what they are doing at that particular moment (based on Fish et al., 2007):

"STOP: Stop, Think, Organize, Plan."

Control group:
Each text-message after the first one included trivia information and began with the statement "Fact of the day:". This was followed by the following messages:

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- Windsor was settled by the French as an agricultural settlement.
- The average life of a taste bud is 10 days.
- A group of toads is called a “knot”.
- The world record for the highest jump cleared by a dog is 68 inches.
- A shark is the only fish that can blink with both eyes.
- There is a city called Rome (Roma) on every continent.
- Venus is the only planet that rotates clockwise.
- The king of hearts is the only king without a mustache.
- The flag of Switzerland and Vatican City are the only two flags that are squares.
- Porphyrophobia is the fear of the colour purple.
- The current Hawaiian alphabet consists of 18 letters.
- Greenland is the largest island in the world.
- It takes 8.3 minutes for light to get from the sun to earth.
- There are 240 dots in an arcade Pac-Man game.
- Madonna’s last name is Ciccone.
- The first 3D movie aired in 1922.
- “lethologica” refers to the inability to remember a word or put your finger on the right word.
- Almonds are a member of the peach family.
- Halley’s comet will be visible again from earth in 2061.
- The male seahorses carry the eggs until they hatch instead of the female.
- Dartboards are made of sisal fibres.
- Rats laugh when you tickle them.
- At latitude 60, you can sail all around the world.
- Giraffes have the highest blood pressure of any mammal.
- There are no wild tigers in Africa, only Asia.
- A group of Rhinos is called a “crash”.
- 31% of Canada is taken up by forest.
- It is estimated that millions of trees are planted by forgetful squirrels.
- Hannibal Lector in ‘Silence of the Lambs’ never blinks.
- It took Leo Tolstoy 6 years to write ‘War and Peace’.
- Charlie Brown’s father was a barber.
- Germans built the first artificial Christmas trees out of dyed goose feathers.
- Mars was named after the Roman god of war.
- When dolphins sleep, one half of their brain remains conscious.
- Your heartbeat changes when you listen to music (faster or slower, depending on the tempo of the music).

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Appendix D

Self-Efficacy for Learning Form – Abbreviated Version

Retrieved from Dr. Barry J. Zimmerman with his permission to use and include it in my dissertation.

INSTRUCTIONS: Using the scale below, please indicate your percentage of confidence regarding each of the following statements. There is no right or wrong answer.

Definitely cannot do it		Probably cannot do it			Maybe can do it		Probably can do it			Definitely can do it
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

	1.	When you miss a class, can you find another student who can explain the lecture notes as clearly as your teacher did?
	2.	When your teacher's lecture is very complex, can you write an effective summary of your original notes before the next class?
	3.	When a lecture is especially boring, can you motivate yourself to keep good notes?
	4.	When you had trouble understanding your instructor's lecture, can you clarify the confusion before the next class meeting by comparing notes with a classmate?
	5.	When you have trouble studying your class notes because they are incomplete or confusing, can you revise and rewrite them clearly after every lecture?
	6.	When you are taking a course covering a huge amount of material, can you condense your notes down to just the essential facts?
	7.	When you are trying to understand a new topic, can you associate new concepts with old ones sufficiently well to remember them?
	8.	When another student asks you to study together for a course in which you are experiencing difficulty, can you be an effective study partner?
	9.	When problems with friends and peers conflict with schoolwork, can you keep up with your assignments?
	10.	When you feel moody or restless during studying, can you focus your attention well enough to finish your assigned work?
	11.	When you find yourself getting increasingly behind in a new course, can you increase your study time sufficiently to catch up?
	12.	When you discover that your homework assignments for the semester are much longer than expected, can you change your other priorities to have enough time for studying?
	13.	When you have trouble recalling an abstract concept, can you think of a good example that will help you remember it on the test?
	14.	When you have to take a test in a school subject you dislike, can you find a way to motivate yourself to earn a good grade?
	15.	When you are feeling depressed about a forthcoming test, can you find a way to motivate yourself to do well?
	16.	When your last test results were poor, can you figure out potential questions before the next test that will improve your score greatly?
	17.	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?
	18.	When you think you did poorly on a test you just finished, can you go back to your notes and locate all the information you had forgotten?
	19.	When you find that you had to "cram" at the last minute for a test, can you begin your test preparation much earlier so you won't need to cram the next time?

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Appendix E

Robert Morris Attention Scale

Retrieved online (Kelly, 2012), with permission from Dr. William Kelly to use and include it in my dissertation.

Using the following scale, please circle the **ONE** answer which best indicates how much you **typically** disagree/agree with each statement. That is, how would you describe yourself **in general**?

1. I often have trouble keeping my mind on what I'm doing. +

Strongly disagree Disagree Not sure or neutral Agree Strongly agree

2. When facing a task that I'm not interesting in, I'm usually able to pay attention anyway.

Strongly disagree Disagree Not sure or neutral Agree Strongly agree

3. It's easy for me to pay attention and concentrate on my activities.

Strongly disagree Disagree Not sure or neutral Agree Strongly agree

4. Frequently when I'm working, I find myself attending to other things. +

Strongly disagree Disagree Not sure or neutral Agree Strongly agree

5. I often find myself paying attention to other interesting yet unrelated activities instead of focusing on the task at hand.+

Strongly disagree Disagree Not sure or neutral Agree Strongly agree

+ denotes reverse scored items.

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Appendix F
Background Questionnaire

Age: _______________

Academic level (e.g. first-year student): ________________

Major: ____________

Gender: ____________

What was your GPA last term? _______________

What will your expected GPA of this term be? _______________

How many courses are you enrolled in during this term? _____________

Have you ever been diagnosed with ADHD? ____ Yes ____ No

If Yes, when? __________

In general, do you have problems with maintaining attention? ____ Yes ____ No

If yes, please specify:

____

____

Please circle the severity of your problems maintaining attention:

0 = not at all 1 = very little 2 = somewhat severe 3 = very severe

In general, do you have problems regulating distractions? ____ Yes ____ No

If yes, please specify:

____

____

Please indicate the severity of your problems regulating distractions:

0 = not at all 1 = very little 2 = somewhat severe 3 = very severe

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In general, do you have problems working towards a desired goal? ____ Yes ____ No

If yes, please specify:

____

____

Please indicate the severity of your problems working towards a desired goal:

0 = not at all 1 = very little 2 = somewhat severe 3 = very severe

Please rank these academic concerns often faced by undergraduate students as they apply to you (1 = most applicable, 2 = second most applicable, etc.…)
(Select "N/A" if it is not applicable to you)

________ Writing essays

________ Time-management (e.g., falling behind in reading assignments or weekly submissions)

________ Not knowing how to start an assignment

________ Studying for exams

________ Reading the course material

________ Retaining attention while studying

________ Organizing course materials

Do you have other difficulties completing your academic work? _____ Yes _____ No

If yes, please specify:

____

____

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On the scale below, please indicate the degree of difficulty that each of these academic tasks represents to you:

0	1	2	3	4	5
not at all difficult					extremely difficult

Writing essays:

0	1	2	3	4	5

Time-management:

0	1	2	3	4	5

Starting assignments:

0	1	2	3	4	5

Studying for exams:

0	1	2	3	4	5

Reading the material:

0	1	2	3	4	5

Organizing course materials:

0	1	2	3	4	5

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Appendix G

Feedback Questionnaire 1 – First Follow-Up Assessment

Please answer the following question by circling the number that best describes your experience.

5	4	3	2	1
Completely agree	Agree	Somewhat agree	Disagree	Completely disagree

1) This was a useful workshop.

5 4 3 2 1

2) I feel that this workshop increased my strategic thinking abilities.

5 4 3 2 1

3) I feel more confident in my strategic thinking abilities.

5 4 3 2 1

4) I believe that I will forget fewer things in my life.

5 4 3 2 1

5) I will continue using the skills I have learned in my everyday life.

5 4 3 2 1

6) Please rate how much you experience difficulties with each GMT component on a day-to-day basis:

5	4	3	2	1
Severe difficulties		Some difficulties		No difficulties

a) STOP what you're doing (i.e., orienting yourself towards the task at hand)

5 4 3 2 1

b) STATE your goal(s) explicitly

5 4 3 2 1

c) SPLIT the goal(s) into subgoals

5 4 3 2 1

d) CHECK what you are doing (i.e., monitoring yourself)

5 4 3 2 1

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7) Please rate how helpful learning about each GMT component was for you:

5	4	3	2	1
Very helpful		Somewhat helpful		Not helpful at all

e) STOP what you're doing (i.e., orienting yourself towards the task at hand)

5 4 3 2 1

f) STATE your goal(s) explicitly

5 4 3 2 1

g) SPLIT the goal(s) into subgoals

5 4 3 2 1

h) CHECK what you are doing (i.e., monitoring yourself)

5 4 3 2 1

8) Name the specific components that made you rate this workshop the way you did:

___

___

___

9) Things I liked about this workshop (please be specific):

___

___

___

10) Things I did not like about this workshop (please be specific), or ways to improve this workshop for future groups:

___

___

___

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Appendix H
Feedback Questionnaire 2 – Second Follow-Up Assessment

Please answer the following question by circling the number that best describes your experience.

5	4	3	2	1
Completely agree	Agree	Somewhat agree	Disagree	Completely disagree

1) This was a useful workshop.

5 4 3 2 1

2) I feel that this workshop increased my strategic thinking abilities.

5 4 3 2 1

3) I feel more confident in my strategic thinking abilities.

5 4 3 2 1

4) I believe that I will forget fewer things in my life.

5 4 3 2 1

5) I will continue using the skills I have learned in my everyday life.

5 4 3 2 1

6) Please rate the severity of your experienced difficulties with each GMT component on a day-to-day basis:

5	4	3	2	1
Severe difficulties		Some difficulties		No difficulties

a) STOP what you're doing (i.e., orienting yourself towards the task at hand)

5 4 3 2 1

b) STATE your goal(s) explicitly

5 4 3 2 1

c) SPLIT the goal(s) into subgoals

5 4 3 2 1

d) CHECK what you are doing (i.e., monitoring yourself)

5 4 3 2 1

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7) Please rate how helpful learning about each GMT component was for you:

5	4	3	2	1
Very helpful		Somewhat helpful		Not helpful at all

a) STOP what you're doing (i.e., orienting yourself towards the task at hand)

5 4 3 2 1

b) STATE your goal(s) explicitly

5 4 3 2 1

c) SPLIT the goal(s) into subgoals

5 4 3 2 1

d) CHECK what you are doing (i.e., monitoring yourself)

5 4 3 2 1

8) Please indicate how useful the following aspects of the workshop were for you to master the goal management skills (see the provided example of the homework assignments as a reminder):

5	4	3	2	1	0
Very useful		Somewhat useful		Not useful at all	N/A

a) Information and reviews provided in the weekly emails.

5 4 3 2 1

b) Overall, homework assignments provided in the weekly emails.

5 4 3 2 1 0

c) Specific homework assignments:

i. Absentmindedness monitoring worksheet

5 4 3 2 1 0

ii. Present-mindedness monitoring worksheet

5 4 3 2 1 0

iii. Breathing exercise

5 4 3 2 1 0

iv. Body scan

5 4 3 2 1 0

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v. Breath focus exercise
5 4 3 2 1 0

vi. Daily Stopping chart
5 4 3 2 1 0

vii. Slips & Success monitoring chart
5 4 3 2 1 0

viii. Everyday Stop!-State chart
5 4 3 2 1 0

ix. Daily Stop-State chart
5 4 3 2 1 0

x. Catalogue tasks
5 4 3 2 1 0

xi. Log Stop!-State-Split Scenarios
5 4 3 2 1 0

xii. Wedding Plan task
5 4 3 2 1 0

d) Text-message reminders to use GMT
5 4 3 2 1

9) Name the specific components that made you rate this workshop the way you did:

10) Things I liked about this workshop (please be specific):

11) Things I did not like about this workshop (please be specific), or ways to improve this workshop for future groups:

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Appendix I

Self-Report Behavioural Automaticity Index

Retrieved from Gardner et al. (2012), with permission from Dr. Benjamin Gardner to use and include in my dissertation.

Please rate the following statements.

5	4	3	2	1
Agree completely	Agree	Somewhat agree	Disagree	Disagree completely

Using the Goal Management Training strategies is something…

1. … I do automatically.
   5 4 3 2 1

2. … I do without having to consciously remember.
   5 4 3 2 1

3. … I do without thinking.
   5 4 3 2 1

4. … I start doing before I realize I'm doing it.
   5 4 3 2 1

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Appendix J
Responses on Feedback Questionnaires 1 and 2

Feedback Questionnaire 1 Responses

Question #8: Name the specific components that made this workshop rate it the way you did:

- The STOP and Check components are on my mind the most and are fairly effective.
- It was helpful to me in my studying aspect.
- The tasks of what I have done in the workshop.
- I still need to incorporate some of these components in my own life. But I did use some during this second testing.
- Instructor was awesome/understanding. Clear concepts/goals.
- Stopping to connect has proven helpful this week, so obviously these steps we learned are starting to help me.
- Thinking back to when I ever tried to use the strategies taught in this workshop.
- Splitting the goal into subgoals has helped my study time be more effective rather than spending too much time figuring out where to start.
- I noticed the differences while I was studying or planning to go somewhere and even learning a new song on the piano and it really worked for me.
- I feel as though organization is a large part to memory.
- I always get off topic and distracted, but when I stop and think about what I am doing and if it is directed towards my goal.
- Time. I still haven't gotten into the habit of using what I have learned in the workshop.
- The number with the letters that made me use the plan that the workshop gave and help guide me in a way it helped.
- I especially liked how we were taught to think about our goal and to split it up so that it is not overwhelming. I also liked how we did it as a group.
- They give me an add-on to the techniques I was already using and helped me improve much more.
- The split and check components seemed to be the most useful components of the workshop. But I found that the state and stop helped me stay on track more often.
- My levels on the GMT components before taking the workshop were already at a pretty good level.
- It was so helpful and informative. I would definitely recommend it.

Question #9: Things I liked about the workshop:

- The fact that my absent-mindedness is on my mind more often allows me to remember to stop and check myself more frequently.
- The alphabet with numbers, the thinking process, and the crossword.
- That we were given a workbook, and were working with others. The discussions.
- Easy methods to remember. Realistic goals.

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- All the components/steps we learned about. Intimate setting. Tasks for practice. Clear and explained. Interesting.
- Stop what you're doing-strategy.
- I liked the interactive activities (e.g., dividing the cards into 2 piles).
- Very interactive, the tasks were fun to complete and I feel I've learned a lot.
- The task of learning to stop and start other tasks and looking/being aware of the main goal.
- I enjoyed the workshop, the tests, e.g. the cards and the bank manager, because it put the things that we're discussing into perspective.
- Simple techniques to solve major attention problems.
- I liked them all overall.
- I loved STOP. Whenever my mind would wander I would say stop and focus. The breathing technique was also perfect for me as a de-stressor.
- The activities used as examples were very helpful for they helped me realize my little mistakes but in a fun and improving way.
- I liked the environment of the workshop. It was a small group of people (all really nice) and it was very open-ended and didn't get boring. Our instructors were very nice as well.
- Learning how to be more present-minded.
- The stimulating activities/tests. I really enjoyed the workshop and the tasks we did.

Question #10: Things I did not like about this workshop, or ways to improve this workshop for future groups:

- Some of the tasks could seem repetitive.
- I think it's good enough because I could understand everything that was taught.
- The puzzles.
- The length of time. Maybe in the future it could be split in two. It is a lot to learn at once.
- Break workshop up into 2 days instead of a 4 hour session.
- I think it was just one broad idea of how to keep ourselves on task. I was hoping for more I think. How to battle procrastination? Time-management tips? But the info given was excellent and is already starting to help. Overall, it was GREAT. Thank you.
- Was hoping for strategies to pump one's determination.
- I think the workshop would be better with more participants to bounce ideas off of.
- None.
- The length of how long the workshop was. Would prefer two shorter ones.
- The workbook is a bit intimidating but you stated we would not be doing everything in it so that made it better.
- None.
- None.
- I liked everything. A way to improve would be to have more stories and explaining things.

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- I liked it very much apart from when people were on their phones…
- There were very few things I disliked. The recording of the workshop made me slightly uncomfortable.
- Have more people in the workshop to facilitate more group brain-storming.
- None.

Feedback Questionnaire 2 Responses

Question #9: Name the specific components that made you rate this workshop the way you did:

- I prefer the breathing part because it calms you down and the card was also fun.
- I enjoyed having a workbook to reference back to for the workshop.
- I liked the opportunity to SEE on paper where I slipped up. It allowed me to think about how I could do better next time. I also liked seeing my distractions on paper. It made them seem silly.
- Rating on whether or not I felt any outcome on my routine.
- I've found that I check in with myself more, which helps me get more work done. The breathing exercises were great and were helpful to remind yourself to take some time out of the day to just be present.
- The stop-state components were very effective when I remembered to use them.
- I made the homework assignment goals in which the stop texts helped me keep on track.
- Near the end, I lost track/motivation of the work, but the beginning was useful. But I personally liked the workshop portion the most.
- The lack of time to practice the concepts learned in the workshop.
- I like all of them because it helps me think about what I can do to stop my mind wandering and focusing on what is in my present time.
- My favourite part was the workshop where we were taught to do deep breathing exercises, STOP, etc. It all made me realize what I was doing and helped me stay on track.
- Well some that I rated is because even though they are helping, there is still some work to be done.
- The breathing exercises help me relax and focus better. The text-messages reminded me that I was procrastinating.
- I wasn't motivated to do the homework tasks. Also, I was enrolled in 5 courses and therefore didn't reserve time for the work.
- The activities. They made you really think.

Question #10: Things I liked about the workshop:

- I liked the puzzle and the written part of the workshop because it helps to increase your IQ and ability skills.
- Was something that we worked into my everyday routines, didn't interfere.

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- I liked all the homework. The workbook was helpful to have and I will continue to use it. I liked that I got something really valuable out of this. I liked the in-person testing, where I could see progress (or not). I like the compensation and how nice everyone was. Thank you.
- Emphasis on the little things that didn't seem important before: such as, STOP helped me sometimes from going on with something that wasn't effective in reaching a goal.
- The texts were the most useful. Since they were sent throughout different times of the day, I would be in a different part of my routine. After a few texts, I would wonder when the next one would come, which provided another opportunity to check in. The emails were helpful reminders of the skills learned in the workshop. Thank you!
- The stop-state exercises and the mental blackboard.
- The text reminders.
- How for the most part, they were quick work. The reminders helped a lot and how approachable the researcher was.
- The different methods used to help improve focus.
- I liked all of them because it helps me think and learn that I have a problem and this helps guide my way to a better me.
- I really liked the text messages throughout the week. They helped me remember.
- My favourite part is the "STOP-think-act" texts. They seemed to always come up right when needed.
- I like that it was relevant to students and I really liked the text reminders.
- Learning to split large tasks into smaller ones on the day we did the workshop.
- It was fun and informative. Very interactive.

<u>Question #11: Things I did not like about the workshop, or ways to improve the workshop for future groups:</u>

- The time – it was too long.
- Great workshop!
- The only thing I found troubling was doing all the homework on top of what I already had to do in a day! I know it was supposed to help.. and that's what made me try my best. But it was a lot (for me anyway).
- I felt it was more focused on stopping and checking myself (organizing), which was good. However, I would have liked more emphasis on execution and maintaining rhythm.
- I did not find the assignments that I did complete to be very helpful. I am not someone who was able to keep a journal, so I never got into a routine of taking time to write down reflections.
- None.
- Some of the homework assignments were dry and not always practical to keep on top of.
- How, if I wanted to be diligent, I would have to bring the book around to document. Where it spent the most time on my shelf, I only took it out when I got

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a text. After a point the activities were taking more time. I didn't feel a fit with the program, e.g., breathing/body scan. So many repetitive charts.

- None.
- None.
- I did not like some of the tasks, they were sometimes boring. Ways to improve would be to make them more interesting.
- Nothing that I can think of. Maybe more "in-class" thing program we did would be even more helpful.
- Nothing, it was very good.
- The problems I have lie greatly in motivation, therefore, I don't think a program like this would be effective for me.
- None.

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Appendix K

Means and Standard Deviations of Participants who Completed All Three Assessments (Group A) and Participants who Completed Only One or Two Assessments in This Study (Group B) on Demographics, Self-Report, and Performance Measures

Table K1

Demographics and Self-Report Measures

Group	Age *M (SD)*	Year in Program *M (SD)*	GPA *M (SD)*	Courses *M (SD)*	SELF-A *M (N)*	RMAS *M (SD)*	GEC t-score *M (SD)*	GMTQ-S *M (SD)*
A	21.23 (3.80)	2.46 (0.98)	66.14 (11.30)	3.74 (1.56)	54.08 (13.32)	19.89 (2.59)	66.00 (9.62)	6.42 (1.60)
B	22.73 (2.76)	3.40 (0.83)	66.44 (12.90)	3.67 (1.45)	55.30 (18.14)	19.67 (3.02)	64.93 (8.78)	5.91 (1.66)

Note: Group A = Participants who completed all assessments, *N* = 35; Group B = Participants who completed either one or two assessments only, *N* = 15.

Table K2

Performance Measures

Group	EFSS *M (SD)*	Inhibition Subdomain *M (SD)*	Fluency Subdomain *M (SD)*	Switching Subdomain *M (SD)*	Working Memory Subdomain *M (SD)*	Processing Speed Subdomain *M (SD)*
A	9.90 (1.76)	10.44 (1.67)	10.40 (3.32)	9.72 (2.09)	9.10 (2.12)	10.79 (2.30)
B	10.50 (1.32)	10.87 (1.34)	11.27 (2.03)	10.00 (2.13)	10.13 (1.52)	12.10 (2.47)

Note: Group A = Participants who completed all assessments, *N* = 35; Group B = Participants who completed either one or two assessments only, *N* = 15. All scores on performance measures are based on age-scaled scores with *M* = 10 and *SD* = 3.

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Appendix L

Results of Mixed Factorial ANOVAs for All Performance Subtasks and Means and Standard Deviations for All Performance Subtasks by Group and Time of Assessment

Table L1

Results of Mixed Factorial ANOVAs for all Performance Subtasks

	df, df error	*F*	*p*	partial η^2
Main Effect for Time				
Digit Span	2, 32	5.82	.01	.27
Letter-Number Sequencing	2, 66	3.03	.06	.08
Color Word Interference - Inhibition	2, 32	6.72	.00	.30
Tower Test	2, 66	13.03	.00	.28
Verbal Fluency Switching	2, 66	2.76	.07	.08
Trail Making Test – Condition 4	2, 66	5.02	.01	.13
Color Word Interference - Switching	2, 66	8.10	.00	.20
Verbal Fluency - Semantic	2, 66	8.92	.00	.21
Verbal Fluency - Phonemic	2, 66	11.18	.00	.25
Symbol Search	2, 66	60.84	.00	.65
Coding	2, 66	21.21	.00	.39
Main Effect for Group				
Digit Span	1, 33	.44	.51	.01
Letter-Number Sequencing	1, 33	1.72	.20	.05
Color Word Interference - Inhibition	1, 33	.16	.69	.01
Tower Test	1, 33	.002	.97	.00
Verbal Fluency Switching	1, 33	.46	.50	.01
Trail Making Test – Condition 4	1, 33	.19	.66	.01

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	df, df error	*F*	*p*	partial η^2
Color Word Interference - Switching	1, 33	1.62	.21	.05
Verbal Fluency - Semantic	1, 33	.01	.93	.00
Verbal Fluency - Phonemic	1, 33	.19	.67	.01
Symbol Search	1, 33	.01	.91	.00
Coding	1, 33	2.61	.12	.07
<u>Interaction Effect Time*Group</u>				
Digit Span	2, 32	1.32	.28	.08
Letter-Number Sequencing	2, 66	.71	.50	.02
Color Word Interference - Inhibition	2, 32	.05	.95	.00
Tower Test	2, 66	1.74	.18	.05
Verbal Fluency Switching	2, 66	1.21	.30	.04
Trail Making Test – Condition 4	2, 66	.17	.85	.01
Color Word Interference - Switching	2, 66	.51	.60	.02
Verbal Fluency - Semantic	2, 66	1.30	.28	.04
Verbal Fluency - Phonemic	2, 66	.35	.71	.01
Symbol Search	2, 66	3.82	.03	.10
Coding	2, 66	3.46	.04	.10

Note. GMT group $N = 16$, control group $N = 19$.

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Table L2

Means and Standard Deviations for All Performance Subtasks by Group and Time of Assessment

	Group	Mean	*SD*
Digit Span			
Baseline	GMT	8.38	2.47
	Control	9.00	2.47
First Follow-Up	GMT	9.38	1.71
	Control	9.53	2.72
Second Follow-Up	GMT	9.38	2.50
	Control	10.21	3.12
Letter-Number Sequencing			
Baseline	GMT	9.13	1.59
	Control	9.79	2.64
First Follow-Up	GMT	9.25	1.34
	Control	9.95	2.57
Second Follow-Up	GMT	9.50	2.31
	Control	10.79	2.37
Color Word Interference - Inhibition			
Baseline	GMT	10.63	2.31
	Control	10.37	2.36
First Follow-Up	GMT	11.69	1.99
	Control	11.32	2.52
Second Follow-Up	GMT	11.38	2.31
	Control	11.16	2.48
Tower Test			
Baseline	GMT	10.19	2.04
	Control	10.58	1.54
First Follow-Up	GMT	13.06	2.72
	Control	12.00	2.56
Second Follow-Up	GMT	12.38	1.78
	Control	13.11	2.42

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	Group	Mean	*SD*
Verbal Fluency Switching			
Baseline	GMT	10.50	3.41
	Control	10.37	3.17
First Follow-Up	GMT	11.06	4.19
	Control	12.05	3.69
Second Follow-Up	GMT	10.56	3.61
	Control	11.89	3.45
Trail Making Test – Condition 4			
Baseline	GMT	8.94	2.62
	Control	8.89	2.81
First Follow-Up	GMT	10.25	2.82
	Control	9.89	2.42
Second Follow-Up	GMT	10.44	1.97
	Control	9.89	2.73
Color Word Interference - Switching			
Baseline	GMT	9.25	3.36
	Control	10.32	3.13
First Follow-Up	GMT	10.25	3.36
	Control	11.37	2.83
Second Follow-Up	GMT	10.06	3.49
	Control	11.68	2.56
Verbal Fluency - Semantic			
Baseline	GMT	10.31	3.91
	Control	10.89	4.18
First Follow-Up	GMT	12.19	4.15
	Control	11.89	3.73
Second Follow-Up	GMT	12.31	4.41
	Control	11.68	3.82

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	Group	Mean	*SD*
Verbal Fluency - Phonemic			
Baseline	GMT	10.31	3.11
	Control	10.05	3.76
First Follow-Up	GMT	11.69	3.77
	Control	11.68	3.46
Second Follow-Up	GMT	11.44	2.78
	Control	10.89	3.48
Symbol Search			
Baseline	GMT	10.81	2.97
	Control	11.21	2.99
First Follow-Up	GMT	13.44	3.42
	Control	13.84	3.52
Second Follow-Up	GMT	15.06	3.11
	Control	13.89	3.11
	Group	Mean	*SD*
Coding			
Baseline	GMT	10.94	2.43
	Control	10.21	2.44
First Follow-Up	GMT	12.50	3.10
	Control	11.05	2.61
Second Follow-Up	GMT	13.25	3.21
	Control	11.16	2.65

Note. GMT group $N = 16$, control group $N = 19$. All scores on performance subtasks are based on age-scaled scores with $M = 10$ and $SD = 3$.

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