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SELF-REGULATED EXECUTIVE FUNCTIONS IN ACADEMIC ACHIEVEMENT

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A dissertation submitted to the Faculty of Graduate Studies in
Partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Graduate Program in Psychology
York University
Toronto, Ontario

January, 2005

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ISBN: 0-494-11638-2
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ISBN: 0-494-11638-2

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Abstract

This study sought to determine whether students' academic achievement can be predicted from their ratings of their own self-regulated executive functions. A new self-report questionnaire, the Self-Regulated Executive Functions Inventory (SREFI) was designed for this purpose. It consists of 84 items across seven subscales: Working Memory, Initiative, Monitoring, Planning, Goal-Setting, Self-Control, and Time Management. Statistical analysis of students' responses on the SREFI revealed a high degree of inter-item agreement, moderate to high interscale correlations, and moderate correlations with most scales of the Behaviour Rating Inventory of Executive Functioning – Parent form. It also compared favourably with scores on the Delis-Kaplan Executive Function System.

A total of 172 students (*M* age = 11:9; *SD* = .81) from two large public middle schools in suburban Toronto participated in the research. The SREFI scales differentiated students with above-average marks from those with average and low-average marks. Students with marks above 80% reported significantly better self-regulation than the other students. There was a great deal of variability in reports of self-regulation among students with average and below-average marks (marks in the 60 to 80% range). Interestingly, students with marks below 60% did not report many difficulties with self-regulation.

There was a significant interaction between scores on the SREFI and IQ, as measured by the Wechsler Abbreviated Scale of Intelligence. Underachieving students with high IQs reported having the most problems with self-regulated executive functions compared to other students, and overachieving students with above- and below-average IQs reported the least problems with self-regulated executive functions. These results are discussed in relation to the models of self-regulation described by Veenman (1993).

The Time Management scale of the SREFI was the most significant factor in the prediction of academic achievement. Time Management had the highest correlations with IQ and the Homework Completion teacher-rated learning skill.

Several models proposing an interactive role of executive self-regulation, affective variables, and skills in academic performance (Ellis & Zimmerman, 2001; Hartman & Sternberg, 1993; Weinstein, Husman & Dierking, 2000) were also tested. The present study confirmed the hypothesis that students with higher levels of self-regulation, as measured by the SREFI, had fewer personality problems and were generally more positive emotionally, as measured by the Achievement and Motivation Profile – Junior (Mandel, 1995), relative to students with lower levels of self-regulation. The results suggested that affective components play a higher role during the second, *Performance*, phase of self-regulation than during the first, *Forethought*, phase (Ellis & Zimmerman, 2001). There were low to moderate correlations between teacher ratings of most student learning skills and student ratings of executive self-regulation.

The results suggest that achievers and overachievers with high intelligence may benefit from learning how to transfer and engage their knowledge of self-regulation to their academic performance. In contrast, students of far below average intelligence should first increase their metacognition: they should learn to recognize the different elements of self-regulation and develop insight into their own skills in this area.

Dedication

This work is dedicated to Harvey Mandel, my supervisor and mentor, whose self-regulated executive functions were a model to many students in their life achievement, especially my own. His commitment, wisdom, humour, selfless service and human caring continues to be a model for the countless fortunate souls whom he touched. He cared most for those children who were unable to achieve to their fullest potential, underachievers, and his legacy will be a community so much better because his work will have made it possible for so many to become true achievers.

Acknowledgments

Professor Harvey Mandel provided the inspiration, guidance, wisdom, constructive criticism, patience and extraordinary research expertise that made the completion of this work possible, just as he had done for countless students for decades. His untimely death was a great personal loss for myself, his students and colleagues, and for the entire community. I will be eternally indebted to him for helping me develop into the professional psychologist I will become.

Professor Jill Rich was a savior, stepping in at the last minute to assume the role of supervisor. Her incredible organizational skills, her willingness to make an enormous contribution to the work is such a short period of time, and her insights and personal support made completion possible.

Professor Susan Murtha, throughout the development of this work, provided great knowledge and expertise, especially in the area concerning the methodological aspects of the study. Her support, kindness and willingness to provide so much input in such a short period of time also made this work possible.

Professor Joanna Blake kindly agreed to serve as a committee member at the very last stages of the work. Her insights and contributions, especially in the areas of language and the communication of research design and findings, improved the final version of the dissertation enormously. For this and her very kind support, I am very grateful.

Finally, great love and appreciation goes to my family for their patience, understanding and continuous support throughout the long process of producing this work. It is hoped that the future will hold rewards for them that will compensate for the loss of my time and support they experienced throughout the past many years. A special thank you and love to my husband, Dr. Edward G. Blackstock, for being next to me through all the stages of doubt, despair, struggle, joy, and pride; all of the difficulties and accomplishments along the way, especially helping to cope with the loss of my supervisor, and providing me always with comfort and love.

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Introduction

In 2002, the Learning Disabilities Association of Canada (LDAC) and its provincial and territorial associations ratified a new definition of Learning Disability (http://www.ldac-taac.ca/english/defined.htm). According to the new definition, students should be identified as having a learning disability only if they have a specific cognitive processing deficit (e.g., memory, language processing problems, or attentional difficulties). For the first time, the definition also included executive functions and metacognition as cognitive processing deficits that can negatively affect the acquisition or learning of basic academic skills. While the contribution of self-regulative executive functions to academic achievement has been studied in children with brain injuries and attention deficit disorder (Barkley, 2000; Clark et. al., 2000; Moffitt, 1989; Ylvisaker & DeBonis, 2000), there has been little research in this regard carried out with the general population.

The original research question of the current study was whether students' academic achievement can be predicted from students' ratings of their executive functions. A review of the literature revealed that the term *executive functions* often overlapped with or included concepts such as metacognition and self-regulation (Brown, 1987; Gioia, Isquith, Guy & Kenworthy, 2001; Miyake, Friedman, Emerson, Witzki, Howerter & Wager, 2000; Stuss, 1992; Tucker & Derryberry, 1992), and that *self-regulative executive function* (Wells & Matthews, 1996) was the most appropriate, fullest, and best term to describe the range of abilities that are required to succeed academically, especially in the post-elementary grades.

Analysis of the literature and further statistical analysis of the collected data broadened the original research question to consider the role of self-regulative executive function in academic achievement in relation to other factors, such as intelligence, affect, and learning skills. In this regard, several existing models that described the interactive role of these factors were considered (Ellis & Zimmerman, 2001; Hartman & Sternberg, 1993; Weinstein et al., 2000).

Chapter 1

Literature Review

This review begins with a discussion of several well-known and accepted findings that demonstrate the importance of academic achievement in personal lives as well as in the socio-economic growth and development of society. A review and analysis of neuropsychological factors related to academic achievement are presented and further narrowed to elucidate the specific role of executive functions. In the following two sections, different definitions of executive functions and their role in academic achievement are reviewed. This review broadens the concept of executive functions to include a hierarchical structure of self-regulated executive functions. Next, interactions of self-regulated executive functions with intelligence and affect are discussed in relationship to academic achievement. In addition, the relation of cognitive and affective components of self-regulated executive functions is reviewed from the viewpoint of neuropsychological findings, followed by discussion of some interactive models that focus on the role of skills and cycles of self-regulated executive functions. Methodological issues, such as the measurement of academic achievement and self-regulated executive functions are raised prior to presentation of rationale and hypotheses of the present study.

Primary Factors Associated with Academic Achievement

It is a widely held and common belief that there is a very high correlation between academic achievement and the quality of one's personal life, as well as the health, effectiveness, and general success of any particular society. What has much less consensus are the specific reasons underlying academic underachievement. Social Darwinians hold that social class is the main determinant of success in school and in life. Many psychologists and educators hold that intelligence is the central determinant. Parents often assume that underachievement is the fault of the school system and poor teaching. While there is certainly some truth in all of these formulations, a systematic, scientific meta-analysis of the relative contributions of the many factors relating to academic underachievement has yet to be realized. It is hoped that the current

study will contribute to that as-yet-unrealized meta-analysis. The major purpose of this section is to review the relative importance of factors related to academic achievement, especially with regard to early identification and remediation strategies for those students who underachieve academically, based on what we already know from prior research. While there are many factors that contribute to academic underachievement, the focus of this study is on neuropsychological deficits, especially in executive functions. This section also contains statistics that demonstrate the negative impact of academic underachievement on the quality of personal lives and on the quality of society in general.

Academic underachievement negatively affects not only achievement through the school years, but has a much further reaching negative impact on personal lives, as was shown by longitudinal research conducted by McCall, Evahn, and Kratzer (1992). This study involved 6,720 American high school students, who were followed up 13 years later. The authors assessed outcomes in three different areas: long-term educational outcome, occupational outcome, and personal life, as measured by divorce rate. Underachievers were worse off compared with achievers matched for mental ability. For both genders, the status and income of the students' first job were consistent with their academic performance but not their mental abilities. Thirteen years later, school underachievers had completed fewer years of formal education (1.63 years or a 10.5% decrement for males, and 1.05 years or a 7.4% decrement for females), and earned less per hour (7.7% for males and 7.4% for females) compared with achievers with the same mental abilities. Underachievers were less than half as likely to attend college or university, and were twice as likely to attend vocational/technical schools compared with achievers with the same mental abilities. Of those underachievers who did attend a college or university, 50% of males and 42% of females dropped out before graduation. Underachievers were more likely to have marriage problems and had higher rates of divorce.

In their discussion of the reasons for academic underachievement, McCall et al. (1992) differentiated *nonlearners* (i.e., those with specific neuropsychological deficits that affected

academic achievement) from *nonproducers* (i.e., those with no obvious learning limitations). Many nonlearners have learning disorders. According to DSM-IV (American Psychological Association, 2000), learning disabilities (formerly academic skills disorders) are diagnosed when achievement on standardized tests in reading, mathematics, or written expression is substantially below that expected for age, schooling, and level of intelligence. In addition, learning problems significantly interfere with academic achievement or activities of daily living that require reading, mathematical, or writing skills. In school settings, students with learning disorders are considered as exceptional students with learning disabilities. It should be noticed that not all underachievers have learning disabilities, and not all students with learning disabilities are underachievers.

The Learning Disability Association of Canada (LDAC) has published on their website (http://www.ldac-taac.ca/english/indepth/bkground/stats01.htm) a list of statistics related to learning disabilities with references to sources up to 2001 that highlight the importance of the early identification of and intervention for students with learning disabilities. The following are facts from this source:

- One in 10 Canadians, or 3 million people, has a learning disability.
- 35% of students identified with learning disabilities drop out of high school. This is twice the rate of nondisabled peers and does not include dropouts who are not identified. The Conference Board of Canada determined that dropouts from the high school class of 1987 will cost society more than $1.7 billion in lost taxes.
-Almost 50% of adolescent suicides had previously been diagnosed as having learning disabilities.
- 30% to 70% of young offenders have experienced learning problems. The cost of detaining a young offender is approximately $100,000 a year.

In 2002, the LDAC and its Provincial and Territorial Associations ratified a new definition of learning disability for national purposes (http://www.ldac-taac.ca/english/defined.htm).

According to the new definition, students should be identified as having a learning disability only if they have a specific cognitive processing deficit. In addition to memory, processing speed, language processing, perceptual-motor processing, visual-spatial processing, and attention, executive functions (e.g., metacognition, planning) were also included for the first time as cognitive processing deficits that can negatively affect the acquisition of basic academic skills.

Considering that the above statistics were collected before the new definition was accepted, the numbers and effects could be even more dramatic if deficits in executive functions are considered as processes related to learning disability. It is important to consider the possibility that many underachievers (students who have academic marks below the level that would be predicted from their cognitive ability) have been perceived as nonproducers rather than nonlearners. In contrast to nonlearners, nonproducers presumably do not have obvious neuropsychologically based learning deficits but rather have low motivation (McCall et al., 1992). Taking into account that executive functions involve capacities for self-determination, self-direction, self-control, and regulation (Stuss, 1992), and that these aspects of cognition concern the expression of ability rather than ability itself (Lezak, 1995), it is possible that deficits in executive functions may sometimes be inaccurately diagnosed or described as "motivational factors."

Gioia (1992) proposed a specific learning disorder related to the development of executive functions, which he called an executive/organizational learning disorder. According to Gioia, students with an executive/organizational learning disorder differ from those with other subtypes by a relatively later onset of academic difficulties. Their performance reflects poorly organized execution of attention, cognition, and behaviour, and difficulties with goal-setting and planning. Children with this type of learning disability have significant academic weaknesses in both written language and arithmetic.

Psychological assessment services in school settings traditionally focus on students in grades 4 and 5, when reading or math problems become obvious. The likelihood of a student in middle or secondary schools being referred for a psychological assessment is small; instead, it is much more likely that the student would have become a behaviour problem or a dropout. Even if referred, it is unlikely that difficulties with executive functioning would be found because of a lack of knowledge in this area and a dearth of psychometric instruments designed to assess this factor in relation to academic achievement.

In summary, there are personal (e.g., low income) and social (e.g., loss of tax revenue) reasons why the role of self-regulated executive functions in academic achievement should be assessed. Despite the obvious need for research on the role of executive functions in academic achievement, only a limited number of studies have been carried out, and none has examined academic achievement from students' rating of their own executive functions.

Components of Executive Functions and Their Relation to Academic Achievement

In order to assess deficits in executive functions, it is important to clearly define this construct and its components. Review of the literature in this regard reveals a broad range of opinions. Some authors subdivide executive functions into compound functions, such as planning (Tucker & Derryberry, 1992), temporal integration (Fuster, 2002), controlling voluntary behaviours (Luria, 1983), problem solving (Fossati, Ergis, & Allilaire, 2001; Shordone, 2000), and the ability to initiate activity (Guilford, 1972; Nathaniel & Brown, 1996). In contrast, Miyake et al. (2000) describe executive functions in simpler, operationally defined elements, consisting of shifting, inhibiting, and updating/monitoring of working memory. Inhibition is identified as the controlled suppression of irrelevant information. Updating and monitoring of working memory representations, in contrast to passive storage, involve the active manipulation of relevant information (Goldman-Rakic, 1996; Smith & Jonides, 1999).

Miyake et al. (2000) suggest that the ability to keep goal-related and other task-relevant information active in working memory during controlled processing might underlie these three

operative executive functions. The importance of the role of working memory is supported by Engle, Tuholski, Laughlin, and Conway (1999), who suggest that in any situation involving controlled processes, such as goal maintenance, error monitoring, and effortful memory search, controlled attention is required. Moreover, Engle et al. proposed that working memory is the crucial component of controlled attention.

Similar to the three elementary executive functions described by Miyake et al. (2000), Gioia and colleagues (2001) describe five subdomains of executive functions, four of which are cognitive (initiation, organizing, planning, and monitoring), and one that is affective (emotional control). Emotional control refers to the ability to modulate/control one's own emotional response as appropriate to a situation or stressor. Those with dysfunction in this area tend to be easily upset and explosive, and they demonstrate disproportionate emotional responses to events. The organizing subdomain of executive functions is in charge of establishing and maintaining order in an activity or place and carrying out a task in a systematic manner. Those with deficits in this area have a scattered approach to problem solving and are easily overwhelmed by large tasks or assignments.

Planning is defined as anticipation of future events, setting goals, and developing appropriate steps ahead of time to carry out an associated task or action. Those who exhibit problems with planning do not evaluate possible future problems, do not start assignments until the last minute, and do not finish long-term projects. One of the major problems that may interfere with the maintenance of planned goals is difficulty in delaying gratification and in inhibiting impulses that are incompatible with progress toward goals (Tucker & Derryberry, 1992).

Monitoring is defined as the ability to check one's own actions during or shortly after finishing a task or activity to assure appropriate goal attainment. Monitoring also refers to one's on-line awareness of comprehension and task performance. An example is periodic self-testing

while learning. According to Pressley and Ghatala (1990), monitoring ability develops slowly and is quite poor in young children and even in some adults.

Difficulties with monitoring and planning have been found to be related to difficulties with prospective memory (Fortin, Godbout, & Braun, 2002; Magdalinski, 2002). Deficits in the ability to bridge cross-temporal contingencies from past, present, and/or future anticipations might result in an impaired ability to establish meaningful cognitive representations and to act upon abstractions (Fuster, 2002). As a result, a concrete attitude can become dominant, and although small sequences of actions can be easily produced, large action sets might not be correctly executed.

Deficient execution of large action sequences can also be related to difficulties with time management. Two dimensions of temporal information are differentiated in the model that links temporal information to working memory: temporal duration and temporal order (Nichelli, 1993). Temporal duration refers to storage of the interval between two successive events; temporal order refers to storage of the sequential occurrence of events. According to the framework of internal clock models (Gibbon, Church, & Meck, 1984; Treisman, Faulkner, Naish, & Brogan, 1990; Zakay & Block, 1996), clock-counter mechanisms monitor the passage of subjective time (clock stage). Records of accumulated time are transferred to working or reference memory (memory stage) for later comparison (decision stage). The decision stage compares current time with remembered time and identifies an appropriate response outcome. Halbig, von Cramon, Schmid, Gall, and Friederici (2002) suggest, however, that impairments of duration processing reflect deficits in executive monitoring functions rather than deficient encoding or maintenance of duration information in working memory.

Several researchers have associated academic achievement with the development of primary components of executive functions, especially working memory (Ashcraft & Kirk, 2001; Daneman & Hannon, 2001; Gathercole & Pickering, 2000; Hitch & Hutton, 2001; Swanson & Sachse-Lee, 2001). Gathercole and Pickering (2000), for example, found that children who failed

to attain expected levels of academic achievement for their age (n = 13, low achievers in language and math; n = 8, low achievers in math; and n = 2, low achievers in English; M age = 7.4, SD = 3.72) also performed poorly on tests of working memory. Swanson and Sachse-Lee (2001) found that because of deficits in working memory, 25 Grade 5 and Grade 6 children with learning disabilities (IQ > 85, reading comprehension < 25th percentile) experienced difficulties in identifying the goals of mathematics word problems compared to younger children who performed at the same reading comprehension and arithmetic levels. Furthermore, Bull and Scerif (2001) reported that mathematical ability in Grade 3 children (N = 93; M age = 7:4) was significantly correlated not just with working memory, but also other primary executive functions, such as inhibition and switching, as measured by the Wisconsin Card Sorting Test and Stroop, counting, and dual tasks.

In summary, the above studies demonstrate that academic achievement can be negatively affected by deficits in the operative, or primary, components of executive functions, such as working memory, inhibition, and switching. The role of more complex executive functions in academic achievement, such as planning and goal setting, will be examined next.

Shelley-Black (2001) reported that children with learning disabilities in mathematics had significantly more impaired performance on a test of executive functions that measured ability to plan compared with children with reading disabilities. McLean and Hitch (1999) reported that children whose scores were in the bottom 25% on the Graded Arithmetic-Mathematic Test but had average scores on the Primary Reading Test (n = 12) differed significantly from age-matched (n = 6) and ability-matched controls in both reading and mathematics (n = 12) on 6 of 10 tests of executive functions (M age = 7:11).

In addition to the ability to plan, the goal-setting aspect of executive functioning is also a significant predictor of academic achievement. Situation-specific goals accounted for 15-17% of the variance in math achievement in a study of 358 students (146 boys, 212 girls; 81% Caucasian, 8% Native Americans, 5 % Hispanic) by Greene, DeBacker, Bhuvaneswari, and

Krows (1999). Students who were able to reasonably estimate their academic achievement goals (n = 83; M age = 7.4; SD = 3.72) earned higher grades than those who could not (Garavalia & Gredler, 2002).

The above review of executive functions suggests a hierarchical structure of executive regulation. The first level consists of primary or operative elements of executive functions, such as working memory and inhibition. The second level consists of more complex functions, such as planning, time management, emotional control, and goal setting. This view of hierarchical structure of executive functions is consistent with the Self-Regulatory Executive Function (SREF) model postulated by Wells and Matthews (1996). The SREF model distinguishes three levels of cognition: (a) a stimulus-driven, lower-level network of interacting processing units, (b) a supervisory executive implementing voluntary control, and (c) self-knowledge.

This section of the literature review demonstrates the important role of the first two levels of executive functions in academic achievement. These studies, however, did not focus on the prediction of academic achievement from the third level of the SREF model, which is students' awareness or self-knowledge of their strengths and weaknesses in the area of executive functions,. Studies in this area include the concepts of metacognition and self-regulation. These concepts and their role in academic achievement will be discussed next.

Self-Knowledge of Executive Functions: Metacognition and Self-Regulation

Definitions of executive functions often overlap with definitions of metacognition, self-determination, and self-regulation. For example, Brown (1987) included executive control and regulation of that system as a part of metacognition. Kluwe (1987) differentiated three aspects of metacognition: metacognitive knowledge, executive control, and executive regulation. According to Stuss (1992), executive functions involve the capacity for self-determination, self-direction, and self-control and regulation.

Self-determination, or knowledge of how one's cognition works, seems to be a part of metacognition, the ability to know one's strengths and weaknesses and to use that knowledge to

accomplish difficult tasks (Flavell, Miller, & Miller, 1993). Ellis and Zimmerman (2001) referred to two distinct aspects of metacognition: knowledge about cognition and the regulation of cognition. According to Wolters and Pintrich (2001), metacognition is a central process used in problem solving that manages and coordinates the other components, such as how and when to use strategies in realistic academic tasks.

Metacognition has become a focus of research on children with learning disabilities (Butler, 1998; Hagen, Barclay, & Newman, 1982; Wong, Harris, & Butler, 2003). A major reason for this trend is that metacognition is considered as a possible explanatory construct for why many learning-disabled students experience difficulties in certain academic settings. If this speculation is supported, metacognitive aspects of problem solving may be remediated through instruction and training. In fact, it has been demonstrated that learning significantly improves when metacognitive skills are included in classroom instruction (Brown & Palinscar, 1989; Cross & Paris, 1988).

Teachers and other students may play an important role in developing metacognitive skills. The more explicit this modeling, the more likely it is that students will develop cognitive and metacognitive skills (Butler & Winner, 1995). Butler (1998) demonstrated that when postsecondary students with learning disabilities ($N = 34$, ages 19- 48 years) had tutoring that promoted self-regulation for 3 hours per week during at least one semester, they had consistent improvement in their metacognitive knowledge about key self-regulated processes, perception of task-specific efficacy, attributional patterns, task performance, and strategic approaches to tasks. Students were also able to transfer these skills across contexts and tasks.

Davidson and Sternberg (1998) suggested that students may have metacognitive performance problems. They may underestimate the difficulty of a task, fail to plan ahead, or be unable to determine when they have studied enough to master material they are attempting to learn. They may also use inadequate or incorrect representations and fail to monitor their progress effectively. For example, they may not recognize when they fully understand

something, they may not gather all relevant information, or use a systematic step-by-step approach, or they may fail to monitor or evaluate the success of their performance. The authors identified three areas of metacognitive knowledge that help in problem solving: encoding and mental representation of the problem, selecting and revising strategies, and identifying and overcoming obstacles.

In general, students with effective metacognitive skills accurately estimate their knowledge in a variety of domains, monitor their on-going learning, update their knowledge, and develop effective plans for learning (Wolters & Pintrich, 2001). Wehmeyer and Palmer (2003) reported a follow-up study of school leavers with mental retardation or learning disabilities who were surveyed 1- and 3-years after they left school to determine what they were doing in major life areas (employment, independent living or community integration). Students were divided into two groups based on self-determination scores collected during their final year at high school. Comparisons between these groups on outcomes at 1 and 3 years post-graduation indicate that students who were more self-determined fared better across multiple life categories, including employment and access to health and other benefits, financial independence, and independent living.

Hartman (2001) suggested that high-achieving students have better metacognitive skills than low-achieving students. Students with higher marks were more accurate in predicting their grades than students with lower marks, and both low- and average-ability students overestimated their future grades. Hartman (2001) also referred to studies where low-achieving students were taught to use metacognitive strategies that improved their reading comprehension.

As any other processing function, awareness of self-regulatory functions develops with age (see Demetriou, 2000, for review). According to Demetriou, awareness and self-initiated notification, the first levels of self-control, appear at the age of 3-5 years. At age 6-8 self-regulation is monitored through inner speech. Short-term goal selection and planning appears only at age 8-10, which further develops into interest about the future, middle-scale planning,

and systematic regulation of everyday activities at age 11-13. At this period, children are able to distinguish different kinds of the same cognitive function and have higher order abstractions about self, although they are not yet well integrated. Finally, at age 14-16, children are able to differentiate between similar cognitive domains, have accurate global self-concept with accurate specific self-representations, and are able to plan their future. According to Demetriou (2000), awareness of specific cognitive processes develops gradually in adolescence and is possible due to the ability to build representational systems, including self-representation.

Demetriou's (2000) review suggests that it is unreasonable to expect students younger than 10-11 to rate their executive functions, but children age 11 and older should have reasonable insight into their abilities in this domain. There are also indications that students with higher ratings of their executive functions should have better marks compared to those who report problems in this area.

The literature also supports the notion that executive functions have a hierarchical structure, where self-knowledge belongs to the highest level of self-regulatory executive functions. This assumption is consistent with the SREF model (Wells & Matthews, 1996), which holds that executive processing is influenced by self-knowledge and conceptualized as a library of plans, or generic proceduralized knowledge. The executive accesses a plan from long-term memory and modifies it to formulate and implement a coping strategy. While Wells and Matthews identify this process under the rubric of self-regulatory executive functions, others truncate the term to *self-regulation*. For example, according to Zimmerman (2000), self-regulation refers to self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals.

The main theoretical conclusion of the literature review so far is that executive functions develop gradually from primary, or operative, to more complex ones. With further development of self-knowledge, these higher level executive functions allow self-regulation of goal-oriented behaviour. The main conclusion of the literature review is that children age 11-13 years should

have the capacity for self-regulation, and this capacity can be assessed with self-rating tools. Students of this age should be able to apply their self-regulative executive functions to their academic achievement; and, therefore, there should be a positive correlation between their marks and self-rated executive functions. This postulation is the main focus of the current study.

Interaction Between Self-Regulative Executive Functions and Intelligence

When assessing self-regulatory executive functions it is important to control other variables that also influence academic achievement. The major one is intelligence. The nature of the relation between self-awareness of executive regulation, intelligence, and academic achievement has been an area of intense debate. In this regard, Veenman (1993) discussed three models of the relation between intelligence and metacognition: the intelligence model, the independency model, and the mixed model.

The intelligence model considers metacognition as one of the components of executive self-regulation and as a manifestation of intelligence. This view is shared by Sternberg (1985) and Pascual-Leone (1983). According to the componential theory (Sternberg, 1985), there are three major components of intelligence, namely metacomponents, performance components, and knowledge acquisition components. The metacognitive components are involved in the processes of planning, monitoring, and evaluating one's own learning and thinking. The performance components of Sternberg's theory involve processes used to implement the instructions of metacomponents, whereas knowledge acquisition components involve processes used to learn how to solve problems.

The development of the executive components of intelligence was underlined in Pascual-Leone's (1983) concept of the mental-attentional mechanism. Central to Pascual-Leone's theory is the developmentally growing mental capacity that determines the processing complexity an individual can handle. Pascual-Leone describes the developing capacity of four constructs, the first three of which are organismic: (a) an individual's capacity to boost task-relevant informational processes; (b) one's capacity to interrupt irrelevant information; (c) field factors

that integrate several different structures into a whole, and therefore transform a quantitative set of activated schemes into a qualitative continuum; and, (d) executive schemes that monitor and control the strategic use of the other three organismic capacities.

In contrast to the intelligence model, the independency model considers metacognition and intelligence as completely independent factors (Veenman, 1993). This assumption is supported by studies in neuropsychology showing that problem solving, creativity, decision making and goal-oriented behaviour are not measured by IQ tests in individuals with acquired frontal lobe injuries (Duncan, Emslie, & Williams, 1996; Eslinger & Damasio, 1985; Shallice & Burgess, 1991).

The mixed model considers interconnections of metacognition and intelligence: Metacognitive knowledge may compensate for low ability or lack of relevant prior knowledge (Minnaert & Janssen, 1999; Swanson, 1990). According to Veenman and Elshout (1994), there is a moderate correlation between metacognition and intelligence. In this study, thinking aloud protocols were used to assess metacognitive skillfulness of undergraduate students with low- and high-average IQ (n = 49 and n = 50 respectively). Among low-intelligence students, a structured learning environment enhanced learning performance for those with low metacognition, and interfered with learning for those with relatively high metacognition. No differences were found for the high-intelligence group. Swanson (1990) found that metacognitive knowledge compensated for IQ when comparing problem-solving capabilities among Grade 5 and 6 students.

The findings of the Minnaert and Janssen (1999) study also supported the mixed model. They tested 500 freshmen (average age of 18–19 years) with a questionnaire to examine the relationship between cognitive regulatory study activities, intelligence, and academic performance. The questionnaire consists of nine regulatory activities: goal-setting, orienting, planning, monitoring, testing, diagnosing, on-line regulating, evaluating, and reflecting. Intelligence was measured with a 72-item group test of intelligence consisting of one-third

verbal, one-third numerical, and one third diagrammatic questions. Participants were divided into three groups by level of intelligence: low, medium, and high. In addition, they were divided into two groups by their level of cognitive regulatory abilities: high and low. Intelligence scores explained approximately 12% of academic performance.

The results of Minnaert and Janssen's (1999) study did not support the intelligence model. Correlations among the three types of measured intelligence and cognitive regulatory study activities were not significant. The correlation between general intelligence and regulatory processes was very low ($r = .1$). The major and significant result of the study was in the interactive effects between intelligence and regulatory activities. Low-intelligence students with high scores on regulatory activities tended to perform at the same level as high-intelligent students with low scores on regulatory activities. The interaction effect was strongest for diagrammatic intelligence and weakest for verbal intelligence.

One of the methodological difficulties in resolving the dispute regarding the role of self-regulated executive function and intelligence is the lack of metacomponents in standard tests of intelligence. This might explain why IQ only partially explains a student's academic performance. Grano, Kenny, and Campbell (1972), for example, suggest that although complex abstract abilities depend upon the acquisition of a number of diverse concrete skills, these concrete acquisitions, taken independently, do not operate causally to form more abstract, complex abilities.

According to Andrews and Violato (1996), while most norm-referenced measures of intelligence (such as the WASI used in this study) primarily tap a convergence of discrete verbal, abstract, and concept formation and reasoning abilities, it has been empirically shown that this type of intelligence plays only a mediating role in academic performance. This conclusion was based on data collected from 205 high school students, who completed the Learning Process Questionnaire and the Learning and Study Strategies Inventory (Andrews & Violato, 1996). The limitation of this study was the relatively high IQ (117.7) of the sample.

Analysis of several studies suggests that the correlation of scores on IQ tests with performance on academic achievement tests is higher than with actual academic marks. For example, Grano et al. (1972) found that IQ, as measured by the Lorge-Thorndike Intelligence Test, was highly correlated (r =.73) with academic achievement composite scores, as measured by the Iowa Tests of Basic Skills, among 5495 children in Grades 4 and 6. In contrast, IQ scores correlated at a lower rate with students' actual performance in school. Poteat, Wuensch, and Gregg (1988), for example, reported that WISC-R Full Scale IQs of students ranging from 6 to 16 years (N = 168; the median age 10 years; 55 females, 113 males) were correlated with their academic marks for both black (n = 81) and white (n = 83) (rs = .32 and .42, respectively). These results were supported by a study conducted by Burke (1989) with 1,688 children in Grades 6-8. Correlations between IQ, as measured with batteries of intelligence tests, such as the Otis-Lennon test, the California test, the Henmon-Nelson test, and the Stanford-Binet test, and academic marks in math and in language arts were .48 and .55, respectively.

It seems that the correlation between IQ, as measured by standard tests, and actual academic performance decreases even further with increasing developmental demands for more abstract and complex abilities and metacomponents. McLaurin and Farrar (1973), for example, reported that the correlation between academic marks and WAIS Full Scale IQ for undergraduate students (N = 201) was only .28. It is possible, however, that an upward skewed restricted range of IQ scores of university students could account for the relatively low correlation between IQ and academic marks.

It is clear that limiting the concept of intelligence to the cognitive processes measured by standard IQ tests may significantly restrict our understanding of the relation between cognition and academic performance. There are suggestions that the ability for executive self-regulation adds to the effect of intelligence on academic achievement. There are, however, other studies that support independent models of the relation between cognitive self-regulation, intelligence, and academic performance. Therefore, it is important to consider level of intelligence when

examining the relation between self-regulatory executive functions and academic achievement. Furthermore, the relation between self-regulatory executive functions and intelligence is a worthwhile theoretical issue in its own right that requires additional research.

Interactive Role of Self-Regulatory Executive Functions and Affect

In addition to intelligence, studies in the area of executive functions and self-regulation suggest that goal-directed, self-monitored behaviour would be impossible without affect. In this regard, Piaget's quote is appropriate: "There is no behaviour pattern, however intellectual, which does not involve affective factors as motives; but, reciprocally, there can be no affective states without the intervention of perceptions or comprehensions which constitute their cognitive structure" (Campbell, 1976, p. 75).

According to Izard (1992), emotions and cognition are interconnected by the use of emotional recognition. Further, both emotional recognition and cognition contribute to adaptive social behaviour. Without emotional recognition, empathy, sympathy, and prosocial behaviour could not be explained. This hypothesis is supported by several studies showing that emotional recognition is related to the encoding and decoding of signals in social contexts (Hoffman, 1975; Garner et. al., 1994; Giannini & Fellows, 1986; Sigman, Kasari, Kwon, & Yirmiya, 1992; Termine & Izard, 1998).

Knowledge of the role of emotions as a regulatory mechanism has been developing since Descartes viewed emotions as regulatory mechanisms of the body: "When it is a question of forcefully avoiding some evil by overcoming it or driving it away – as anger inclines us to do – then the spirits must be more evenly agitated and stronger than they usually are. Whereas, when it is necessary to avoid harm with patience – as fear inclines us to do – then the spirits must be less abundant and weaker" (reprinted from Fancher, 1994, p. 21).

Today, our understanding of the role of affective factors in self-regulation is more advanced. Martinez-Pons (2000), for example, has developed a self-regulation model of emotional intelligence. The author defines a self-regulated person as one who is motivated to

succeed at some task, sets realistic goals for the task, uses specific strategies in seeking these goals, evaluates strategy effectiveness, and adjusts his or her performance to ensure success. Each of the sequential elements of the model is associated with and related to being in touch with, sorting, and managing one's moods and emotions. In addition, self-regulation is a predictor of affective state, such as depression, positive affect, and life satisfaction.

According to Damasio's (1999) structure of self-regulation, emotions and high reasoning are linked through feelings, where feelings are images associated with unconscious sensory patterns signaling pain, pleasure, and emotions. For Damasio, emotions are complex, stereotyped patterns of response that interact with high reasoning, or complex plans and conscious images that are a matter of consciousness.

According to Zimmerman (2000) self-regulation depends on self-beliefs and affective reactions, such as doubts and fears. Consistently, the self-regulatory executive function model (Matthew, 2000; Wells & Matthews, 1996) specifies that in states of severe distress, self-regulatory executive functioning is associated with perseverative worry, a syndrome of self-focused attention, negative self-appraisals, ruminative coping, and impaired attention to the external world.

The role of affective components in self-regulation is viewed in the literature from two perspectives. One is focused on inner sources for affective self-regulation. For example, Zelazo (2003) designated executive functions as 'hot,'(i.e., affectively significant) or 'cool'(i.e., functions that integrate cognitive activities in self-goal behaviour without the involvement of emotions). The second perspective emphasizes the role of affective self-regulation in relation to external situations, such as stress, competing attractions, and fatigue (Hartman, 2001). In regard to affective systems that influence academic performance, most studies have focused on the role of personality and motivation.

Three major motivational theories are supported by experimental studies: Interest theory, Self-efficacy theory, and Attributional theory. According to Interest theory, students work harder

and are more successful with problems that interest them than on problems that do not interest them. McCall et al. (1992) described underachievers as often being bored and disinterested. Ross, McCormick, Krisak, and Anand (1985) found that if personalized examples are incorporated into tasks, performance significantly improves.

According to the self-efficacy theory of motivation, students work harder on learning a task when they judge themselves more capable than when they lack confidence in their ability to learn. There is a positive correlation between students' self-efficacy and the use of active learning strategies, comprehension of material, and persistence in learning (see Mayer, 2001, for review). Observing a peer model doing academic tasks (subtraction) improves self-efficacy, but observing a teacher does not (n = 72, ages 8:6-10:10; Schunk & Hanson, 1985). McCall et al. (1992) found that underachievers had a low perception of their abilities, and low self-esteem. Whereas achievers are motivated to prove their adequacy, underachievers give up or avoid tasks that might end in failure.

Finally, according to the attributional theory, the kind of causal ascription that a student makes about success and failure is also related to academic performance. Students are more likely to work hard on academic tasks if they attribute academic success and failure to effort rather than to ability (Weiner, 1986). Borkowski Weyhing, and Carr (1988) showed that students with a reading disability (n = 75, ages 10-14) improved their academic achievement after being trained to believe that academic success depends on effort.

Pecaut (1979) emphasized the role of personality in academic performance above other factors and described underachievers as four types of seekers: (a) trust seekers, who are emotionally explosive, isolated, and withdrawn; (b) approval seekers, who try to fulfill the expectations of others; (c) dependency seekers, who project their responsibilities onto others; and (d) independence seekers, who are rebellious and oppositional to authority figures. Similarly, Roth (1970) differentiates underachievers with anxiety and guilt due to preoccupation with their

relationship with their parents, from those with "adolescent reaction," characterized by the intense search for independence and oppositional behaviour.

The most developed classification of achievement in relationship to emotional problems was developed by Mandel and Marcus (1988). Their classification was based on the Developmental Theory Model and was linked to classification of affective disorders described in the Diagnostic and Statistical Manual (APA, 2000). Mandel and Marcus differentiated six personality types of academic underachievers linked to the diagnostic scheme in the DSM-IV (APA, 2000): Anxiety Disorder Underachiever (10-15% of all underachievers), Conduct Disorder Underachiever (5-10%), Dysthymic Underachiever, Oppositional Defiant Disorder Underachiever, and Identity Problem Underachiever (all together 5-7%), and Academic Problem Underachiever (30-49%).

In this schema, Anxiety Disorder Underachievers have chronic and excessive anxiety not associated with stressors, high or unrealistic standards, and feelings of inadequacy. Often these individuals are obsessive and compulsive as well, and they depend on authority figures for approval. Conduct Disorder Underachievers are irritable and impulsive students with repetitive and persistent patterns of opposition to authority and acting out behaviour. They have low frustration tolerance and often have temper outbursts. These students are characterized by a lack of guilt and manipulative behaviour. The desire for instant gratification and disobeying rules significantly interfere with their academic achievement. Dysthymic Underachievers have chronic mild depressive or irritable moods, excessive self-doubt, guilt, pessimism, and a sense of hopelessness. Their academic success is negatively affected by their low level of energy, a tendency to give up, poor concentration, and difficulty making decisions.

Academic Problem Underachievers are described as easy going, well-adjusted students who often lack a sense of purpose or direction. They are not introspective and have low insight. These students passively resist being more independent. Academically, their difficulties show up in procrastination and difficulties in transforming intentions into actions. It should be

emphasized that 30-49% of all underachievers described by Mandel and Marcus (1988) are of the Academic Problem Type, with no diagnosable mental disorder. These students have at least average intelligence and do not come from families with significant dysfunction. The authors suggested that these underachievers are unmotivated to study and do not want to take responsibility for their own achievement. In contrast, they are motivated to prolong the comfort of being dependent, and they resist processes that would require them to make decisions and monitor their plans in order to become fully independent from their families. There is no research, however, that has measured these students' levels of self-regulated executive functions.

Kehr, Bless P., and Von Rosenstiel (1999) have shown that individuals (N = 82, age 25-55, M age = 34.8) who use self-regulatory strategies (e.g., attention control, motivation control, volition control, and emotion control) to pursue personal goals as adults activate the reward system, whereas those who use self-control to acquire scripts that they consider alien to their own goal structure basically activate the punishment system. The latter behaviour is characterized by avoidance, neglect, denial, and suppression of competing goals. Lemos (2002) reported that pressure to comply with the goals of others hinders personalization of goals and leads to overcontrol, rigid behaviour, or under-controlled behaviour, governed by one´s urges. These research findings highlight the need to distinguish explicitly between students´ goal striving for personal versus imposed goals. Fredrickson (2001) reviewed the literature on the effect of positive emotions, which temporarily create a broader mind set and prompt individuals to expand the self, share information with others, and push themselves to their limits.

In summary, several components of affective self-regulation are important to consider in relation to academic achievement, namely motivation, goal setting, affective strategies used to achieve goals, and affective state. In the present study, these components were evaluated in relation to different categories of academic achievement, as well as to cognitive self-regulation.

Neuropsychological Evidence for Self-Regulatory Cognitive and Affective Functions

The interactive relation between cognitive and affective factors of self-regulated executive functions is supported by recent neuropsychological findings. In this section, a review of the literature on this topic with adults will be followed by a review of literature concerning children.

Many studies show that self-regulatory cognitive and affective functions are associated with the frontal lobes. The neuroanatomy of motivation, affective self-regulation, metacognition, and executive functions has been derived primarily from research on people with frontal lobe damage, mostly resulting from traumatic brain injuries (TBI) and dementia. Hart, Giovannetti, Montgomery, and Schwartz (1998), for example, found that individuals with TBI (n = 18, M age = 33.6 years), in contrast to a control group (n = 18, M age =33.7 years), were deficent in detecting errors in their everyday actions and in correcting those errors, skills that are important for academic and vocational success.

Deficits in metacognition subsequent to frontal lobe damage are often manifested in an inability to self-correct using feedback from the environment, a decreased ability to self-monitor behaviour, and an apparent lack of concern or general apathy. Although it is difficult to isolate the contribution of the frontal lobes to a personal sense of awareness, a number of studies have documented the brain-injured person's inability to recognize his/her higher cognitive difficulties, which in turn appears to be an indicator of impaired sense of self (Luria, 1973; Prigatano & Schacter, 1991, Stuss & Benson, 1986). Sherer, Bergloff, Levin, High, Oden, and Nick (1998) found that self-awareness of strengths and weaknesses was strongly related to return to work or to vocationally oriented education in adults with TBI (N = 66; M age = 31.7 years, SD = 12.2; educational level M = 12.8, SD = 2.6; n = 44 severe TBI, n = 8 moderate, n = 14 mild TBI).

In addition to metacognitive factors associated with the frontal lobes, damage to this area may cause affective problems. Among them is frontal abulia, a syndrome characterized by apathy and loss of spontaneity, drive, and curiosity. These symptoms are associated with damage to the anterior cingulate circuit, which mediates motivation (Cummings, 1993; Mega &

Cummings, 2001). Deficits in processing emotions and affective self-regulation are also related to the orbitofrontal circuit. Damage to the lateral orbitofrontal circuit of the frontal lobes may result in the syndrome of frontal disinhibition. This circuit assists the organism with socially governed behaviour and integration of object feature analysis with emotional associations. Manifestations of trauma to this circuit are impulsivity, disinhibition, loss of foresight and social judgment, and inability to delay gratification (Blair & Cipolotti, 2000; Eslinger & Damasio, 1985). The above studies are limited, however, due to small sample sizes (n =1 and *14*, respectively).

Research increasingly demonstrates that emotions are involved in decision making. The brain area associated with this is the orbitofrontal circuit. Robbins (2002) concluded that right-sided damage to the orbitofrontal cortex impairs decision-making cognition, and patients' decision making is affected by their desire for immediate gratification. In contrast, left-sided lesions appear not to affect decision making.

The role of the orbitofrontal circuit in decision making and its relation to reinforcement has been demonstrated in many studies using the gambling task developed by Bechara, Damasio, Damasio, and Anderson (1994) and the betting task of Rogers, Everitt, Baldacchino, Johnson, Swainson, London, Deakin, Sahakian, and Robbins. (1999). The gambling task consists of four decks of cards. Subjects are told that they will make a long series of selections (100 in total) from the various decks. They can switch from deck to deck as often as they wish, and the overall goal of the task is to maximize the profit on a loan of $2000 of play money provided at the beginning of the test. In addition, subjects are told that they will receive a monetary reward after each and every card choice, but that after choosing some cards, there would also be a penalty. The combined reward and penalty would sometimes result in a net loss of money, depending upon the deck and card chosen. Subjects are not told, however, the proportion of rewards to penalties associated with each deck. Picking from the low risk decks yields a lower immediate

gain than the high-risk decks; however, over the long term, choosing from the low risk decks is more profitable.

The gambling and betting tasks have been used to differentiate orbitofrontal damage from damage in the dorsolateral frontal cortex, the area associated with cognitive executive self-regulation. Damage to the dorsolateral circuit may result in cognitive and behavioural disorganization, loss of abstraction skills, loss of the ability to generate and test hypotheses, decreased creativity, and impaired problem-solving. It is also associated with impaired attentional regulation and/or working memory and environmental dependency, or stimulus bound and concrete behaviors, and a diminished ability for planning. Levin, Culhane, Hartmann, Evankovich, and Mattson (1991) conducted an analysis of seven measures of purported frontal lobe functioning and found Planning and Strategy to be one of the most significant variables associated with the frontal lobes. In this research, 52 normal children were tested with the Wisconsin Card Sorting Test, California Verbal Learning Test – Children's Version, Word Fluency, Animal Naming and Design Fluency, the Twenty Questions task, the Go No-Go task, and the Tower of London.

Fortin, Godbout, and Braun (2002) showed that patients with frontal lobe lesions have a great deal of difficulty with time management. They associated this deficit with poor event-based prospective memory and even more with time-based prospective memory. In event-based prospective memory tasks, people establish the intention to perform an action when the environment cues them to do so (Einstein & McDaniel, 1990). In time-based tasks, people monitor the passage of time until a critical action must be taken (e.g., taking medication at scheduled times; Einstein, McDaniel, Richardson, & Guynn, 1995).

The development of frontal lobes in children is viewed as a multistage process (Passler Isaac, & Hynd, 1985). The efficiency of executive functions increases from childhood to adulthood (Dempster, 1992; Harnishfeger, 1995; Johnson, Fabian, & Pascual-Leone, 1989; Pascual-Leone,1983; Pascual-Leone & Goodman, 1979; Tipper & McLaren, 1990; Welsh &

Pennington,1988). It has been found that the ability to inhibit attention to irrelevant stimuli and perseverative responses is mastered by age 12 (Passler et al.,1985). Memory intrusion of irrelevant information decreases as children get older and develop efficient inhibition (Harnishfeger & Bjorklund, 1994; Harnishfeger & Pope, 1996). According to Krikorian, Bartok, and Gay (1994) and Welsh, Pennington, and Groisser (1991), children's ability to plan visual-motor tasks becomes comparable with adult-level performance shortly after age 12. Levin et al. (1991) reported a significant developmental gain in planning at a slightly older age (between ages 12 and 15).

Children with traumatic frontal lobe injuries and impaired executive functions show behavioural and cognitive deficits related to their impaired attention, academic production deficits, and social problems in the absence of apparent intellectual, linguistic, or perceptual deficits (Mateer & Williams, 1991). The effects of early brain injury in children may appear later in adolescence (Ylvisaker & DeBonis, 2000), at the time when self-regulatory demands are dramatically increased.

Children who had TBI may exhibit different symptoms later in life. The commonly delayed symptoms related to earlier TBI in early adolescence include behavioural problems associated with decreasing external control, inability to meet the expectations for increasing behavioural self-regulation, difficulty with increasingly abstract information, and difficulty organizing large amounts of information during their adolescence.. The commonly delayed symptoms related to earlier TBI in middle adolescence include difficulty achieving communicative effectiveness in varied social settings requiring varied social registers, social withdrawal, increasing academic failure because of the cumulative effect of new learning problems, and general difficulty with divergent thinking and flexible problem solving.

In addition to trauma to the frontal lobes, impaired executive functions are reported in children with brain diseases, such as meningitis (Taylor, Schatschneider, Petrill, Barry, &

Owens, 1996) and children with attention deficit hyperactivity disorder (Clark, Prior, & Kinsella, 2000; Moffitt et al., 1989).

In summary, neuropsychological research studies demonstrate that self-regulated executive functions are associated with the frontal lobe. It seems that different circuits are involved in cognitive and affective components of executive self-regulation, but there is a dynamic interaction of these two brain areas and, therefore, of corresponding processes. However, studies examining the relation between cognitive and affective development on the one hand, and functioning of the frontal lobes in early and middle adolescence, on the other have mostly involved the characteristics and performance of brain-injured children and children with clinical diagnoses such as attention deficit hyperactivity disorder. Very few studies have focused on the development of frontal lobe functioning in typically developing children. None have examined children's ratings of self-regulated executive functions in general, and the relation between cognitive components of self-regulation and affect.

Interactive Models of Self-Regulation

Analysis of the literature so far has consistently broadened the original topic of executive functions. First, it was shown that there is a hierarchical structure of self-regulated executive functions. Furthermore, it was shown that self-regulated executive functions may have an interactive relation with intelligence and have cognitive and affective components. This section explores further how executive functions interconnect with other systems in self-regulated academic performance.

Weinstein et al. (2000) proposed a Model of Strategic Learning with a learner at its core: an individual with a unique set of personality characteristics, prior knowledge, and school achievement history. Around this core are three broad components in interaction: self-regulation, will, and skill. Self-regulation includes such variables as time management and a systematic approach to learning and accomplishing academic tasks. This last variable includes setting goals, reflecting, planning, monitoring and evaluating progress components. The Will factor of the model includes variables such as motivation for achievement (e.g., academic learning goals, interest, and values), affect

toward learning (e.g., worry, apathy, academic stress, curiosity, and anger), and beliefs (e.g., self-efficacy and attributions for academic outcomes). Finally, the Skill factor of the model consists of using problem-solving skills, identifying important information, listening and note-taking, and other learning skills.

Analysis of the Self-Regulation and Will components of this model shows that they are closely related to the cognitive and affective factors of self-regulated executive functions discussed above. These areas have a strong biological component that is linked to genetic predisposition. The third area of Weinstein et al.'s model (2000), Skill, was not previously discussed in relationship to the other two components. It is of particular interest, however, because it is an area that can be influenced by training.

Hartman and Sternberg's (1993) Behaviour, Affect, Cognition, and Environment Interacting Systems (BACEIS) model of improving thinking, which described factors that affect performance, is another multifactorial and interactive model that combines cognitive, affective, and social systems. The model is presented in adapted form in Figure 1. The BACEIS model differentiated two supersystems, internal and external. The internal supersystem consisted of cognitive and affective systems. The model suggests that internal factors of student's cognition and affect are related to each other and are also related to interacting external factors from the student's academic and nonacademic environments.

The cognitive part of the internal supersystem is made up of two components: cognitive and metacognitive. The affective part of the internal supersystem consists of motivation, affective self-regulation, and attitudes. The external supersystem consists of the academic environment, such as teacher characteristics, content, class environment, and instructional techniques, and nonacademic environment, such as social economic status, family background, and cultural forces.

Mandel and Marcus (1988) emphasize the importance of multifactorial and interactive factors in academic achievement. In addition to personality factors, they stress the importance of an adolescent's insight into his or her personality characteristics, family and peer interactions,

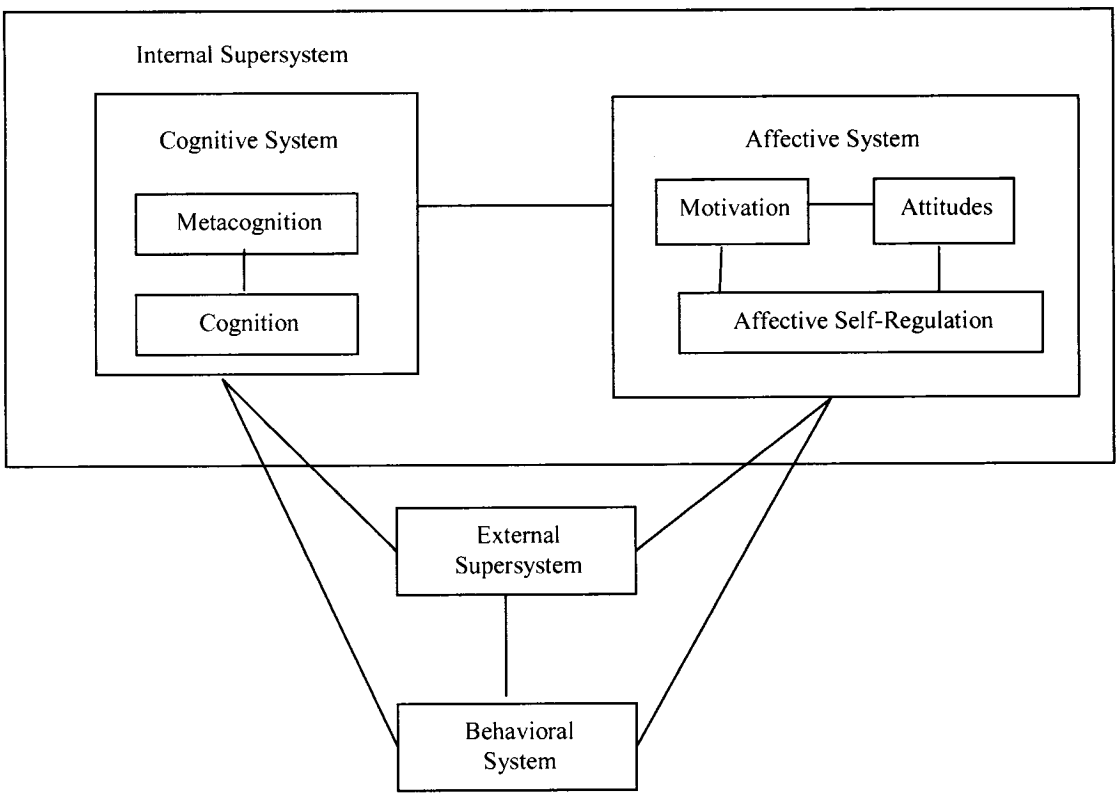


Figure 1. Systems of the BACEIS model (Hartman & Sternberg, 1993).

and school influence. Biological factors such as intelligence and attention also impact achievement in this model.

Whereas the described models suggest, but do not focus on, the dynamic interaction of parts of self-regulation, Ellis and Zimmerman's (2001) model fills this gap. The authors described self-regulation in a three-phase cycle: forethought, performance, and self-reflection. The Forethought phase includes goal setting, strategic planning, goal orientation, and self-motivation beliefs. The Performance phase includes self-control and self-monitoring. Finally, the self-reflection phase includes self-judgment and self-reaction, such as self-satisfaction.

Analysis of each of the self-regulatory phases of Ellis and Zimmerman's (2001) model reveals that its phases consist of both internal cognitive and affective components; in this regard, they conceptually reflect the BACEIS model of Hartman and Sternberg (1993). It should be noted, however, that the affective components in Ellis and Zimmerman's model (2001) are involved only in the first and last phases. According to the model, while motivational aspects play an important role at the beginning of performance, emotional self-judgment and self-reaction play the most important roles in completing the self-regulated behaviour.

Two cognitive components of the Forethought phase of self-regulation in the Ellis and Zimmerman model (2001), planning and goal setting, are comparable to components of executive functions. Tucker and Derryberry (1992) consider planning as the most important executive function because it determines "what information needs attention, what goals require effort" (p. 233). The authors suggest that the ability to plan requires close interactions between the cognitive representations of the frontal cortex and the more elementary mechanisms of emotional evaluation and motivational control of the subcortex. This suggestion supports the interactive mechanisms of affective and cognitive components of the BACEIS model of Hartman and Sternberg (1993). Furthermore, the interactive nature of cognitive and affective components comes from Tucker and Derryberry's (1992) division of planning into three subfunctions: (a)

representing possible future events in working memory, (b) attaching affective significance to these events, and (c) organizing actions to influence possible outcomes.

The first subfunction of planning, representing possible future events in working memory, is supported by Ingvar's view (1985) that behaviour is organized according to projections of possible future events, termed memories of the future. The lack of this function may contribute to frontally lesioned patients' difficulty in extending various cognitive and motor operations in a coherent goal-directed activity, particularly when this activity extends over an interval of time (Luria, 1980).

Attaching significance to future events, a second subfunction of planning proposed by Tucker and Derryberry (1992), is related to the role of affect in performance. There is evidence that anxiety interferes with performance, and that people with anxiety disorders suffer from too much motivated planning (Powell, 1979). Excessive cognitive preparation for action by these patients may lead to failure in situations where methodical behaviour and careful organization are required, despite their verbal fluency and insight into life problems. For example, obsessive-compulsive patients show tightly focused and highly structured organization, but often fail to accomplish goals because of deficits in executive self-regulation.

The third subfunction of planning is organizing actions. One of the major problems that may interfere with the maintenance of planned goals is difficulty in delaying gratification and in inhibiting impulses that are incompatible with progress toward goals (Tucker & Derryberry, 1992). This is especially a problem for people with disinhibition syndrome. According to Powell (1979), a planning defect may be invisible over a short time frame, but it becomes unmasked over extended periods during which various actions must be continually related to adaptive goals.

The relation between affective and cognitive components of the Forethought phase of self-regulation in Ellis and Zimmerman's model (2001) is supported by Bigg's model (1987), in which motives and strategies define distinct approaches to learning (surface, deep, and

achieving). It is interesting that what Bigg referres to as strategies in his model could also be referred to as the application of executive functions and metacognition. Students of the higher approaches levels in Bigg's model, Deep and Achieving, are not only intrinsically motivated, but are good at organizing their study to best understand the academic material, are self-directed learners, schedule their time effectively, and use planning, reviewing, and other organization skills in their schoolwork. In contrast, extrinsically motivated students who adopt the Surface approach use only primary cognitive functions. According to Bigg, these students limited their processing efforts to memorizing essential details that could be reproduced through rote learning and rehearsal strategies, and they focused on the pragmatic aspects of learning.

The results of a study by Valentin (2002) suggest that the self-evaluation of past performance affects the Forethought phase for future tasks. Data from the Achievement and Motivation Profile-Junior version (AMP-Jr.; Mandel et al., in press) of 348 students in Grades 5-8 at three urban middle schools were analyzed using structural equation modeling. The Achiever scale of the AMP-Jr. is a predictor of the degree to which an individual is achieving. The Goal scale was designed to tap sense of purpose as well as degree of satisfaction with goal attainment. Individuals with moderate elevations on this scale have a relatively clear sense of their goals and are satisfied with their progress. The Plan scale was designed to measure the extent to which an individual values planning, organization, and follow-through.

In addition to the three scores on the AMP-Jr., students' academic average on their report cards and demographic data, such as their grade level, ethnicity, gender, and participation in special programs, were used for statistical analyses. The goodness-of-fit indices indicated a good fit of the path analysis for the model presented in Figure 2a ($\chi 2 = 6.62$, $CFI = 1$, $RMSEA = 0.00$, $df = 8$, $p = .58$). These results suggest that students' self-perception, whether they achieve or not, moderately correlates with their real academic achievement as measured by their grades, and this in turn determines their self-perception of skills in goal orientation and planning. The model suggests that students do not make the opposite connection, specifically

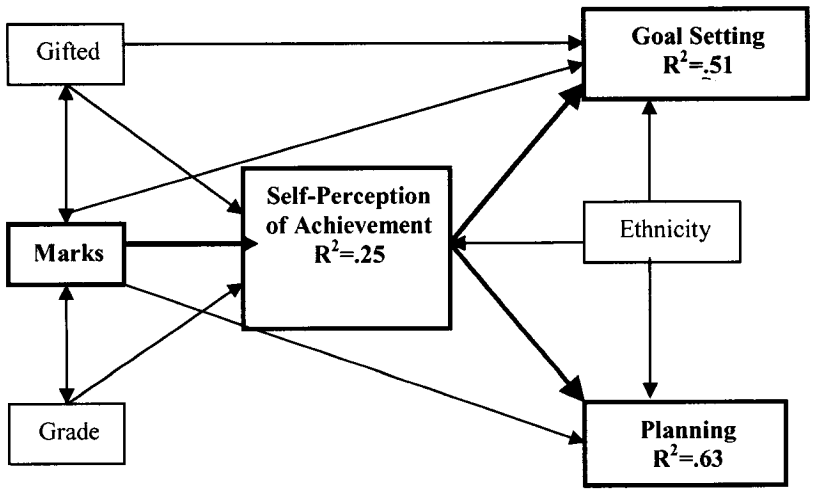


Figure 2a. Model of interconnection of achievement and metacognitive aspects based on the AMP-Jr (χ^2 = 6.62, *df* = 8, *p* = .58, *CFI* = 1.00, *RMSEA* = 0.22, *df* = 8, *p* = .00, *N* = 348) (Valentin, 2002).

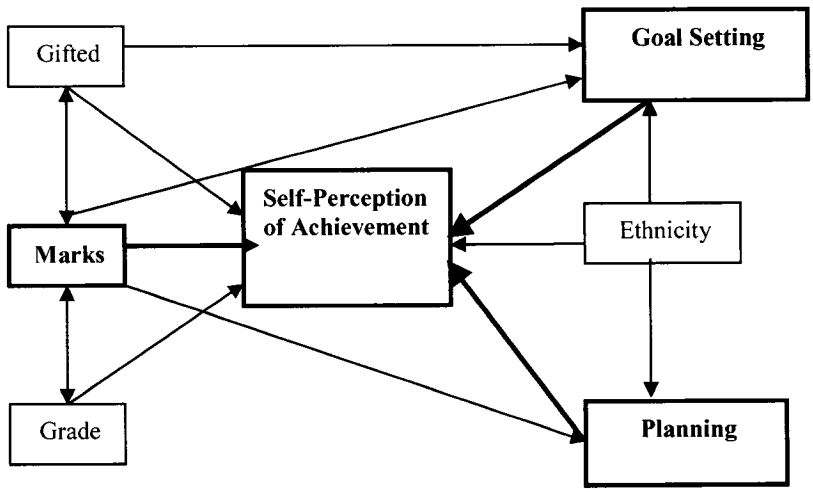


Figure 2b. Model of interconnection of achievement and metacognitive aspects based on the AMP-Jr ($\chi 2$ = 144.65, *df* = 8, p=.00, *CFI* = 0.82, *RMSEA* = 0.22, *N* = 348) (Valentin, 2002).

that if they plan better and set goals they would have better academic achievement. In fact, the same model, but with links between Achievement and Plan/Goal scales in the opposite direction to that presented in Figure 2a was not significant ($\chi 2$ = 144.65, *CFI* = 0.82, *RMSEA* = 0.22, *df* = 8, p = .00, Figure 2b). These results are contradictory to the model of interaction of cognitive, motivational, and self-system components of metacognition described by Borkowski (1996). According to Borkowski, children first develop executive processes, and only after refining these processes they form attributional beliefs about their own effort and ability, as well as achievement motivation.

In contrast, a dynamic model of cognitive and affective processes in academic achievement developed by Volet (1997) differentiates executive processes in relation to their interactions with affective variables. According to that model, goals are formed secondarily to motivation control variables, such as self-competence, interest, and emotional state. In this regard, Valentin's (2002) results support Volet's (1997) model. According to Volet (1997), there are two phases of interaction between cognitive and affective variables. The first phase leads to the development of intended goals. Factors such as motivational control and task perception form intended goals. In the second phase, motivation control and task perception form action control (e.g., initiative/disengage, persistence) that then forms actual goals. According to that model, performance is a product of actual goals.

In summary, self-regulation consists of phases in which affective and cognitive components are interconnected and influence performance. The models and experimental findings, however, are not consistent in specifying the nature of the interactions between cognitive and affective elements. At several points in the literature it is suggested that skills, in relationship to self-regulated executive functions, also be considered. The present study examines the relation between cognitive aspects of self-regulation, affect, and intelligence. It will be important and meaningful to explore the specifics of these interactions. Because the major purpose of the present research is to inform and hopefully improve educational strategies, it is

also reasonable and important to examine the role of skills in relation to self-regulative executive functions in the academic context.

Methodological Aspects Measuring Academic Achievement and Self-Regulative Executive Functions

Two final methodological issues merit consideration for the present study: how to measure academic achievement and how to measure self-regulated executive functions. This section will discuss both issues.

In the scientific literature on school performance, academic achievement is typically conceptualized in one of three ways The first approach differentiates students by their performance on academic tests. For example, Gathercole and Pickering (2000) distinguish between low and high achievers. Low achievers are identified as those with one or more scores below that expected for their age or grade mates on nationally normed tests of achievement of basic academic skills. One of the limitations of this approach is that it uses standardized academic achievement tests rather than students' actual academic performance. This may mask problems that are related to goal-directed behavior, such as motivation, metacognition, and executive functions. Students who perform well on a test of basic academic skills, such as reading, numerical operations, and writing, may still fail to complete long-term projects or homework, have difficulty shifting from one task to another, or be unable to solve complex problems.

To overcome these limitations, students in the present study were categorized by level of academic performance, as indicated by their marks. Students whose marks were lower than average were classified as low performers. Those whose marks were in the average range were labeled average performers, and those with marks above average were labeled high performers.

The second method of categorizing academic achievement distinguishes among achievers, underachievers, and overachievers (Mandel & Marcus, 1988). Underachievers and overachievers are students whose academic marks differ significantly from what would be

predicted based on general cognitive ability. There have been several approaches used to define the discrepancy between mental ability and academic achievement (Fraser, 2000). Among these are simple difference scores and regression (Farquhar & Payne, 1964; McCall et al., 1992). The simple difference score defines underachievers as those with discrepancies between scores on mental ability and academic achievement measures of at least one standard deviation. The regression method consists of calculating the regression line for the achievement measure and then calculating the deviation of each subject's score from that regression line.

Mandel and Marcus (1988) point out that the primary advantage of the regression method is the integration of both categories of achievement, by level of IQ and discrepancy between IQ and achievement. It enables one to determine whether an individual is of low, medium, or high ability, and how much that individual's academic performance deviates from his or her ability level. The limitation of this method is the assumption that the standard error of estimate, or measurement, is a constant value across the range of ability (McCall et al., 1992). In order to address this limitation, regression analysis for identifying achievers, underachievers, and overachievers was used in the present study in addition to the categorization of students as low/average/high performers.

Several approaches have been used to evaluate children's self-regulation. Swanson (1990), for example, used an interview technique to assess metacognition in middle-school children. Interviews are rich in clinical data, but relatively lengthy and time-consuming to administer and analyze. Zimmerman and Martinez-Pons (1986, 1988) used a structured interview and teacher ratings for evaluating students' metacognition. They found that teacher ratings of self-regulation were slightly correlated with student ratings of their own self-regulation and moderately related with achievement measures.

Several researchers (Pressley & Ghatala, 1989; Sperling, Howard, & Miller, 2002) have used calibration techniques to assess metacognition. In calibration techniques the magnitude of difference between students' actual performance and students' judgment of their performance is

used as a measure of metacognition. Additionally, inventories have been used to measure metacognitive processes in school-age learners (Fortunato et al., 1991; Schmitt, 1990; Sperling et al., 2002). These inventories, however, were designed mostly to tap a student's awareness of how to use specific problem-solving and learning strategies rather than to examine executive self-regulation components.

Prior to the current research there were no published self-report questionnaires of executive functions for children. Two parent report measures were, however, found: the Children's Executive Functions Scale (see Molho, 1996 for references) and the Behaviour Rating Inventory of Executive Function (BRIEF; Gioia et al. 2000). The Children's Executive Functions Scale covers five domains of behaviour believed to represent executive functions: inhibition-impulse control, social appropriateness, problem-solving, initiative, and motor planning. The BRIEF was designed to estimate executive functions in children 5 to 18 years old. The test is normed by age and gender, and has two validity scales and eight clinical scales: Inhibit, Emotional Control, Shift, Initiative, Working Memory, Organization of Materials, Planning/Organization, and Monitoring. The first three scales are summarized with the Behavioural Regulation Index, and the remaining five scales comprise the Metacognition Index.

Although there is no self-report questionnaire developed to estimate children's executive functions, there are several self-report questionnaires for adults. Among them are the Frontal Systems Behavior Scale (Grace & Malloy, 2001), the Cognitive Symptom Checklist: Executive Functions (O'Hara, Belingrath, & Lisicia, 1993), and Self-Rating Scale of Executive Functions (Coolidge & Griego, 1995). The 46-item rating of the Frontal Systems Behavior Scale yields three theoretically derived subscales that measure the three frontal behavioural syndromes: apathy, disinhibition, and executive dysfunction. The Cognitive Symptom Checklist provides a checklist of executive functions in the following domains: Planning, Self-Correction, Organization, Processing Speed/Reaction Time, Initiation/Follow Through, Mental Flexibility, Sequencing, Problem-Solving, and Reasoning. The Self-Rating Scale of Executive Functions

contains a set of 16 items associated with the following scales: Poor Planning, Inability to Complete Tasks, and Trouble with Decision-Making.

In summary, there are two methodological aspects under consideration: how to measure academic achievement and how to measure self-regulatory executive function. Analysis of the literature led to the conclusion that two approaches to the differentiation of academic achievement were best suited for the purposes of the current study: (a) differentiating students as low, average, or high performers on the basis of their actual academic marks and (b) differentiating students as underachievers, achievers, or overachievers on the basis of the discrepancy between their actual marks and marks predicted from their IQ. Regarding the measurement of executive function, because no existing inventories measure self-perception of executive functions in middle-school children, a new questionnaire, the Self-Regulatory Executive Function Inventory (SREFI), was designed for the current research.

Statement of the Problem

Analysis of the literature showed that executive functions and metacognition are highly interconnected, are mediated by the frontal lobes, continue to develop into adolescence, and are involved in goal-directed behaviour. Awareness and use of these functions in performance are referred to as part of self-regulated executive functions. Both practitioners and researchers are interested in the development of self-regulatory abilities in school-age learners. There is a need, however, to further understand the components of self-regulated executive functions in relationship to academic achievement.

The theoretical models and research findings reviewed above highlight the importance of the interconnection of cognitive and affective components of self-regulated executive functions. There is a lack of empirical data on different cognitive and affective components of self-regulation in relation to academic achievement.

Furthermore, it is important to understand the role of intelligence, as measured by standard tests, in relation to self-regulation and academic achievement. Although intelligence is

considered to be developmentally stable, there are no studies to show that self-regulation can be enhanced with training.

Hypotheses

The literature review revealed that our knowledge about the role of self-regulated executive functions in academic achievement is narrowed to a very limited number and range of studies. Among them are studies with children who have clinical problems, such as traumatic brain injuries or attention deficits hyperactivity disorder (Clark et. al., 2000; Moffitt, 1989; Ylvisaker & DeBonis, 2000). Other studies have focused on investigating the impact of specific elements of executive functions, such as working memory, on academic achievement (Bull & Scerif, 2001; Gathercole & Pickering, 2000; Swanson & Sachse-Lee, 2001).

No study has examined the role of several aspects of complex executive functions, such as planning and time management, on a student's academic achievement. Furthermore, whereas research has indicated a positive correlation between metacognition and academic achievement (Hartman, 2001; Wehmeyer & Schwartz, 1997), awareness of executive strengths and weaknesses in relation to academic achievement has never been addressed. The literature in the developmental and clinical areas related to this topic, therefore, suggested the following hypotheses.

H1: Students with higher academic marks would report fewer problems with self-regulated executive functions, as measured with the SREFI.

The review of the literature revealed that there is no self-report measure of executive functions for middle school children. To test the above hypothesis a new inventory of self-regulated executive functions, the SREFI, was developed. Because high scores on this measure reflect poorly developed functions, there should be a significant negative correlation between scores on the SREFI and academic marks in Language Arts and Mathematics obtained from recent Ontario Student Report cards. Students who perform better at school should report fewer problems with executive functions.

H2: Students with higher general cognitive ability scores, as measured with the WASI, would report fewer problems with self-regulated executive functions, as measured with the SREFI.

Students' cognitive ability was measured using one of the two verbal subtests and one of the two nonverbal subtests of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). In general, students with higher intellectual abilities should have better developed self-regulated executive functions, and report fewer problems on the SREFI, resulting in lower scores on that measure.

A significant correlation between the SREFI and WASI scores would be consistent with the intelligence model (Veenman,1993) and would provide an additional proof of the parallel development of intelligence and self-regulated executive functions, as theoretically and empirically described by Pascual-Leone (1983). If H2 is rejected, the results will be in favor of the independent model.

H3: There would be an interactive relationship among academic marks, general cognitive ability, as measured with the WASI, and self-regulative executive functions, as measured with the SREFI.

The next question that needed to be addressed is how intelligence and self-regulated executive functions might predict academic achievement. The analysis related to this question would contribute to investigating the mixed model (Veenman, 1993). One of the possible interactions could be the one where metacognitive knowledge compensates for low ability or lack of relevant prior knowledge (Minnaert & Janssen, 1999; Swanson, 1990).

Consistent with H3, one of the possible outcomes can support the independency model: students with higher cognitive abilities who report problems with self-regulated executive functions (high scores on the SREFI) should have lower marks than students of the same level of intelligence who indicate no problems with self-regulation (i.e., low scores on the SREFI).

Similarly, students of low cognitive abilities should show better marks if they report better self-regulation (i.e., low scores on the SREFI).

H4: Achievers, overachievers and underachievers would differ in self-ratings of self-regulative executive functions, as measured with the SREFI.

Analysis of H4 could potentially yield results supporting the compensatory model in which students who perform better than predicted from their cognitive ability (overachievers) have good self-regulation (i.e., low scores on the SREFI) despite their level of intellectual abilities. In contrast, students who performed significantly lower than predicted from their IQ would have low self-regulation (i.e., high scores on the SREFI) despite their IQ level.

Commonality between Hypotheses 3 and 4 is that they both consider the role of intelligence in academic achievement. The difference between them is in how intelligence is considered. Hypothesis 3 leaves space to find any complex (perhaps nonlinear) relationship between self-regulation and low/high intelligence in relation to academic achievement.

The second approach (H4) does not differentiate students by intelligence, but by the match between their cognitive abilities and their marks. Here a linear relation between marks and abilities is assumed. This approach is the one that is most commonly used in the literature on academic achievement. It is also common for research based on regression analyses of academic achievement to assume that average marks in Language Arts and Math contribute equally to predicted marks. To decrease measurement error, the regression formula in this study included marks for both academic subjects (without collapsing them into one average mark).

H5: Students with better learning skills, as measured with teacher-rated learning skills from the Ontario student reports, would report fewer problems with self-regulated executive functions, as measured with the SREFI.

In addition to intelligence, the literature review suggested a relation between skills and self-regulated learning (Weinstein et al., 2000). Keeping in mind the need for screening tools of self-regulated executive functions in the school setting, it was hoped that teacher estimations of

learning skills from the Ontario Student Reports would be a first indicator of deficits in executive self-regulation and would be correlated with SREFI scores.

It is expected that such learning skills as homework completion, independent work, initiative, and goal setting will have the most significant correlations with the SREFI. According to H5, students who have high scores on teachers' rating of learning skills would have fewer problems with self-regulative executive functions, as indicated by low scores on the SREFI.

H6: Students, who reported fewer problems with self-regulated executive functions on the SREFI, would also report fewer problems with motivation and affect on the AMP-Jr.

Consistent with research on the role of both cognitive and emotional components in self-regulated executive functions, students who are motivated to work, oriented to achieve, and generally happy should show fewer problems with self-regulated executive functions. The literature review suggested that the AMP-Jr questionnaire is suitable for the purposes of testing the above hypothesis because it addresses issues of personality, motivation, and achievement.

Chapter 2

Method

Participants

A total of 172 students (age $M = 11.9$; $SD = .81$) with no identified learning disabilities from two large suburban public middle schools participated in the research. Both sexes were approximately equally represented. Table 1 provides information on the number of participants from each school by age and gender.

Parents of these children were also recruited to complete a questionnaire. A total of 74 parents, 23 of whose children attended School A (23% of total) and 51 of whose children attended School B (62% of total), completed and returned the questionnaire forms.

Measures

Several objective measures and questionnaires were used in this study, as well as students' academic marks and teacher-estimated learning skills from Ontario Student Reports. Participants and measures involved in the research are presented in Table 2.

Ontario School Records - Marks. Academic performance histories obtained from the recent Ontario School Records were used as part of the procedure for identifying academic performance. First, marks in English reading and writing were averaged to one mark in Language Arts, and marks in different math skills were averaged to one mark in Math. Then these scores were averaged to constitute the Marks variable.

The Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was used in this study as a measure of cognitive ability. It is a standardized test that was developed to meet the demands for a short and reliable measure of intelligence in clinical, psychoeducational, and research settings. The WASI consists of four subtests: Vocabulary, Block Design, Similarities, and Matrix Reasoning. An estimated Full Scale IQ (FSIQ) score, however, can be calculated on the basis of two scores from the Vocabulary and Matrix Reasoning subtests. The Vocabulary

subtest requires the examinee to orally define visually and orally presented words. The Matrix Reasoning subtest consists of 35 incomplete patterns that the examinee completes by choosing a

Table 1

Frequency Distribution of Participants by School, Age, and Gender

Age in years	School A			School B			Total
	Boys	Girls	Total	Boys	Girls	Total	
11	16	16	32	13	16	29	61
12	12	9	21	19	13	32	48
13	10	10	20	9	12	21	44
14	6	11	17	0	0	0	24
Total	44	46	90	41	41	82	172

Table 2

Participants and Measures Involved in the Research

Measure	Participants		Number of students	Type of Testing	Approximate Time
1. SREFI	Students:	Total	172	Group	20 min
		School A	93		
		School B	79		
2. AMP-Jr	Students:	Total	79	Group	20 min
		School A	0		
		School B	79		
3. WASI	Students:	Total	134		
		School A	56	Individual	30 min
		School B	78		
4. BRIEF	Parents:	Total	77	Home	15 min
		School A	23		
		School B	54		
5. D-KEFS	Students:	Total	24		
		School A	24	Individual	2.5 h
		School B	0		
6. Review		Total	172	Individual	20 min
of the OSR		School A	90		
		School B	82		

SREFI – Self-Regulated Executive Functions Inventory; AMP-Jr – Achievement and Motivation Profile – Junior Version; WASI – Wechsler Abbreviation Scale of Intelligence; BRIEF – Behavior Rating Inventory of Executive Function; D-KEFS – Delis-Kaplan Function Scale

response from five possible choices. Administration time of these subtests is approximately 15 minutes.

The correlation between the two-scale WASI FSIQ (FSIQ-2) and FSIQ measured with the WISC-III is .81 (n = 146; Wechsler, 1999). Nevertheless, the authors of the test warned that the WASI cannot provide a comprehensive evaluation of an individual's intellectual functioning because it targets only limited domains of cognitive functioning. Consequently, the main uses of the WASI are retesting and screening for a quick estimate of cognitive functioning. This is consistent with the use of WASI in the current study.

The WASI can provide relatively accurate estimates of WISC-III IQ scores for individuals with learning disabilities. Discrepancies between WASI and WISC-III IQ scores (n = 35) ranged from .2 to 1.1 points. Correlations between FSIQ-2 and Wechsler Individual Achievement Test Composite scores (n = 210) are r = .69 for Reading, r = .66 for Math Composite, and r = .72 for Written Expression (Wechsler, 1999).

*Achievement and Motivation Profile – Junior Version (*AMP-Jr; Mandel et al., in press). The AMP-Jr was used in this study as a measure of affective factors of self-regulation related to academic performance. It retains the structure of the original AMP (Mandel et al., 1995), but with simplified language. The AMP-Jr is a self-report measure of 140 items designed to determine an individual's personality style and interpersonal attributes with particular reference to motivation, work habits, and other characteristics that impact on academic achievement. Each item is scored on a 5-point Likert scale ranging from 1 ("Always True") to 5 ("Always False"). The questionnaire takes approximately 20 minutes to administer and 15 minutes to score.

Similar to the original AMP, the AMP-Jr scale scores fall into five areas: Response Style (Inconsistent Responding, Self-Enhancing, and Self-Critical styles), Motivation for Achievement (Achiever, Motivation, Competitiveness, and Goal Orientation), Inner Resources (Relaxed Style, Happiness, Patience, and Self-Confidence), Interpersonal Strengths (Assertiveness, Personal

Diplomacy, Extroversion, and Cooperativeness), and Work Habits (Planning & Organization, Initiative, and Team Player).

In general, the original AMP is both a statistically reliable and valid psychometric instrument. AMP interitem scale reliabilities range from .58 to .84, with a median Cronbach alpha of 0.75. Test-retest reliabilities on AMP scales range from .61 to .89, with a median of .83. Further information about the factor structure of the AMP, the items which load on each scale, and the loading of each scale on a factor can be found in Mandel et al. (1995).Very few AMP scales correlate significantly with IQ, as measured with the Matrix Analogies Test scores, whereas several AMP scores, particularly the Motivation for Achievement scores, are strongly related to actual achievement as measured by grade point average.

The 13-item Achiever scale of the AMP-Jr reflects the degree to which students perceive themselves as actually achieving. This scale contains items that assess a student's view of his or her academic achievement and attitudes toward school and work. Items on the Achiever scale fall into two content areas; one pertaining to school achievement and one reflecting general achievement.

The 11-item Motivation scale measures a student's need to achieve and motivation to succeed. Items on this scale evaluate energy level, optimism, effort, and degree of follow-through. An excessively low score may reflect an absence of the need to achieve, or it may reflect a student's resignation about the lack of past achievement. An excessively high score may reflect a student who has exaggerated goals or achievement needs.

Self-Regulated Executive Functions Inventory (SREFI; Valentin, 2001). Because no inventories were found to measure self-perception of self-regulation in middle school children, a new questionnaire, the Self-Regulated Executive Functions Inventory, was designed specifically for the current research (see Appendix A). The SREFI consists of 84 statements randomized from seven subscales: Working Memory, Initiative, Monitoring, Planning, Goal-Setting, Self-Control, and Time Management (see Appendix B). Each scale comprises 12 items scored on a 4-

point Likert scale ranging from 0 ("Never") to 3 ("Always"). The questionnaire takes approximately 20 minutes to administer and 10 minutes to score.

Most of the items in the questionnaire were incorporated from a student handbook from the schools where the testing took place. The handbook consists of a part of *The seven habits of highly effective teens: A guide for good habit development and successful agenda use* (Covey, 1989). It contains brief definitions of effective habits and self-checks. Examples of statements from this source are: "When my parents say no when I want to do something, I get angry and argue with them"; "When my teacher gives an assignment that I don't like, I don't do it."

Several executive function inventories were considered during the design of questions for the SREFI. One of these was the BRIEF, some scales of which, such as the Initiative, Working Memory, and Monitor scales, were used in the construction of the SREFI. The Emotional Control and Plan/Organize scales of the BRIEF were modified for the Self-Control and Planning scales of the SREFI. Because the BRIEF consists of several statements related to time-management, but does not have a separate scale, a Time Management scale was created for the SREFI.

Although the scales of the BRIEF and the SREFI are similar, the statements are different. For example, statements from the BRIEF, such as "Underestimate time needed to finish tasks" and "Starts assignments or chores at the last minute," were used in the SREFI in the following way: "I am usually wrong in estimating the time needed to finish my assignments" and "I put off important things until the last minute." A few of the statements on the SREFI were incorporated from the Cognitive Symptom Checklist: Executive Functions (O'Hara, et al., 1993).

Items from the original version of the SREFI were presented to several teachers from the participating middle schools who suggested language modifications to make the items more age-appropriate. In contrast to the BRIEF, idioms were not used in the SREFI. Because the SREFI was created specifically for this study, information about its reliability and validity will be presented at the beginning of the Results chapter.

The Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2001). In this study, the BRIEF was used as a standardized questionnaire to measure executive functions in children and to validate the SREFI questionnaire. The BRIEF consists of parent and teacher questionnaires with 86 items each and was developed to assess impairment of executive functioning in children 5–18 years old. The inventory consists of two validity scales that measure negativity and inconsistency of responses and eight clinical scales: Shifting, Emotional Control, Initiative, Working Memory, Monitor, Plan/Organize, Organizing Materials, and Inhibit. As described earlier, the clinical scales form two indexes: Behavioral Regulation (three scales) and Metacognition (five scales), as well as a Global Executive Composite score.

Normative data for the BRIEF are presented in the form of T-scores, percentiles, and 90% confidence intervals for four developmental age groups by gender. These data comprise child ratings from 1,419 parents and 720 teachers from rural, suburban, and urban areas in the United States. The clinical sample includes children with developmental disorders or acquired neurological disorders, such as Reading Disorder, Attention Deficit Hyperactivity Disorder, Traumatic Brain Injury, Tourette's Syndrome, mental retardation, localized brain lesions, and high-functioning autism.

The BRIEF has good reliability (Cronbach alphas from .80 to .98), good test-retest reliability (r =.82 for parents and r =.88 for teachers), and moderate correlations between teacher and parent ratings (.32 to .34). The authors of the BRIEF (Gioia et al., 2001) reported that convergent validity has been established with other measures of inattention, impulsivity, and learning skills, and divergent validity has been demonstrated against measures of emotional and behavioral functioning. The test requires 10-15 minutes to administer and 15-20 minutes to score.

Teacher ratings of learning skills. Teacher ratings of learning skills were obtained from the recent Ontario Student Reports. There are nine learning skills that appear on the Ontario Student Reports for Grades 1 to 8: Independent Work, Initiative, Homework Completion, Use of

Information, Cooperation with Others, Conflict Resolution, Class Participation, Problem Solving, and Goal Setting to Improve Work. These learning skills are rated on a 4-point scale: 3 - Excellent, 2 - Good, 1 - Satisfactory, and 0 - Needs Improvement.

Examples of *Independent Work* learning characteristics include working well without supervision, completing tasks on time and with care, following schedules, using planners to organize time effectively, accepting responsibility for own behavior, and identifying and pursuing learning goals and tasks independently. *Initiative* includes behaviours such as attempting a variety of learning activities, demonstrating a positive attitude toward learning, seeking challenges and taking risks, approaching new learning situations with confidence, attempting a variety of learning activities, showing interest in and curiosity about objects and events, and helping others or volunteering. The *Homework Completion* (work habits) learning skills reflect the student's efficient use of time, organization of materials, completion of tasks, interest and enthusiasm for homework assignments, attention to detail, consistent effort, and flexibility. *Use of Information* learning skills include recognition when assignments and projects would benefit from additional information and identifying the type of information needed, showing regard for accuracy in analyzing and evaluating information, asking questions to clarify meaning and ensure understanding, organizing information logically and creatively, and considering all information and alternatives before reaching a conclusion. *Cooperation with Others* reflects skills such as taking turns, listening to, acknowledging, and considering different opinions, following classroom and school procedures, seeking consensus before making decisions, and sharing responsibility for carrying out decisions. *Conflict Resolution* characteristics include resolving conflicts independently and when they occur in socially acceptable ways, mediating different opinions, helping others or the group to identify and use strategies for conflict resolution, listening in order to understand conflicts before acting or offering a resolution, and negotiating to solve problems and resolve conflicts. *Class Participation,* in addition to participation in class and group activities, includes learning skills

such as accepting various roles within the group, accepting a share of the work to be done, contributing information and ideas to cooperative problem solving, listening to others without interrupting; and helping to motivate others and encouraging others to participate. *Problem Solving* includes skills such as applying logic in solving problems, devising a plan to solve a problem, carrying out the plan, checking the solution/results, evaluating the plan, solution, or result, applying successful strategies to new problems, and making connections between different problems and solutions. Finally, *Goal Setting to Improve Work* includes characteristics such as identifying strengths and areas for work improvement, accepting comments about performance from others, identifying specific steps or actions needed to reach goals or to improve, identifying appropriate criteria for assessing work and using them, and revising goals or steps and strategies when necessary.

Delis-Kaplan Executive Function Scale (D-KEFS; Delis, Kaplan, & Kramer, 2001). The D-KEFS was selected as a direct measure of executive functions and was used to validate the SREFI questionnaire results for a select number of participants. The D-KEFS has a diverse array of executive function tests. Moreover, it has normative scores for children and adolescents, and the norms were developed as a result of a national standardization study involving 1700 children and adults. The D-KEFS has eight subtests: Trail Making, Verbal Fluency, Design Fluency, Word-Color Interference, Tower, Sorting, Word Context, and Twenty Questions. The test takes 2.5 hours on average to administer and 30 minutes to score for each child. Each of the D-KEFS subtests is described below.

The D-KEFS *Trail -Making* Test measures the ability to switch and inhibit irrelevant information in a visual-motor task. It consists of five conditions: Motor Speed, Visual Scanning, Number Sequencing, Letter Sequencing, and Number-Letter Switching. On the Motor Speed condition the examinee is asked to trace a line that connects circles as quickly as possible. Visual Scanning requires the examinee to cross out all occurrences of a specified number from an array of numbers and letters. Number Sequencing and Letter Sequencing require the examinee to

connect numbers in ascending order and letters in alphabetical order, respectively. Number-Letter Switching requires the examinee to alternate between connecting numbers in ascending order and letters in alphabetic order (e.g., 1-A-2-B-3-C). Both speed and accuracy of performance are recorded for each subtest.

The D-KEFS *Verbal Fluency* Test measures productivity in the verbal domain and switching between categories. It comprises three testing conditions: Letter Fluency, Category Fluency, and Category Switching, on which the examinee is asked to generate words as quickly as possible that begin with a particular letter, that belong to a designated semantic category, or that alternate between two different semantic categories, respectively. For each trial of each condition, the examinee is allowed 60 seconds.

The D-KEFS *Design Fluency* measures productivity in the spatial domain and switching between visual stimuli. The examinee is asked to draw as many different designs as possible in 60 seconds. During each of three conditions, rows of boxes, each of which contain an array of small circles, are presented to the examinee, who is asked to draw a different design in each box using only four lines to connect the circles. In the Filled Dots condition the boxes have only filled circles. In the next two conditions, Empty Dots Only and Switching boxes contain filled and empty circles. The examinee draws designs connecting only empty dots in the Empty Dots Only condition, and switches between connecting empty and filled circles in the Switching condition. The numbers of different and same designs are calculated for each of the conditions.

The D-KEFS *Word-Color Interference* subtest quantifies the ability to inhibit irrelevant information and to switch between categories. Speed and accuracy are measured in four different conditions: naming colored patches; reading words, which are names of colors printed in black ink; naming the color ink of printed color words (e.g., saying blue if the word "red" printed in blue ink); and finally shifting between the last two conditions.

The D-KEFS *Sorting Test* measures problem-solving, verbal and spatial concept formation, and flexibility of thinking on a conceptual task. It consists of two conditions: Free

Sorting and Sort Recognition. For both conditions, the examinee is presented with two sets of six cards that display both stimulus words and various perceptual features. The examinee is asked to sort the cards into two groups and describe the categorization rule applied. In the Free Sorting condition, the examinee is asked to sort the cards in as many ways as possible. In the Sort Recognition condition, the examiner sorts the cards, and the examinee has to describe the sorting rule applied.

For The D-KEFS *Twenty Questions Test* the examinee is presented with a stimulus page illustrating pictures of 30 common objects and is asked to identify an unknown target object with the fewest number of yes/no questions possible. The initial abstract score of this measure represents how many objects are eliminated by the first question. The total Weighted Achievement score is the number of questions asked. This subtest evaluates reasoning from particular facts to a general conclusion.

For the D-KEFS *Word Context Test* the examinee attempts to discover the meaning of a made-up word (e.g., prifa) on the basis of its use in five clue sentences. The examinee guesses the meaning of the word after each sentence. The test measures verbal deductive reasoning skills. The highest score of 5 on each trial of the test is awarded when the examinee reports the correct meaning after being presented with the first clue sentence and consistently reports the response for the remaining clue sentences. This subtest measures reasoning from general facts to reach a particular conclusion.

The D-KEFS *Tower Task* measures the ability to plan in the spatial modality. It requires the examinee to move disks varying in size from small to large across three pegs to build a designated tower in the fewest number of moves possible. In constructing the target towers, the examinee may move only one disk at a time and may never place a larger disk over a smaller disk. The total Achievement score of the measure reflects the number of moves made to build a target tower within a limited time.

Procedure

Permission for testing children in the two schools was obtained from the research committee of the suburban public board of education. Students in Grades 5, 6, 7, and 8 were provided consent forms in school and asked to take them home to show to their parents. Students and parents who agreed to participate in the research were asked to sign the consent forms and return them to school. The consent forms are presented in Appendix C. Students who returned the signed consent forms completed the SREFI in their classrooms during school hours. In addition, students from School B completed the AMP-Jr.

Subsequent to the group testing sessions, participants were individually tested with the WASI at their schools during school hours. Students from School A who scored at least one standard deviation above the mean on the SREFI were subsequently tested individually with the D-KEFS during school hours at School A.

Students from School A received self-addressed return envelopes containing the BRIEF for parents and a letter asking parents to complete the questionnaire and send it to the examiner. Parents who did not return their forms received another copy of the questionnaire during the subsequent academic term and were asked this time to return the completed forms with their children to school. Students from School B returned the completed BRIEFs to their teachers for collection by the researcher.

In addition, Ontario Student Reports were used to obtain academic marks and teacher's estimation of learning skills. Marks for the most recent three terms from the Ontario Student Reports were averaged to obtain the students' average marks in Math and Language Arts.

Chapter 3

Results

The major part of this chapter contains the results of the six previously stated hypotheses. Results on the statistical properties of the SREFI are presented first. Descriptive statistics of the samples will then be presented before describing the results of the hypothesis testing. The last section of this chapter contains the results of testing the models of interaction of affective and cognitive components of self-regulation, as well as learning skills.

Statistical Properties of the SREFI

Reliability. Cronbach alpha coefficients were calculated to determine the degree of interitem agreement for each SREFI scale. An alpha coefficient of at least .7 indicates a good consistency among items (Hatcher, 1994). The mean alpha coefficient for the SREFI scales for both schools combined was .725. For School A, the mean alpha coefficient was .71, and for School B it was .73. Table 3 provides alpha coefficients for each subscales for the two schools. The results suggest that the SREFI scales had good internal consistency across both samples. Because of this all 84 items of the originally designed SREFI were retained.

SREFI interscale correlations. The Pearson interscale correlation coefficients of the SREFI are presented in Table 4. All scales were significantly and positively intercorrelated (p = .01). The highest correlation coefficients were found between the Planning and Monitoring scales, and Planning and Goal Setting scales. The lowest correlation coefficients were between the Goal Setting and Self-Control scales.

Factor analysis of the SREFI scales. The are two major approaches in factor analysis: data reduction and structural detection. Both approaches were applied to the SREFI data. The purpose of data reduction is to remove redundant (highly correlated) variables from the data file. The principal components method of extraction was used in the current analysis for this purpose. Table 5 shows seven components for the seven variables of the SREFI and the percent of variance accounted for by each variable. The first component carried the largest load, 59% of the

variability for the data, suggesting that the SREFI scales should be reduced to one component.

Table 3

Alpha Coefficients for the SREFI Scales for Schools A and B

The SREFI Scales	School A	School B	Means
Goal Setting	.65	.69	.67
Self-Control	.73	.73	.73
Time Management	.74	.73	.74
Planning	.80	.78	.79
Monitoring	.75	.78	.76
Initiative	.70	.77	.74
Working Memory	.63	.66	.65

Table 4

Pearson Correlation Coefficients of the Self-Regulated Executive Functions Inventory Scales

	G	SC	TM	P	M	I	WM
Goal Setting (G)	1						
Self-Control (SC)	.35*	1					
Time Management (TM)	.52*	.49*	1				
Planning (P)	.68*	.38*	.61*	1			
Monitoring (M)	.66*	.37*	.69*	.71*	1		
Initiative (I)	.66*	.38*	.57*	.56*	.57*	1	
Working Memory (WM)	.48*	.52*	.48*	.38*	.36*	.47*	1

* significant at the $p < 0.01$ level (two-tailed)

Table 5

Principal Component Analysis of the Self-Regulated Executive Functions Inventory Scales

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	4.15	59.29	59.29
2	0.91	13.03	72.32
3	0.59	8.42	80.74
4	0.43	6.13	86.87
5	0.41	5.91	92.79
6	0.28	4.03	96.82
7	0.22	3.18	100

Further analysis with the Rotated Component Matrix revealed that all variables of the SREFI contributed significantly to the first component (see Table 6). The highest contributions were made by the Monitoring, and Goal Setting, Time Management and Planning scales. The lowest contribution coefficient was for the Self-Control scale. Therefore, in subsequent analyses, the SREFI scales were reduced to one component.

Structural detection, the second type of factor analysis, is used to generate hypotheses regarding causal mechanisms or to screen variables for subsequent analysis (for example, to identify collinearity prior to performing a linear regression analysis). The purpose of structural detection is to examine the underlying (or latent) relationship among the variables. This analysis is based on an assumption that some of the variability in the data cannot be explained by the components (factors). Although the total variance explained by the solution is smaller, the addition of this structure to the factor model makes these methods ideal for examining the relationship among the variables. The latent analysis of the SREFI scales revealed that only one factor accounted for the variables of the SREFI, confirming that the variables of the SREFI can be reduced to a single Composite score.

Means and standard deviations of the SREFI scales. The data were further analyzed with descriptive statistics. The means and standard deviations of the SREFI scales for each of the schools and effect size indexes (Cohen's *d*) comparing the data are presented in Table 7. Cohen's *d* statistics is the difference between group means expressed in standard deviation units. Values from approximately .00 to .20 are considered less than small, values from approximately .20 to .49 are considered small, values from approximately .50 to .79 are considered moderate, and values above .80 are considered large. Cohen's d is an independent of sample size statistics. Moderate and large Cohen's d's indicate that with a larger sample size group mean comparison is likely to be significant. Considering that the SREFI scales had an equal number of questions, there was no need to further standardize the scores for comparison across scales. Higher scores reflected a greater number of problems.

Table 6

Rotated Component Matrix for the Self-Regulated Executive Functions Inventory Data

The SREFI Scales	Component
Goal Setting	.82
Self-Control	.62
Time Management	.82
Planning	.82
Monitoring	.83
Initiative	.79
Working Memory	.67

Table 7

Means and Standard Deviations of the Self-Regulated Executive Functions Inventory Scales for Schools A and B

The SREFI Scales	School A		School B		Total		Cohen's
	Mean	SD	Mean	SD	Mean	SD	d
Goal Setting	15.94	4.53	14.41	4.95	15.6	4.74	.32
Self-Control	11.79	4.92	11.38	4.91	12.2	4.9	.08
Time Management	12. 41	4.9	10.28	4.88	11.5	4.89	.44
Planning	16.81	5.93	14.24	5.46	15.5	5.7	.45
Monitoring	13.38	5.11	11.74	5.07	12.8	5.09	.32
Initiative	13.04	4.6	10.3	4.7	11.67	4.65	.59
Working Memory	13.04	4.6	13.25	4.62	13.15	4.61	-.01

Students in School A consistently reported more problems with self-regulation than students in School B. The Cohen's *d* coefficients, however, indicate that the differences are small on all the scales, except for the Initiative scale, for which the index was moderate (Table 7). The overlap in the distributions of the SREFI scales for the two schools ranged from 65 to 93%. The greatest numbers of problems were reported on the Goal Setting and Planning scales. The lowest means (fewest problems) for each school were on Time Management and Initiative.

Validity. Two comparisons were conducted to gather evidence of the validity of the SREFI, with the BRIEF – Parent, and D-KEFS. It should be noticed that only 5 items of the BRIEF were included in the SREFI (6%). In contrast to the SREFI, the BRIEF does not consist of the Goal Setting and Time Management scales.

Pearson correlations between the BRIEF and the SREFI are presented in Table 8. All of the BRIEF scales that comprise the Metacognitive cluster, namely Initiative, Working Memory, Planning/Organizing, Organization of Materials, and Monitoring, were significantly and positively correlated with all scales of the SREFI. The highest correlation was found between the SREFI Time Management scale and the BRIEF Monitoring scale ($r = .55$).

The relations were somewhat different for the Behavioral Regulation cluster of scales of the BRIEF and the SREFI scales. The BRIEF Shift scale was not significantly related to any scales of the SREFI. The BRIEF Inhibition scale was significantly and moderately correlated with all of the SREFI scales except Time Management and Goal Setting. The BRIEF Emotional Control scale was significantly correlated only with the Monitoring, Time Management, and Self-Control scales of the SREFI.

The validity of the SREFI was also evaluated with the D-KEFS using a sample of 24 students from School A (M age = 12, SD = 1). The D-KEFS was used as a performance measure of executive function, in contrast to the self-perception scores from the SREFI. Overall, students who reported problems on the SREFI had performance deficits in executive functioning, as objectively measured by the D-KEFS.

Table 8

Pearson Correlations between BRIEF and SREFI Scales

BRIEF/SREFI	G	SC	TM	P	M	W	I
Inhibition	.11	.34**	.19	.36**	.42**	.33**	.39**
Shift	.11	.17	.06	.09	.15	-.01	.19
Emotional Control	.06	.29**	.57**	.16	.23*	-.04	.16
Initiative	.31**	.30**	.41**	.27*	.41**	.26*	.47**
Working memory	.31**	.30**	.37**	.25*	.39**	.38**	.38**
Planning/Organizing	.29**	.24*	.31**	.31**	.34**	.26**	.33**
Organization of Materials	.20	.40**	.25*	.36**	.39**	.28**	.33**
Monitor	.34**	.37**	.55**	.36**	.42**	.33**	.39**

* significant at the p = .05

** significant at the p = .01

BRIEF – Behavioral Rating Inventory of Executive Function; SREFI - Self-Regulated Executive Functions Inventory; G – Goal Setting; SC – Self Control; TM – Time Management; P – Planning; M – Monitoring; WM – Working Memory

The process of student selection for D-KEFS testing occurred in the following way. Students who were selected for D-KEFS testing were those with SREFI scores at least one standard deviation above the mean for school A on more than 2 subscales of the SREFI (an experimental group) and with scores within one standard deviation (a control group). Three of 38 students with no problems (all SREFI scores within the mean plus one SD range), 6 of 30 students with one problem (one standard deviation above the mean on one of the SREFI scores), and 6 of 10 students with two problems on the SREFI were tested with the D-KEFS. The average IQ of these students was 102.62 (SD = 11.7, n = 15). The mean IQ for this group of students was .09 standard deviations from the mean IQ for School A (M = 101.5, SD = 12, n = 58), indicating approximately a 100% overlap in the two distributions.

Further, 9 students with more than two problems on the SREFI (2 of 6 students with three problems on the SREFI, 3 of 4 students with four problems, and all 4 students with five problems) were also tested with the D-KEFS. The mean IQ for this group (M = 90.1, SD = 11.7, n = 9) was .96 standard deviations below of the average IQ for School A (52% of a nonoverlap in the two distributions). There were no students who reported more than five problems on the SREFI.

Among the 24 students who completed the D-KEFS, 15 reported having problems with planning, 12 had problems with monitoring, and 11 had problems in Goal Setting. Only 2 students in this group reported problems with working memory. Among the 9 students who did not endorse any or only one problem on the SREFI, 5 students (56%) did not have problems with executive functions as measured by the D-KEFS. Their scores were at least in the average range. Three out of the 9 students had one score in the low-average range (scaled score = 7) while the rest of these scores were in the average range. Among the 15 students with two or more identified problems on the SREFI 14 (87.5%) had at least two below-average scores on the D-KEFS. In general, students with below-average IQ had more difficulties on the D-KEFS than those with average or above-average IQ. The individual with the most problems on the D-KEFS

was a boy, ZK (IQ = 92; marks in both subjects = 72), who obtained seven below-average scores on the D-KEFS. The highest frequencies of scores that indicated executive problems were for the Tower and Sorting-2 D-KEFS subtests.

In summary, statistical analysis of students' responses on the SREFI revealed a high degree of interitem agreement for each of the seven SREFI scales and moderate to high interscale correlations. Scores on the SREFI scales showed significant moderate correlations with scores on all five metacognitive scales of the BRIEF – Parent form, suggesting that the SREFI is a valid measure of metacognitive components of self-regulation. The absence of a composite score on the D-KEFS made it difficult to explore specific relations between executive functions performance and executive functions self-ratings. Nevertheless, the results indicate that students who reported problems on the SREFI produced performance deficits in executive functioning, as objectively measured by the D-KEFS. These results support the validity of the SREFI.

Factors Contributing to Executive Self-Regulation

To verify the homogeneity of the sample, the schools A and B were compared with ANOVA and Cohen's *d* coefficients. The results of the analyses are shown in Table 9. An ANOVA revealed that School B had significantly higher scores on both WASI subtests and marks in Language Arts, but not in Math. The Cohen's *d* coefficients ranged, however, from small to medium and indicated that the overlaps between the distributions were above 72%. There was a significant difference between scores on the WASI Vocabulary and Matrices subscales for School A, $F(1, 56) = 9.4$, $p < .01$, but not for School B.

When considering School, Age, Gender, and IQ scores as independent variables and the SREFI Composite as dependent variable, linear regression analysis revealed that IQ, $F(1, 127) = 9.49$, $p = .002$, and School, $F(1, 127) = 6.33$, $p = .01$, but not Age and Gender played significant roles in predicting the SREFI Composite scores. Analysis with the above independent variables

Table 9

Descriptive and ANOVA Comparisons of the Schools A and B in Marks on Language Arts and Math and Scores on the WASI Subtests and Composite IQ

	School	N	M	SD	F	p	Cohen's d
Marks in Language Arts*	A	90	73.1	5.6	4.95	.027	-.35
	B	82	75.0	5.4			
Marks in Math	A	90	75.6	7.2	1.87	.175	-.18
	B	82	77.0	8.0			
Vocabulary*	A	58	46.0	10.5	5.58	.019	-.42
	B	78	50.3	10.1			
Matrices*	A	58	54.7	6.4	5.37	.022	-.38
	B	78	56.9	5.1			
IQ*	A	58	101.5	12.0	5.28	.023	-.38
	B	78	106.0	11.6			

* significant at the $p < .05$ level

revealed that School contributed significantly, $p < .01$, to prediction of marks in Language Arts, $F(1, 127) = 8.59$, but not in Math. In contrast, IQ contributed significantly, $p < .01$, to predicting marks in both Language Arts, $F(1, 127) = 8.59$, and Math, $F(1, 127) = 12.16$. Girls outperformed boys on Language Arts, $F(4, 127) = 12.16$, $p < .01$, but there was no gender difference in prediction of marks in Math.

ANOVA with School as the independent variable was performed on the learning skills scales. This analysis revealed that scores on two of the nine teacher-rated learning skills, namely Initiative and Problem Solving, were significantly ($p < .01$) higher for School B than School A, $F(9, 172) = 8.25$ and $F(9, 172) = 5.69$.

Further comparison of the two schools with an ANOVA revealed that students in School A reported significantly ($p < .01$) more problems than students in School B on several scales of the SREFI, namely Goal Setting, $F(1, 169) = 9.25$, Time Management, $F(1, 169) = 10.86$, Monitoring, $F(1, 169) = 6.69$, and Initiative, $F(1, 169) = 12.05$. There was a marginally significant trend in the same direction on the Planning scale, $F(1, 169) = 3.66$, $p = .06$), but no significant differences in responses between schools on the Working Memory and Self-Control scales. Comparison of the scores on the SREFI scales between the two schools with Cohen's *d* coefficients indicated that the distributions of scores for the schools were highly overlapped.

In general, the differences between schools in scores on SREFI, WASI, and teacher-rated learning skills were small but significant. According to Statistics Canada, the two school communities differed on many variables, such as ethnicity, language spoken at home, average income, religion, and occupation. In the school A community, 48% of the population is Chinese and 27% South Asian; in the school B community only 19% were Chinese and 10% South Asian. Analysis of occupations revealed that in the school A community, 7% of population was in management positions and 5% in social science, education, and government services, while these numbers were 18% and 12% in the school B community. At the same time, more adults from the school A community were in manufacturing and processing (16% vs. 1% in the school

B community). Average income was 64% higher in the school B community than in the school A community. While there were an approximately equal number of adults with high school and college education, there were more adults with a university degree in the school B community (56%) compared to the school A community (32%). In the school B community, 38% identified themselves as practicing Judaism while none from the school A community did. In contrast, there was a high percent of people in the school A community who practiced Hinduism (17%). These results suggest that the two samples differed by variables that were not originally investigated in this study, such as social-economic status and cultural background.

While there were significant differences in group means between the schools, the effect size indexes for the scales of the WASI, SREFI, teacher-rated learning skills, and marks in Language Arts and Math were low to moderate, and Cohen's d coefficient did not exceed .44. Still, many of the statistical analyses (e.g., regression formulas to predict academic achievement) were done separately for each school.

Hypothesis Testing

H1: It was hypothesized that students with higher academic marks would report fewer problems on the SREFI.

Pearson correlation coefficients between academic marks in Language and Math and SREFI scales for both schools (see Table 10) revealed that only scores on the Time Management, Monitoring, and Initiative scales of the SREFI were significantly related to academic marks in both subjects. In addition, scores on the Self-Control and Working Memory scales of the SREFI were significantly related to academic marks in Math, but not in Language Arts. The highest correlation coefficient between these variables was found for the Time Management scale. Students who reported fewer problems with time management had better marks. This funding was supported by a linear regression analysis. Of the seven scales of the SREFI, only the Time Management scale was a significant predictor ($p = .01$) of marks in Math, $F(7, 157) = 3.66$,

Table 10

Pearson Correlation Coefficients between the Self-Regulated Executive Function Inventory Scales (SREFI), Academic Marks in Language Arts and Math, and IQ

The SREFI Scales	Language Arts	Math	IQ
Goal Setting	-.14	-.10	-.21**
Self-Control	-.14	-.27**	-.15
Time Management	-.36**	-.34**	-.26**
Planning	-.14	-.15	-.13
Monitoring	-.26**	-.20**	-.24**
Initiative	-.18*	-.18**	-.23**
Working Memory	-.13	-.16*	-.24**

** Correlation is significant at the .01 level (two-tailed)

* Correlation is significant at the .05 level (two-tailed)

R^2 = .215 (bottom panel of Table 11) and Language Arts, $F(7, 157) = 3.83$, $R^2 = .144$ (top panel of Table 11). Because the order in which the scales of the SREFI were entered into the regression formulas did not make differences in the results, the scales were entered in an atheoretical order.

To further examine which aspects of cognitive self-regulation were most highly associated with marks at school, the sample was divided into three groups. Students whose average academic mark was lower than one standard deviation from the mean for their school were labeled as Low Performers. Students whose scores were within one standard deviation for their school, were identified as Average Performers, and those whose marks exceeded one standard deviation from the mean for their school were identified as High Performers.

For School B, the mean mark in Language was 75% (SD = 5), and the mean mark in Math was 77% (SD = 8). For School A, the mean mark in Language was 77% (SD = 8), and the mean mark in Math was 76% (SD = 7). The descriptive data for the SREFI scale scores are presented in Table 12 for each of the Performance groups by academic subject. Low and Average Performers did not differ much in their responses on the SREFI and had much higher scores on all scales of the SREFI compared to high performers. The lowest scores on the SREFI were obtained by high performers in both subjects (see Figure 3).

An ANOVA revealed that students of different performance levels significantly differed in responses on the SREFI Composite score, $F(1, 163) = 15.6$, $p = .001$. Further analyses involving multiple comparisons using the Tukey HSD and effect size correlations revealed significant among the three academic performance groups in responses on several SREFI scales (see Tables 13 and 14, respectively). High Performers in Language Arts reported significantly fewer problems on the Goal Setting, Time Management, Planning, Monitoring, and Initiative scales than either Average or Low Performers. They also reported significantly fewer problems on working memory compared to Average Performers. High Performers in Math reported significantly fewer problems with self-control, time management, monitoring, and initiative than Low or Average Performers.

Table 11

Linear Regression Analysis of Marks in Language Arts and Math based on Self-Regulated Executive Functions Inventory Scales

		B	Std. Error	Beta	t	p
Language Arts:						
	(Constant)	77.4	1.59		48.77	.00
	Goal Setting	0.07	0.14	0.06	0.51	.61
	Self-Control	0.03	0.1	0.03	0.32	.75
	Time Management*	-0.45	0.13	-0.39	-3.38	<.01
	Planning	0.14	0.11	0.14	1.24	.22
	Monitoring	-0.16	0.14	-0.14	-1.14	.26
	Initiative	-0.03	0.13	-0.03	-0.24	.81
	Working Memory	0.02	0.12	0.02	0.18	.85
Math:						
	(Constant)	81.83	2.17		37.69	<.01
	Goal Setting	0.2	0.2	0.12	1.01	.31
	Self-Control	-0.23	0.14	-0.15	-1.64	.10
	Time Management*	-0.51	0.18	-0.32	-2.82	.01
	Planning	0.08	0.16	0.06	0.49	.62
	Monitoring	-0.04	0.19	-0.03	-0.23	.82
	Initiative	-0.09	0.18	-0.06	-0.52	.60
	Working Memory	0.05	0.16	0.03	0.3	.77

* significant at the 0.01 level

SREFI – Self-Regulated Executive Functions Inventory

Table 12

Means (Standard Deviations) of the Self-Regulated Executive Functions Inventory Scales as a Function of Academic Performance Groups in Language Arts and Math

	n	G	SC	TM	P	M	I	WM
Language Arts								
Low Performers	21	15(5)	13(5)	14(5)	16(5)	14(5)	14(4)	10(4)
Average Performers	97	16(5)	12(5)	11(5)	17(5)	13(5)	14(4)	12(4)
High Performers	16	11(3)	10(4)	7(4)	12(4)	8(4)	9(5)	8(5)
Math								
Low Performers	25	15(5)	13(6)	13(5)	16(5)	13(5)	14(4)	11(5)
Average Performers	103	16(5)	12(5)	11(5)	17(6)	13(5)	13(5)	11(4)
High Performers	11	13(4)	8(3)	7(4)	13(6)	8(6)	10(5)	8(5)

G – Goal Setting; SC – Self Control; TM – Time Management; P – Planning; M – Monitoring; WM – Working Memory

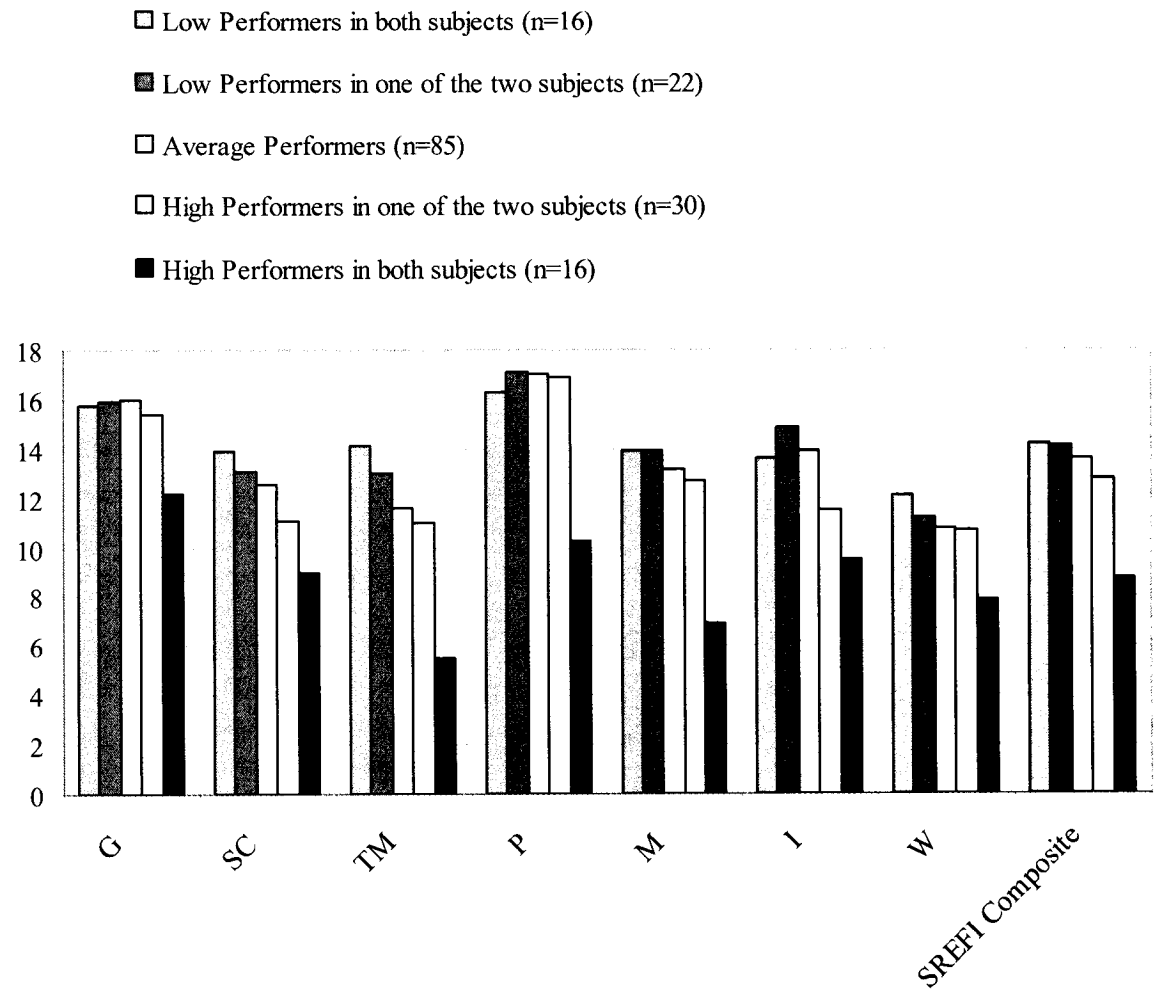


Figure 3. Responses on the Self-Regulated Executive Functions Inventory (SREFI) as a function of academic performance.

Table 13

Multiple Comparison with Tukey HSD of Academic Performance Groups in Language Arts and Their Responses on the SREFI Scales ('low'- Low Performers, 'average' – Average Performers, 'high' - High Performers)

SREFI Scales	Academic Performance Groups		Mean Difference	SE	p
Goal Setting	average	low	1.29	1.11	.48
	average	high	5.36*	1.28	<.01
	high	low	-4.07*	1.55	.03
Self-Control	average	low	-0.28	1.24	.97
	average	high	2.65	1.43	.16
	high	low	-2.93	1.74	.21
Time Management	average	low	-2.2	1.08	.11
	average	high	4.67*	1.25	<.01
	high	low	-6.87*	1.52	<.01
Planning	average	low	1.48	1.26	.47
	average	high	5.75*	1.45	<.01
	high	low	-4.27*	1.77	.05
Monitoring	average	low	-1.08	1.08	.58
	average	high	5.21*	1.24	<.01
	high	low	-6.29*	1.52	<.01
Initiative	average	low	-0.36	1.06	.94
	average	high	4.97*	1.23	<.01
	high	low	-5.32*	1.49	<.01

Working Memory	average	low	1.13	1.09	.56
	average	high	4.07*	1.26	<.01
	high	low	-2.94	1.53	.14

* significant at the .05 level

Table 14

Multiple Comparison with Tukey HSD Academic Performance Groups in Math and Their Responses on the SREFI Scales; ('low'- Low Performers, 'average' – Average Performers, 'high' - High Performers)

SREFI Scales	Academic Performance Groups		Mean Difference	SE	p
Goal Setting	average	low	0.29	1.06	.96
	average	high	3.17	1.53	.10
	high	low	-2.88	1.74	.23
Self-Control	average	low	-1.29	1.19	.53
	average	high	4.33*	1.71	.03
	high	low	-5.62*	1.95	.01
Time Management	average	low	-1.86	1.04	.18
	average	high	4.61*	1.49	.01
	high	low	-6.47*	1.7	<.01
Planning	average	low	-0.23	1.21	.98
	average	high	4.06*	1.74	.05
	high	low	-4.29	1.98	.08
Monitoring	average	low	-0.11	1.04	.99
	average	high	5.05*	1.49	<.01
	high	low	-5.16*	1.7	.01
Initiative	average	low	-0.52	1.02	.87
	average	high	3.57*	1.47	.04
	high	low	-4.10*	1.67	.04

Working Memory	average	low	-0.52	1.05	.87
	average	high	3.43	1.5	.06
	high	low	-3.95	1.71	.06

* significant at the .05 level

Analysis of scatter plots between the SREFI Composite score and students' marks in Language Art and Math suggests that the relationship between academic performance and executive self-regulation is not linear (Figure 4). Students with marks in Language above 80% produced much lower scores on the SREFI Composite score compared with other students. In Math, this threshold was approximately 85%. In contrast to Language Arts, a nonlinear relation between self-regulation and academic performance in Math appeared for High and Low Performers. Surprisingly, students who had marks in Math lower than approximately 65% also obtained lower SREFI Composite scores.

In summary, H1 was partially supported by the findings. Only 3 out of 7 scales of the SREFI, namely Time Management, Monitor, and Initiative, were significantly and negatively correlated with academic marks, and only one scale, Time Management, was a significant predictor of academic marks. Comparison of Performance groups revealed that while there was no significant difference in responses on the SREFI between Average and Low Performers, High Performers reported significantly better developed self-regulation in all areas compared to the other two groups.

H2*: It was hypothesized that students with higher general cognitive ability scores, as measured by the WASI, would report fewer problems with self-regulated executive functions, as measured by the SREFI.*

A significant Pearson correlation ($r = .50$, two-tailed, $p = .001$) was found between FSIQ and marks in Language Arts and Math. Therefore, intelligence alone contributed 25% of the variability of students' school marks in the sample. Comparison of the regression and smooth fit lines on a scatter plot of the interaction between IQs and average marks in Language Arts and Math suggested that this relationship was linear (see Figure 5).

Analysis of the Pearson correlation coefficients among IQ and SREFI scales confirmed that students with higher levels of general intelligence reported significantly fewer problems with self-regulated executive functions (see Table 10). All the scales of the SREFI, except the

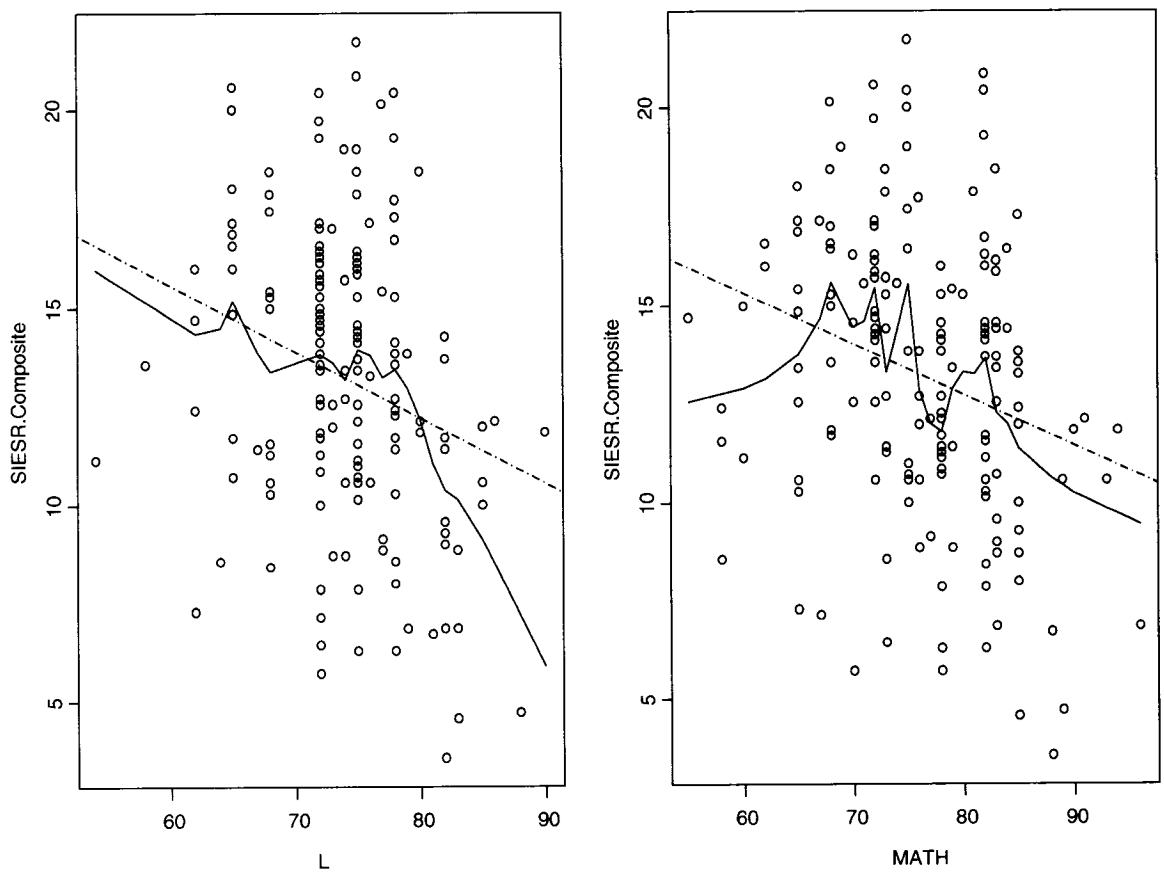


Figure 4. Scatter plots of the Composite scale of the SREFI and marks in Language Arts and Math. The dotted lines correspond to regression lines and the solid lines to the smooth fit lines.

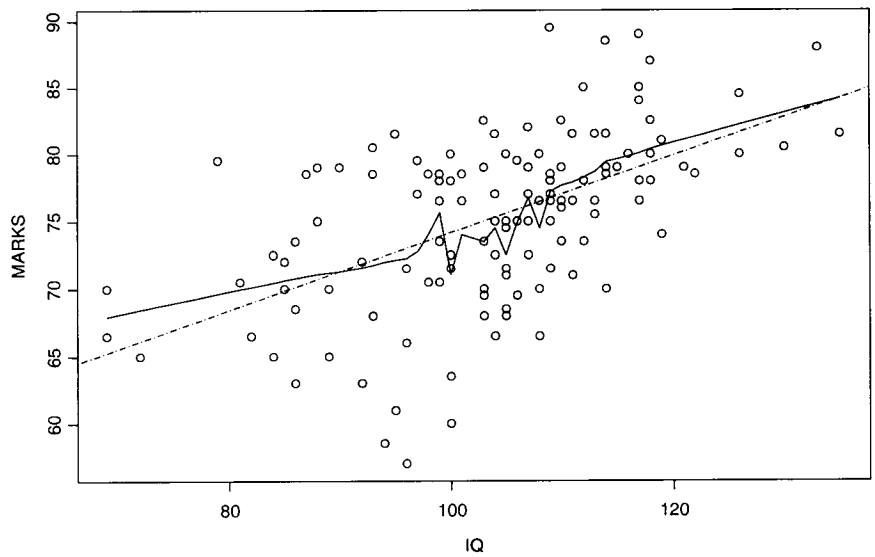


Figure 5. Scatter plot of the interaction between IQ and academic marks: *r*egression (dotted) and smooth fit (solid) lines.

Planning and Self-Control, were significantly correlated with IQ. The highest correlation was between IQ and the Time Management scale (r = -.26).

In order to conduct further analyses of the relationship between intelligence and cognitive self-regulation, the sample was divided into three groups according to IQ. Students whose IQ scores were within one standard deviation for their school were identified as Average IQ students. Those with IQ scores lower than one standard deviation from the mean for their school were labeled as Below-Average IQ students, and those who exceeded one standard deviation from the mean for their school were identified as Above-Average IQ students. There were 14 Below-Average IQ students, 82 Average IQ students, and 34 Above-Average IQ students who completed the SREFI across both schools.

Comparison of the three intelligence groups in their responses on the SREFI is presented in Figure 6. The graph indicates that Below-Average IQ students reported many more problems with self-regulated executive functions, as measured by the SREFI, than Average and Above-Average students. The mean scores of the SREFI scales for Average and Above-Average IQ students are similar.

Significant differences ($p < .05$) among the three intelligence groups were found on most SREFI scales, including Time Management, $F(1,129) = 8.5$, Monitoring, $F(1, 134) = 5.28$, Self-Control, $F(1, 129) = 4.1$, Working Memory, $F(1, 134) = 5.5$, and Initiative, $F(1, 134) = 8.34$. There were marginally significant trends for the Goal Setting, $F(1, 134) = 3.48$, $p = .06$, and Planning, $F(1, 134) = 2.98$, $p = .09$, scales as a function of IQ. There were no interactions between School and IQ Level groups in these analyses. Effect size indexes revealed that students with Below-Average IQ reported higher scores on most scales of the SREFI compared to the other two groups of students. The highest effect size indexes were on the Time Management (45% of nonoverlap in distribution of the scores), Initiative, and Working Memory scales. The Self-Control scale had the lowest effect size index.

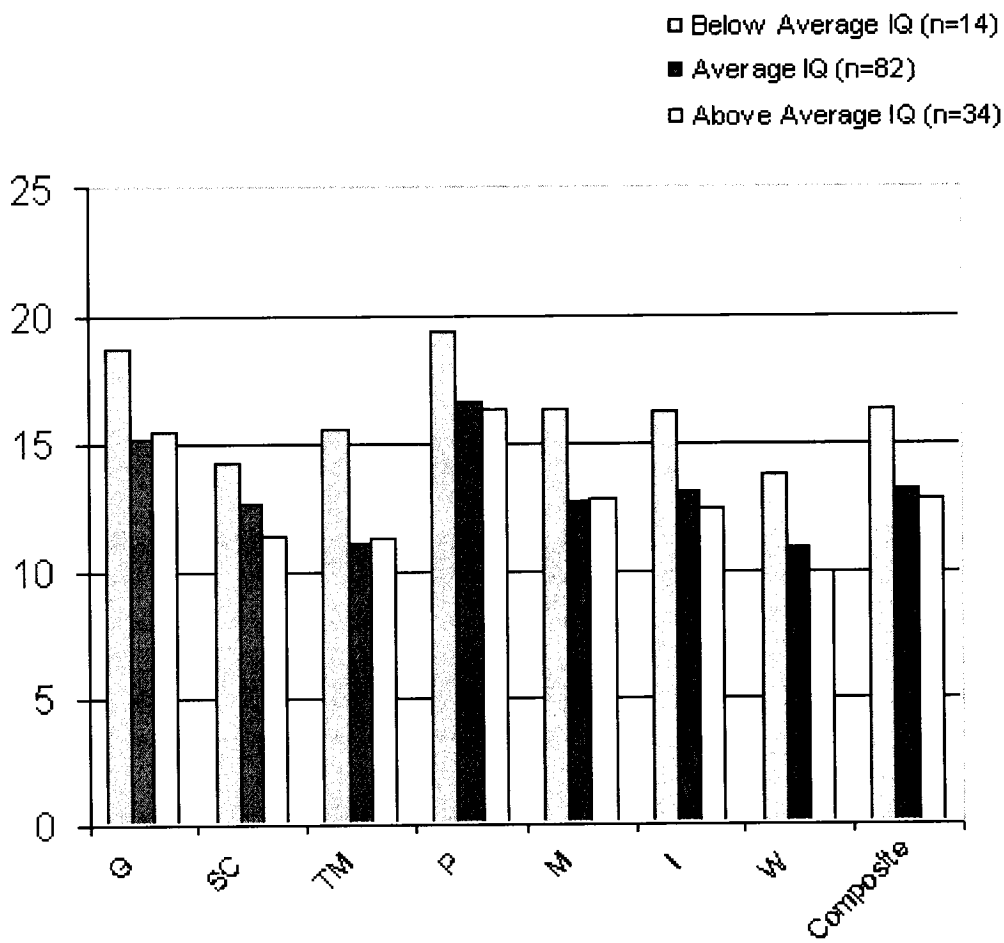


Figure 6. Responses on the Self-Regulated Executive Functions Inventory (SREFI) scales by different intelligence groups.

To further clarify the relationship between intelligence, academic performance and cognitive self-regulation, each of the intelligence groups was divided by their level of academic performance. SREFI scores and mean IQs are presented for these subgroups in Figures 7-9. The fewer problems with cognitive self-regulation that students of above-average intelligence reported, the higher was their academic performance, $F(1, 40) = 8.5, p = .005$ (Figure 7a). Comparison of the bar graphs (Figure 8) indicates that students of average intelligence who had high-average marks in one subject reported fewer problems with self-regulated executive functions than the other academic performance groups with the same range of intelligence, with the exception of Self-Control. An ANOVA revealed, however, that the difference between the performance groups of average and below-average intelligence was not significant. Within the average intelligence group, students with below-average grades reported fewer problems compared to those who had average and above-average academic performance. Students with below-average IQ (Figure 9) and average marks reported fewer problems on most scales of self-regulation than the other two performance groups within the same range of intelligence. In general, there was a clear pattern among the intellectual groups of increasing number of problems with all aspects of executive self-regulation as they experienced more difficulties with academic performance (see Figure 10).

In summary, H2 was supported partially. Students with higher scores on general cognitive ability reported significantly fewer problems on the SREFI, reflecting higher levels of self-regulated executive functioning. Specifically, it was found that students with below-average IQ estimated their executive self-regulation as being much more problematic than students with average and above-average IQ. The greatest difference among these intelligence groups was found on the Time Management scale of the SREFI.

H3: *It was hypothesized that there would be an interactive relationship among academic marks, general cognitive ability as measured by the WASI, and self-regulated executive functions, as measured by the SREFI.*

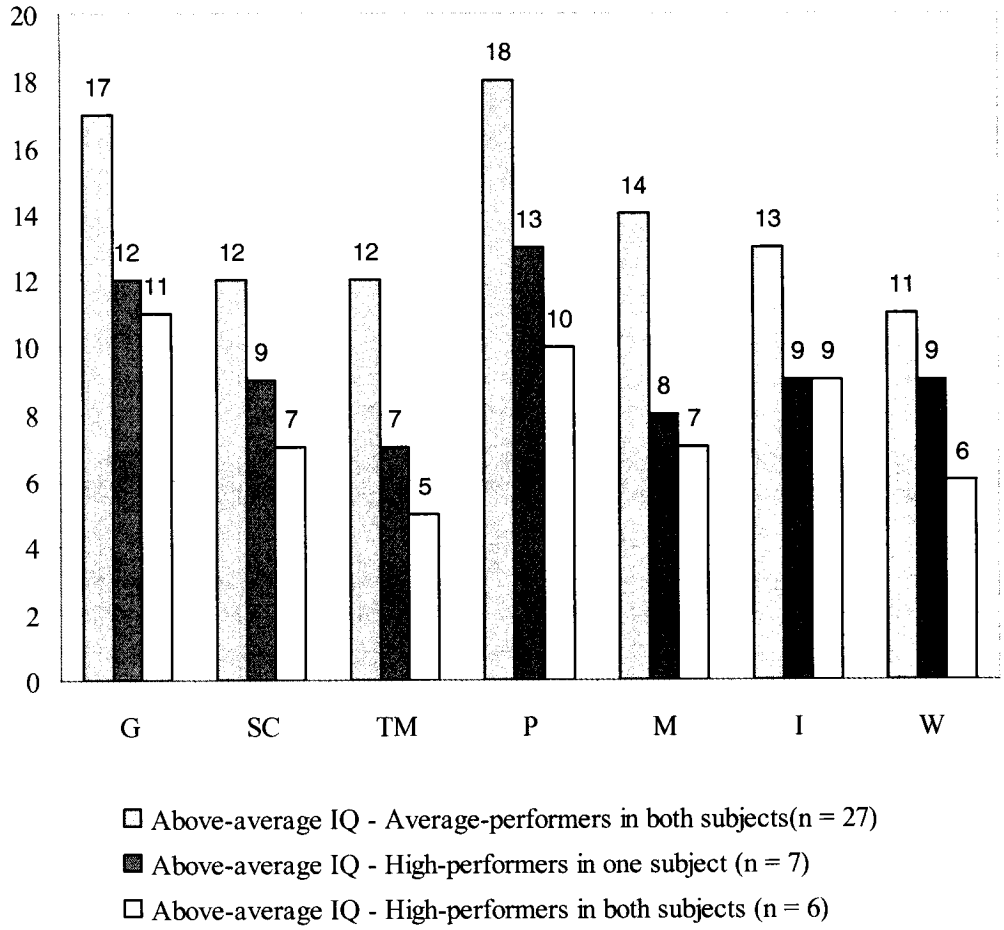


Figure 7a.

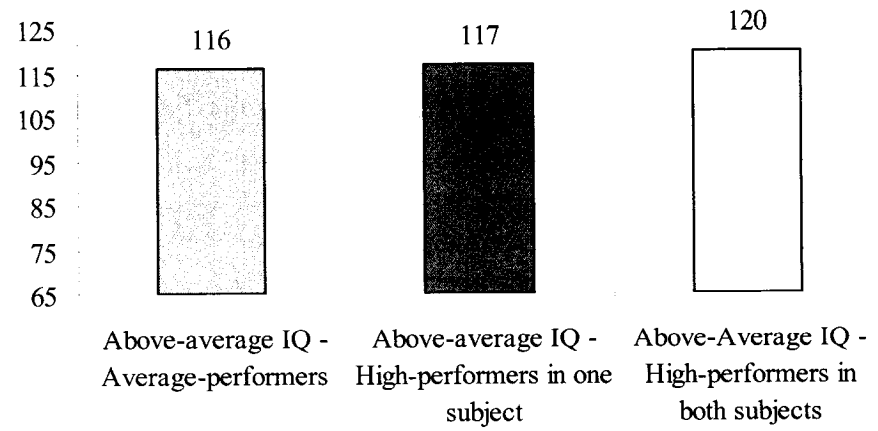


Figure 7b.

Figures 7. Comparison of the academic performance groups with above-average intelligence in their (a) responses of the SREFI scales and (b) IQ.

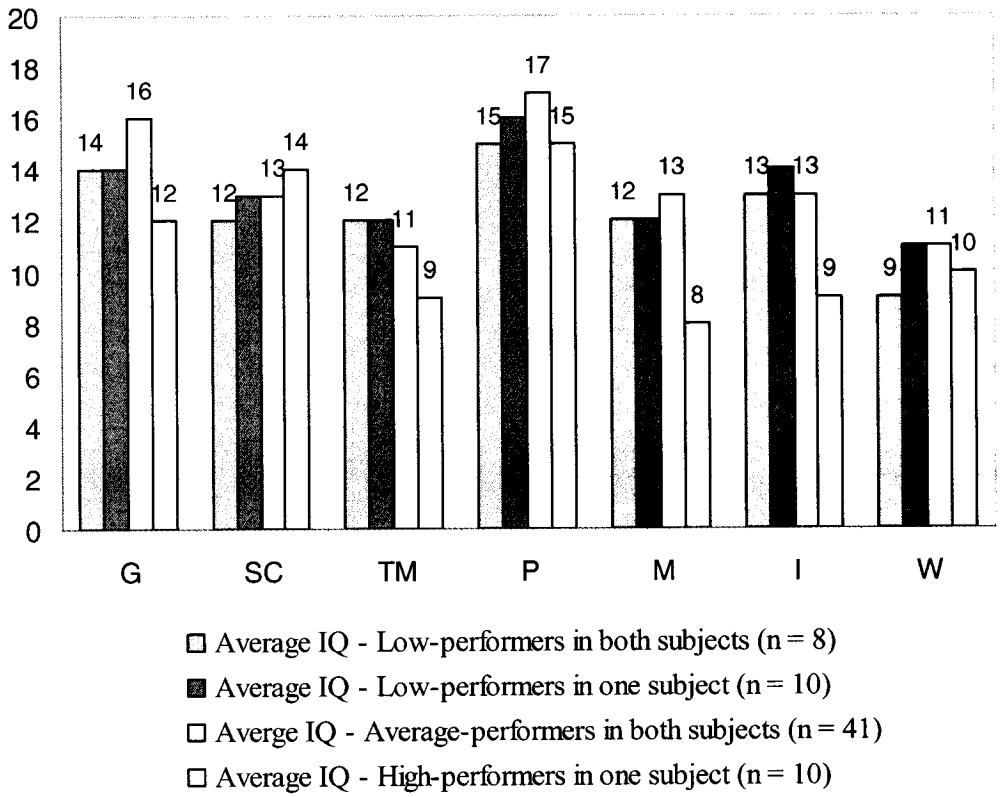


Figure 8a.

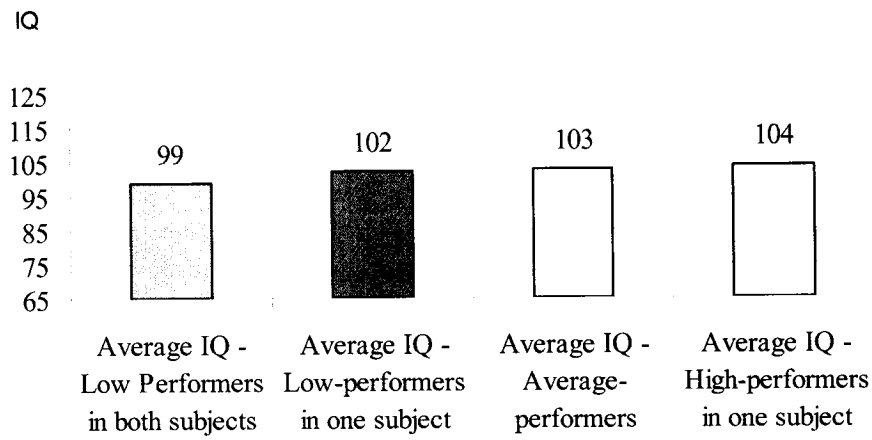


Figure 8b.

Figures 8. Comparison of the academic performance groups with average intelligence in their (a) responses of the SREFI scales and (b) IQ.

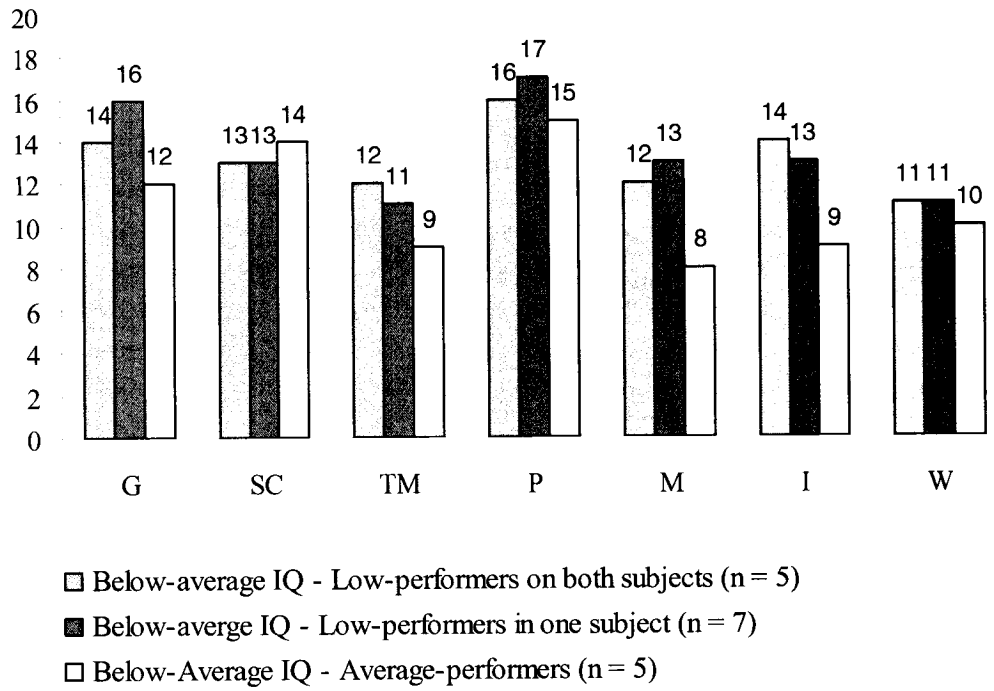


Figure 9a.

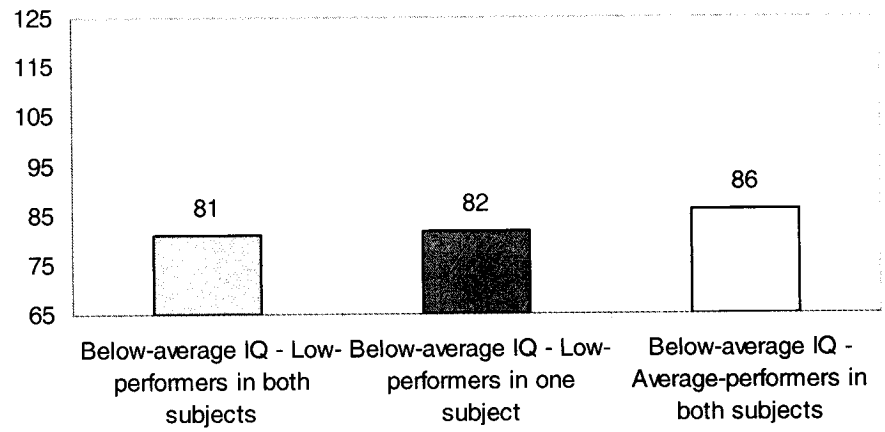
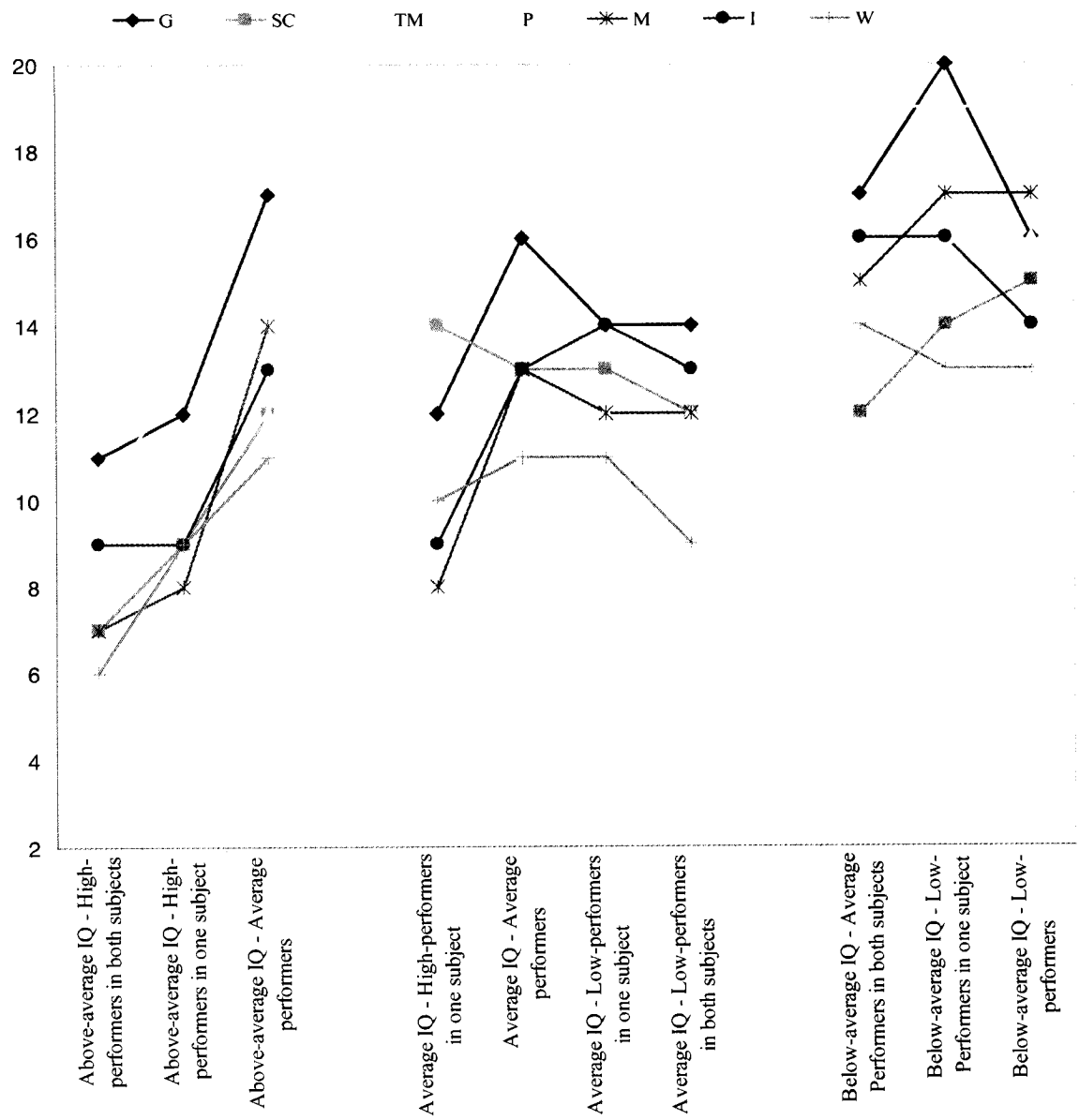


Figure 9b.

Figures 9. Comparison of the academic performance groups with below-average intelligence in their (a) responses of the SREFI scales and (b) IQ.



Figures 10. Comparison of academic performance by intelligence groups in their responses of the SREFI scales.

Regression analysis revealed that in addition to IQ there was a significant interaction between IQ and Composite score on the SREFI in predictions of the academic marks averaged across Language Arts and Math; see Table 15. The 3D plot of IQ scores, the Composite score of the SREFI, and Marks are presented in Figure 11. The graph shows that marks of students with low intelligence increased with higher levels of reported problems on the SREFI, whereas marks of students with high intelligence decreased with higher levels of reported problems on the SREFI.

Figure 12 displays 2D scatter plots for students with below-average IQ; Marks are graphed on the Y-axis, and the SREFI Composite (top), and scores of the two scales that contributed most to school marks for the total sample, the Time Management (middle) and Monitoring (bottom) are plotted on the X-axis. These plots suggest that there are some students of below-average IQ who did well academically even when they reported higher scores on the SREFI Composite and Monitoring scale. In contrast, students with average IQ did not show similar interaction between executive regulation and marks (see Figure 13). The strongest relationship between executive regulation and marks was found for students with above-average IQ (see Figure 14). The more difficulties they reported on the SREFI the lower were their academic marks.

In summary, the hypothesis H3 that there would be an interactive relationship among academic marks, general cognitive ability as measured by the WASI, and self-regulated executive functions, as measured by the SREFI, was supported. The more students of below-average IQ identified difficulties in the area of executive self-regulation, the better they performed academically. The opposite was found for students of above-average IQ scores. The more problems with self-regulation they identified, the lower were their academic marks. For students with above- and below-average IQ, the relationships were strongest for the Planning, Goal Setting, and Monitoring scales. In addition, scores on the Time Management scale were strongly associated with marks for students of above-average intelligence.

Table 15

Regression Analysis of Prediction of Performance Level based on IQ and the SREFI Composite Score

	B	SE	*t*	*p*
Intercept	0.19	.43	0.43	.66
IQLevel	1.35	.27	4.93	<.01
SREFI Composite	-0	.01	-1.89	.06
Gender	-0.1	.01	-1.08	.28
Grade	0	.05	0.03	.97
IQLevel*SREFI Composite	-0.1	.01	-3.24	<.01

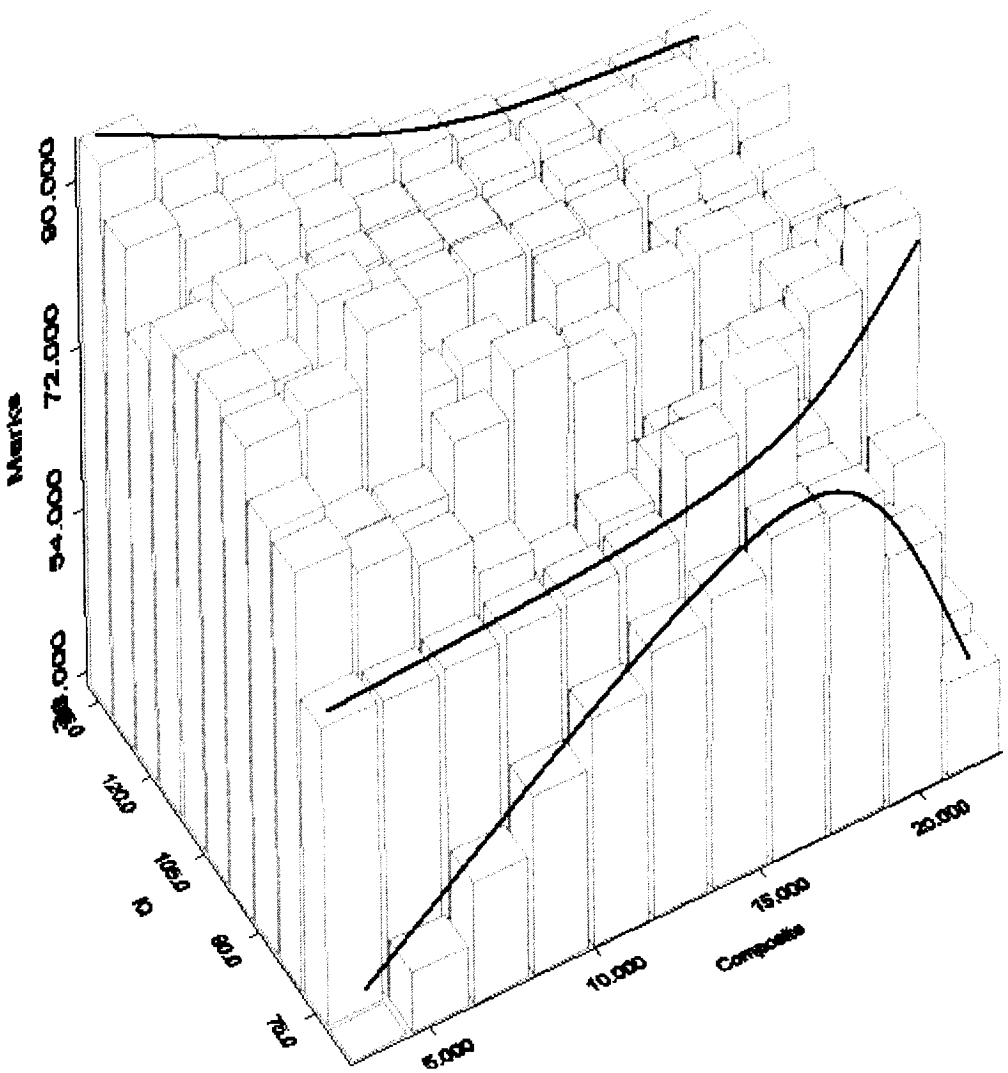


Figure 11. 3D plot of interaction of academic marks, the SREFI composite scores, and IQ.

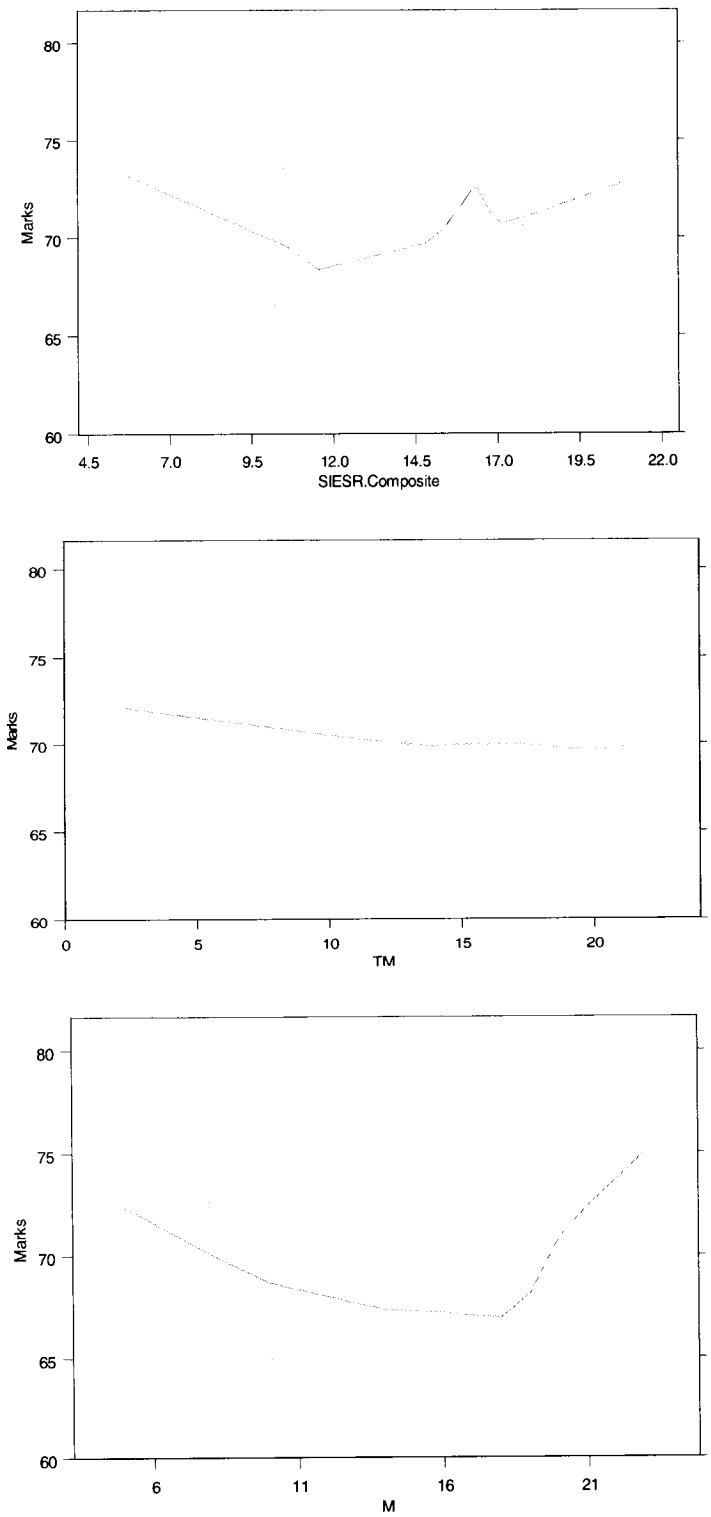


Figure 12. Scatterplots and smooth fit lines of marks and SREFI Composite, Time Management (TM), and Monitoring (M) Scores for students of below-average IQ.

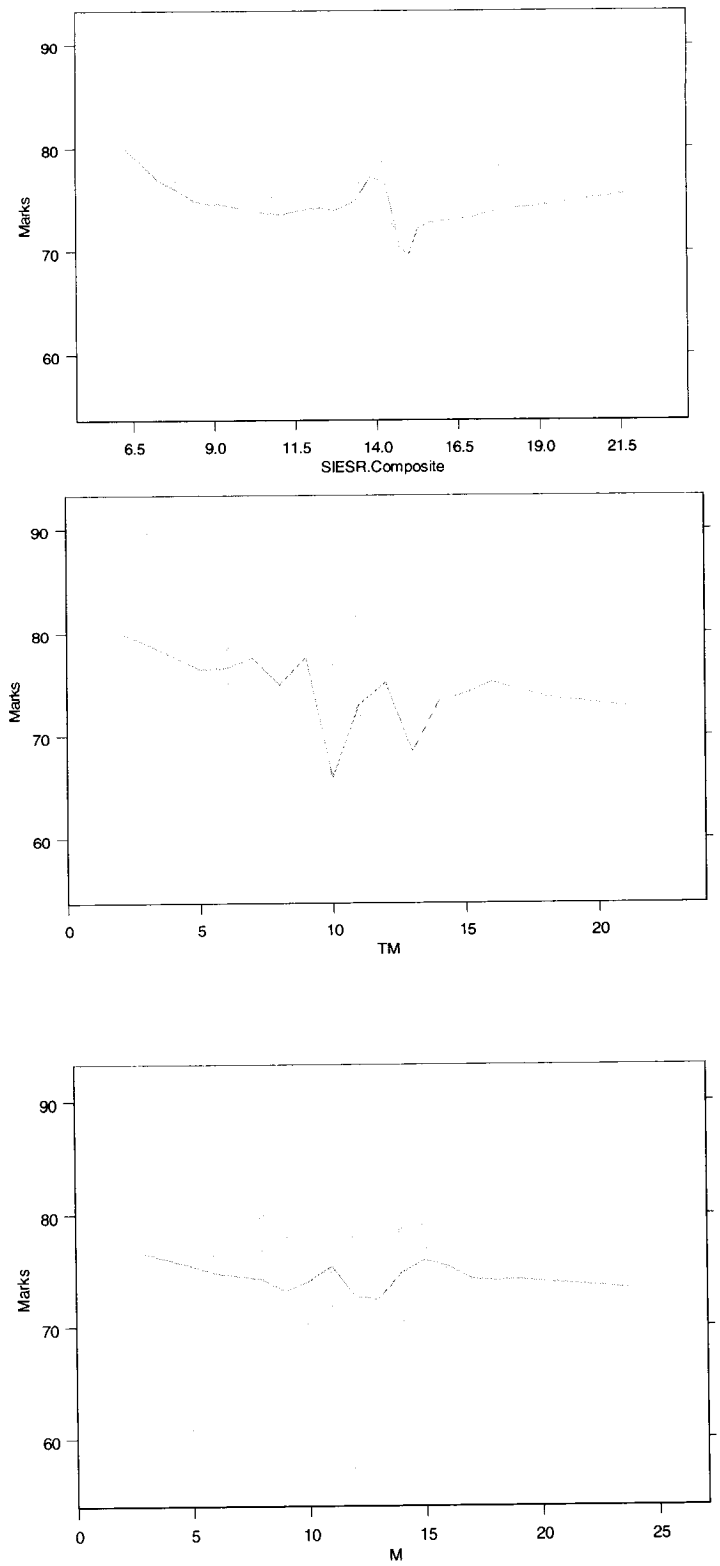


Figure 13. Scatterplots and smooth fit lines of marks and SREFI Composite, Time Management (TM), and Monitoring (M) scores for students of average IQ.

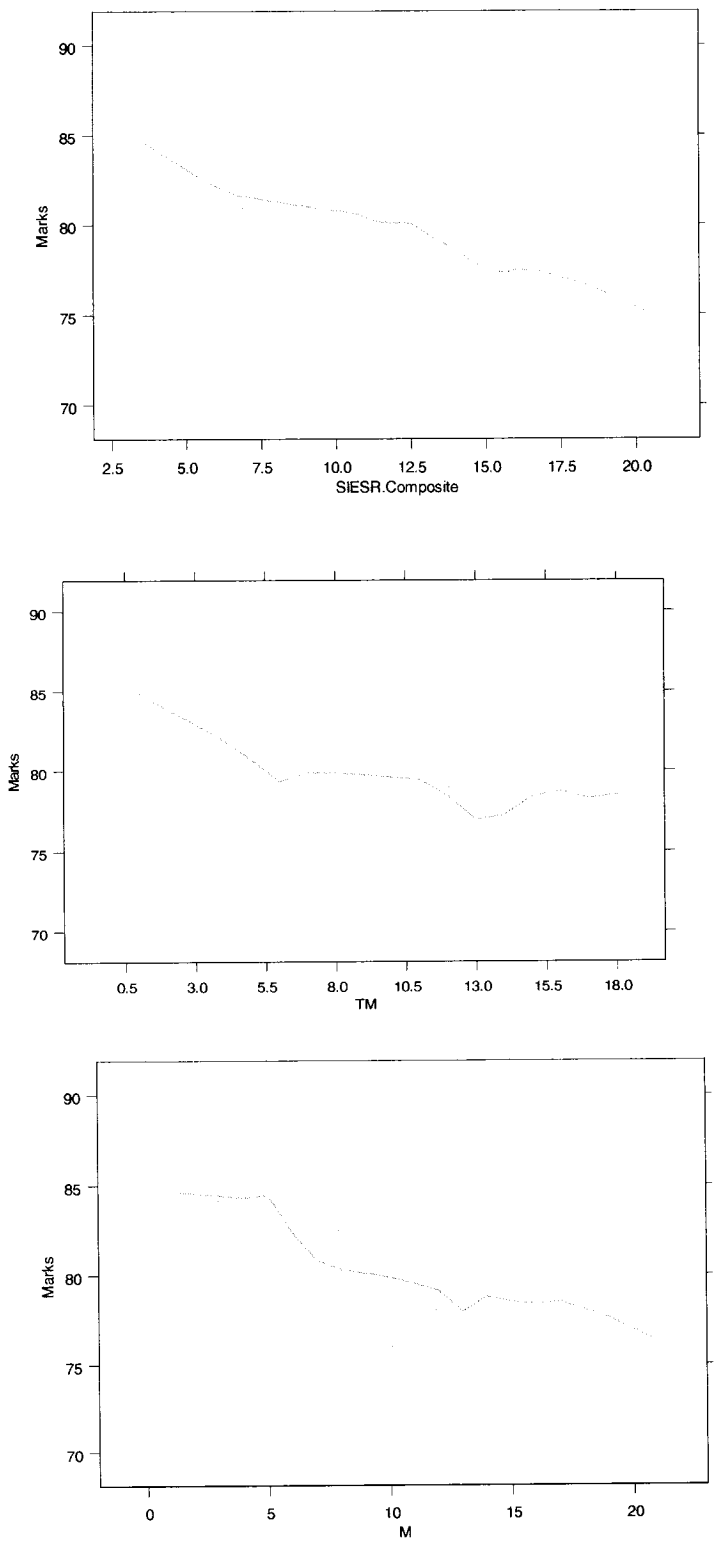


Figure 14. Scatterplots and smooth fit lines of marks and SREFI Composite, Time Management (TM), and Monitoring (M) Scores for students of above-average IQ.

H4: It was hypothesized that achievers, overachievers and underachievers would differ in self-ratings of executive self-regulation, as measured by the SREFI.

Achievers, Overachievers, and Underachievers were identified using regression formulas. Because the two schools that participated in the study differed in group means for level of intelligence, regression formulas were calculated separately for each of the schools. Individual academic marks in Math and Language Arts were predicted based on the students' scores on the Vocabulary and Matrix Reasoning scales of the WASI. Because there was a significant difference between the two WASI scales for School A, $F(1, 56) = 9.4$, $p < .01$, but not for School B, and the Cohen's d coefficients were large for both schools (d = 1.0 and d = .82 respectively), the FSIQ-2 scores were not used for the regression analysis. The model that was based on the two WASI scales for the prediction of marks had better fit indexes than the one that used the FSIQ-2 scores (e.g., *RSE* = 4.8 and *R2* = .34 for the model of predicting the Language Arts marks in School A from the two subtests scores versus the *RSE* = 5.1, *R2* = .27 for the model with the FSIQ-2 scores).

In addition to scores on the WASI scales, gender was also included in the regression formulas as an independent variable because of the significant gender difference in favor of girls in Language Arts marks, $F(1, 128) = 9.61$, $p = .002$. While gender did not significantly contribute to marks in Math, this variable was still included in the regression formulas for predicting marks in Math because the model with the gender variable had better fit indexes compared to the one that did not. The regression formulas used to calculate the predicted marks in Language Arts and Math were:

School A:

Language Arts Marks = 46.43+ .16 * Vocabulary + .32 * Matrices + 2.82*Gender (1)

(F = 8.95, df = 3, 53; p = .000; R^2 = .34, RSE = 4.89)

Math Marks = 43.34 +.22 * Vocabulary + .40 * Matrices + .9* Gender (2)

(F = 6.85, df = 3, 53; p = .000; R^2 = .23, RSE = 6.68)

School B:

Language Arts Marks = 48.35 + .22 * Vocabulary + .21 * Matrices + 2.54*Gender (3)

(F = 11.11, df = 3, 73; p = .000; R^2 = .31; RSE = 4.63)

Math Marks = 40.97 +.33 * Vocabulary + .32 * Matrices + .67*Gender (4)

(F = 8.09, df = 3, 73; p = .000; R^2 = .25; RSE = 7.18)

Students whose actual marks in both Language Arts and Math were within one standard deviation were labeled Achievers. Students who had marks below one standard deviation were labeled Underachievers, and students whose actual marks exceeded one standard deviation from the predicted scores were labeled Overachievers. Appendix D consists of a frequency distribution of different groups of achievers in both schools by academic subject and gender. The two schools had a different percent of students in each of the achievement groups. There were 18% underachievers at least in one of the academic subjects in School A, there were 12% in School B. For achievers, the difference was 64% in School A and 46% in School B. The largest difference was for overachievers: 18% in School A versus 42% in School B.

An ANOVA for the three achievement groups in Language Arts and Math revealed no significant differences in the Composite scores of the SREFI among the achievement groups. Analysis of the scores for each of the SREFI scales showed that achievement level did not significantly differ in any of the scales except Time Management, $F(1, 130) = 5.8$, $p = .017$. On that scale, achievers ($M = 12.1$, $SD = 4.5$) did not differ much (Cohen's $d = .09$) from underachievers ($M = 11.8$, $SD = 4.0$). However, achievers reported more problems with time management than did those who overachieved in both subjects ($M = 7.3$, $SD = 5.7$, $d = .93$) or in one subject ($M = 10.3$, $SD = 5.5$, $d = .35$).

Further comparison of overachievers in one versus both academic subjects revealed significant differences in their SREFI composite scores, $F(1, 37) = 5.04$, $p = .03$, but not in IQ scores, $F < 1$. Students who overachieved in both subjects had lower scores on the SREFI. Therefore, they reported better executive self-regulation than those who overachieved in only one subject despite the fact that both groups had the same level of IQ (Figure 15).

In contrast to overachievers, underachievers in one subject did not differ in their responses on the SREFI from underachievers in both subjects, $F < 1$. Students who underachieved in both subjects had lower IQs ($M = 99$, $SD = 6$) compared to students who underachieved in only one subject ($M = 105$, $SD = 5.2$). An ANOVA revealed that these groups did not significantly differ in IQ scores, $F < 1$. Cohen's d = 1.25 indicated, however, that with an increased sample size, the difference could be significant.

Therefore, the H:4 hypothesis that achievers, overachievers, and underachievers would differ in self-ratings of executive self-regulation, as measured by the SREFI, was only partially supported. Overachievers reported better time management compared to achievers and underachievers. Overachievers in both Language Arts and Math reported fewer problems with self-regulation compared to overachievers in only one subject. Underachievers did not differ from achievers on SREFI scores.

H5: It was hypothesized that student who reported fewer problems with self-regulated executive functions, as measured by the SREFI, would have better learning skills, as measured by teacher-rated learning skills from the OSR.

The descriptive data for teachers' estimations of learning skills are presented in Table 16. Analysis of Pearson correlation coefficients between teachers' estimations of learning skills and students' responses on the SREFI revealed significant negative correlations among most of the scales (see Table 17). Most correlation coefficients ranged from -.11 to -.31, which indicates that only up to 9% of the variance of students' reports of self-regulation were associated with their teacher-reported learning skills.

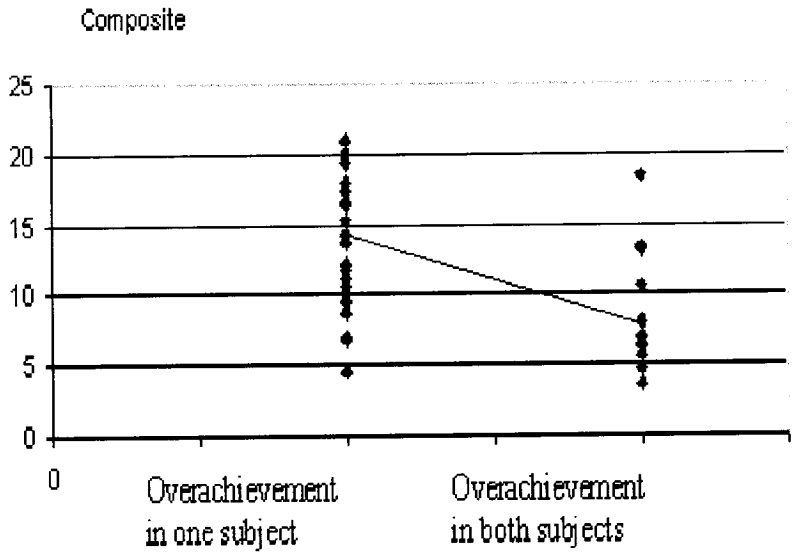


Figure 15. Scatterplot of SREFI Composite scores among overachievers.

The strongest realtion was found between the Time Management scale of the SREFI and the teacher-estimated Home Completion learning skill (r = -.51). This indicates that 25% of difficulties with completing homework may be accounted for by poor time management. The box-plot in Figure 16 demonstrates this relationship. In general, it was found that the Time Management scale was significantly negatively correlated with all the teacher-rated learning skills.

Regarding the contribution of learning skills to academic marks, linear regression analysis revealed that students' marks in Language Arts, $F(9, 162) = 19.8, p < .01, R^2 = .52$ (see Table 18) and Math, $F(9, 162) = 13.3, p < .01, R^2 = .42$ (see Table 19) could be predicted by a set of their teacher-rated learning skills estimates from their report cards. However, only three learning skills significantly contributed to predicting marks in Language Arts, namely Initiative (p = .04), Participation in Class (p = .01) and Use of Information (p = .01). In prediction of Math marks, two scales, Problem Solving (p = .01) and Goal Setting (p = .04), significantly contributed to the model.

In summary, the H5 hypothesis that there would be a significant negative relationship between student ratings of self-regulation, as measured by the SREFI, and teacher ratings of student learning skills from the Ontario Student Reports was supported. There were low to moderate negative correlations between most learning skills and cognitive components of self-regulation. The highest negative correlation was found between teacher-rated student homework completion and the student self-rating of time management.

H6: It was hypothesized that students who reported fewer problems with self-regulated executive functions on the SREFI would also report fewer problems with affective self-regulation on the AMP-Jr.

Analysis of the correlations between scales of the SREFI and AMP-Jr revealed that many scales were significantly correlated, except for the Cooperation, Planning, Initiative, and Team scales of the AMP-Jr (see Appendix E). The highest correlation coefficients were found between

Table 16

Means and Standard Deviations of the Teacher-Estimated Learning Skills

		IndW	Init	HCom	UseI	Coop	CRes	Partic	PSol	Goal
A	M	1.79	1.76	1.87	1.72	2.27	2.13	1.77	1.63	1.8
(n=90)	SD	1.15	1.05	1.07	0.9	0.76	0.72	1.02	0.92	1.05
B	M	1.93	2.16	2.1	2.04	2.18	2.15	1.67	1.94	1.99
(n=82)	SD	0.89	0.74	0.94	0.73	0.57	0.61	0.89	0.74	0.66
Total (n=172)	M	1.85	1.95	1.98	1.87	2.23	2.14	1.72	1.78	1.89
	SD	1.03	0.94	1.01	0.83	0.68	0.67	0.96	0.85	0.89

IndW - Independent Work; Init – Initiative; HCom - Homework Completion; UseI – Use of Information; Coop – Cooperation with Others; CRes – Conflict Resolution; Partic – Class Participation; PSol – Problem Solving; Goal – Goal Setting

Table 17

Pearson Correlation Coefficients for the SREFI Scales and Teacher-Estimated Learning Skills

SREFI Scales/ Learning Skills	G	SC	TM	P	M	I	W
Independent Work	-.13	-.16*	-.31**	-.18*	-.24**	-.22**	-.29**
Initiative	-.24**	-.18*	-.41**	-.25**	-.35**	-.29**	-.32**
Homework Completion	-.23**	-.33**	-.51**	-.31**	-.39**	-.27**	-.39**
Use of Information	-.21**	-.21**	-.29**	-.13	-.23**	-.20**	-.25**
Cooperation with Others	-.16*	-.20**	-.21**	-.14	-.11	-.21**	-.27**
Conflict Resolution	-.14	-.20**	-.23**	-.15*	-.12	-.21**	-.25**
Class Participation	-.12	-.06	-.21**	-.06	-.12	-.17*	-.15
Problem Solving	-.20**	-.24**	-.30**	-.20**	-.23**	-.22**	-.17*
Goal Setting to Improve Work	-.18*	-.21**	-.39**	-.28**	-.24**	-.24**	-.29**

* Correlation is significant at the .05 level (two-tailed)

** Correlation is significant at the .01 level (two-tailed)

G – Goal Setting; SC – Self-Control; TM – Time Management; P – Planning; M – Monitoring; WM – Working Memory

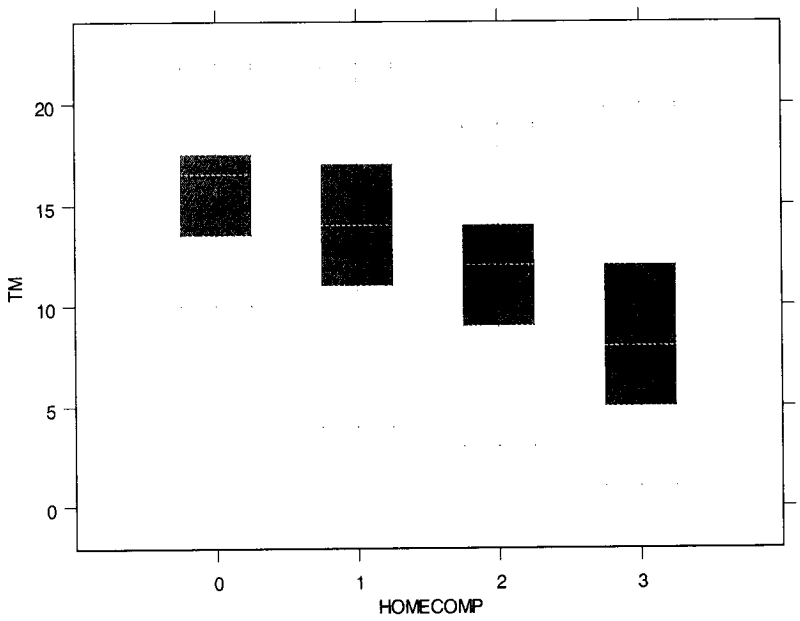


Figure 16. Box-plot of relation between the Homework Completion (HOMECOMP; 0 – does not complete homework, 3- excellent in completing homework) teacher-rated learning skills and the SREFI Time Management (TM) scale.

Table 18

Linear Regression Analysis of Marks in Language Arts Based on Teacher-Estimated Learning Skills

Learning Skills	B	Std. Error	Beta	t	p
(Constant)	64.43	1.17		54.97	<.01
Independent Work	0.54	0.53	0.1	1.02	.31
Initiative*	1.13	0.56	0.19	2.03	.04
Homework Completion	-0.13	0.48	-0.02	-0.28	.78
Use of Information*	1.61	0.62	0.24	2.59	.01
Cooperation	-1.11	0.74	-0.14	-1.5	.14
Conflict Resolution	0.61	0.77	0.07	0.79	.43
Participation*	0.99	0.37	0.17	2.69	.01
Problem Solving	0.71	0.59	0.11	1.2	.23
Goal Setting to Improve Work	0.96	0.55	0.15	1.74	.08

* significant at the p = .01 level

Table 19

Linear Regression analysis of Marks in Math based on Teacher-Estimated Learning Skills

	B	Std. Error	Beta	t	p
(Constant)	65.09	1.77		36.85	<.01
Independent Work	1.05	0.8	0.14	1.31	.19
Initiative	0.22	0.84	0.03	0.26	.80
Home Completion	0.75	0.72	0.1	1.04	.30
Use of Information	0.87	0.94	0.1	0.93	.35
Cooperation	-0.2	1.12	-0.02	-0.18	.86
Conflict	-0.45	1.17	-0.04	-0.38	.71
Participation	-0.08	0.56	-0.01	-0.14	.89
Problem Solving**	2.29	0.89	0.26	2.56	.01
Goal Setting to Improve Work*	1.7	0.84	0.2	2.03	.04

*significant at the p = .01 level

the Time Management scale of the SREFI and the Achievement and Motivation scales of the AMP-Jr (*r*s = -.64). The Motivation scale of the AMP-Jr was significantly and highly correlated with all scales of the SREFI. The association between the Motivation scale of the AMP-Jr and the Composite score of the SREFI was strong and negative (r = -.77, see Figure 17). In contrast, the Motivation score of the AMP-Jr was uncorrelated with IQ (r = .06).

Students with lower composite SREFI scores had higher levels of happiness (r = -.6), were more relaxed (r = -.67), self-confident (r = -.54), patient (r = -.44), assertive (r = -.42), and were interpersonally diplomatic (r = -.69), as measured with corresponding scales of the AMP-Jr. There was no significant correlation, however, between students' executive self-regulation and their levels of cooperativeness (r = -.05) or skills of working in teams (r = .02). In general, students who had higher motivation scores and lower scores on emotional problems reported good executive self-regulation. Therefore, the H6 hypothesis that there would be a significant negative relationship between student self-regulation scores, as measured by the SREFI, and student ratings of affective self-regulation, as measured by the AMP-Jr., was supported.

Interactive Models of Self-Regulation

The interactive model of the cognitive and affective components of the Forethought and Performance phases of self-regulation was analyzed with different models. In order to test the relationship between the cognitive and affective components of the two phases of self-regulation (Figure 18), scores on the Goal-Setting and Planning scales of the SREFI were operationally defined as representing the cognitive components of the Forethought phase, while the Initiative, Working Memory, Time Management, and Monitor scale scores of the SREFI represented the cognitive components of the Performance phase. The Achiever, Motivation, Competitiveness, and Goal Orientation scales of the AMP-Jr were used as affective components of the Forethought phase. In addition to the Self-Control scale of the SREFI, two scales of the AMP-Jr, Patience and Relaxed Style, were used to measure affective components of the Performance phase.

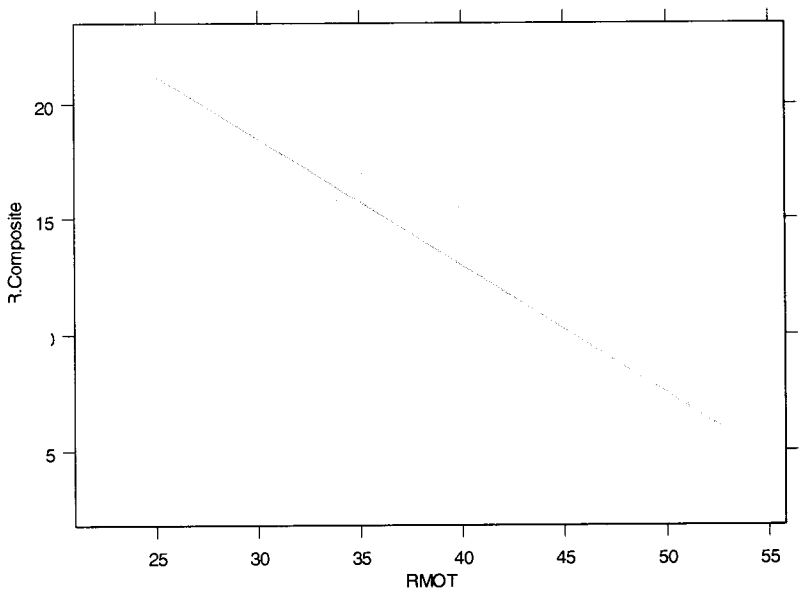


Figure 17. Scatter plot and the regression line of the interaction between the row scores on the Motivation scale (RMOT) of the AMP-Jr and the Composite score of the SREFI.

The data were analyzed using structural modeling. Analyses were conducted using the EQS statistical package (Raykov & Marcoulides, 2000). The estimation procedure used was maximum likelihood. The model (see Figure 18) was originally estimated by examining several overall fit indexes, including chi-square ($\chi 2$), degrees of freedom (*df*), and the comparative fit indexes (*CFI*; Hu & Bentler, 1995). It was found that the hypothesized model was close (p = .001), but not a good fit: $\chi 2 = 404.4$, $df = 112$, $CFI = .963$, $RMSEA = .096$.

The regression weights of the model and the covariances of the factors for the model are presented in Appendix F. Significant covariances were found between the cognitive components of self-regulation, $t = 7.1$, $p = <.01$, as well as affective components, $t = 4.3$, $p = < .01$, of the Forethought and Performance phases. While there was a significant covariance between the cognitive and affective components of the Performance phase of self-regulation (t = 2.3, p = .02), the covariance between the affective and cognitive components of the Forethought phase was not significant (t = .6, p = .5). Therefore, the analysis of covariances suggested that affective components play a role only in the Performance phase of self-regulation.

Attempts to create a model with a better fit were unsuccessful. The fit indexes were still high after some variables and connections that did not significantly contribute to the model were removed. Therefore, the analysis was shifted to creating models of predicting marks in different intelligence groups with regard to IQ, scores on the SREFI, AMP-Jr, and learning skills. The results of regression analyses of the models, in which dependent variables were Marks in both subjects, and independent variables were IQ, Composite scores of the SREFI, teacher-estimated learning skills, and AMP-Jr, are presented next for each of the IQ groups.

In the group of students with above-average IQ, the linear model was significant, $F(4, 22) = 2.88$, $p = .05$. None of the above independent variables, however, significantly contributed to prediction of marks for this group of students. In the group of students with average and below-average IQ, the models were also significant, $F(4, 137) = 16.67$, $p = .001$, and $F(4, 15) = 4.13$,

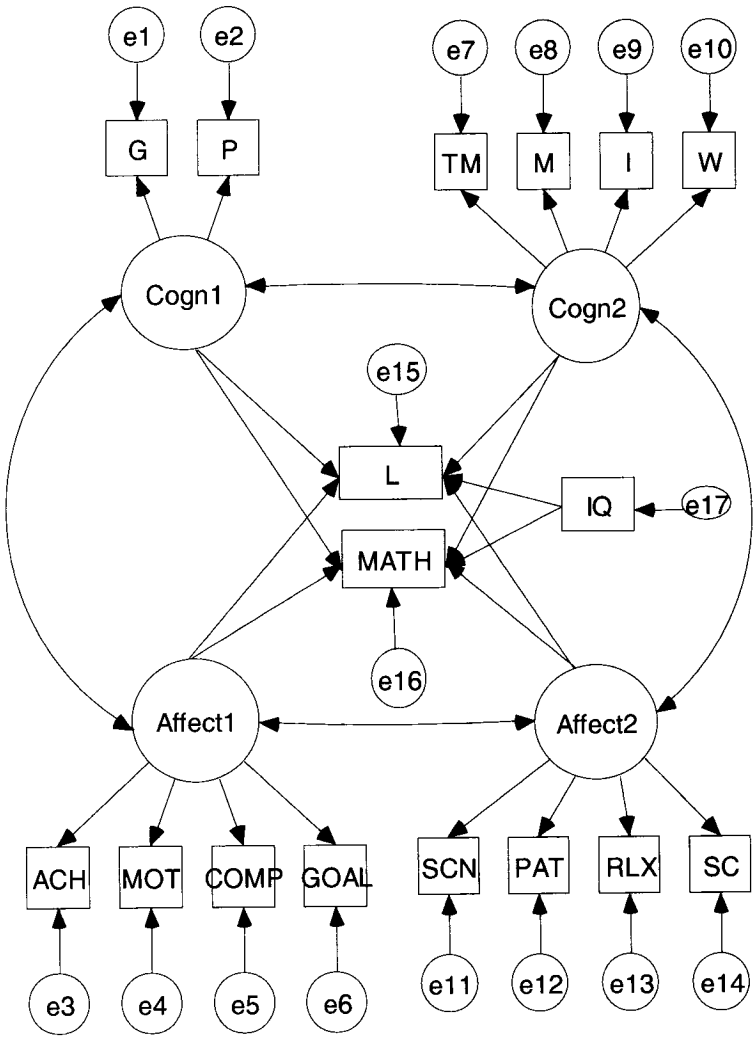


Figure 18. Model of cognitive and affective components of executive self-regulation.

Latent Factors:

Cogn1 - Cognitive components of the Forethought phase of self-regulation (Ellis & Eimmeman, 2001); Cogn2 – Cognitive components of the Performance phase of self-regulation; Affect1 -

Affective components of the Forethought phase of self-regulation; Affect2 - Affective components of the Performance phase of self-regulation

The SREFI scales: G – Goal Setting; SC – Self Control; TM – Tie Management; P – Planning; M – Monitoring; WM – Working Memory; SC – Self-Control

The AMP-Jr scales: ACH – Achievers; MOT – Motivation; COMP – Competitiveness; GOAL – Goal Orientation; SCN – Self-Confidence; PAT – Patience; RLX – Relaxed Style; L – Marks in Language Arts; MATH – Marks in Math; *e* – error of measurement

$p = .02$, respectively. Neither IQ score nor the SREFI and AMP-Jr composite scores contributed significantly to the prediction of marks for these groups. Teacher-estimated learning skills, however, played significant ($p < .05$) roles in prediction of marks for both IQ groups. In addition to learning skills, self-regulation, as measured with the SREFI Composite scores, also significantly contributed to the prediction of marks for the below-average IQ students. The more students of below-average IQ identified problems with self-regulation, the higher were their marks.

In summary, within each of the three intelligence groups level of IQ did not differentiate students' marks. For students of average and below-average IQ, teacher-estimated learning skills composite scores contributed significantly to the prediction of marks. The teacher-estimated learning skill that differentiated the students of average IQ from students of both the above-average (Cohen's $d = 1.17$) and below-average IQ groups (Cohen's $d = -.7$) was Initiative. Individual Work and Problem Solving (Cohen's ds = .8), and Goal Setting, Participation, Use of Information, and Homework Completion (Cohen's ds = .7) were teacher-estimated learning skills that differentiated students of average and below-average IQ.

Effect size indexes also differentiated the IQ groups in their scores on the SREFI. Cohen's ds were large for the Time Management scale (= -.94) and medium (= .7) for the Goal Setting, Monitoring, Initiative, and Working Memory scales for the students of average versus below-average IQ. Cohen's ds were small for all SREFI scales for students of average versus above-average IQ. The effect size indexes for the AMP-Jr scales among the IQ groups were small.

Chapter 4

Discussion

This chapter discusses the role of self-regulated executive functions in academic achievement, its interaction with intelligence, and the relation between students' reports of self-regulated executive functions and teacher-rated learning skills and affect, as measured with the AMP-Jr. Models of self-regulated executive functions will then be discussed, followed by the limitations of the study and proposals for future research.

Role of Self-Regulated Executive Functions in Academic Achievement

The current research employed the SREFI for the purpose of determining the extent to which students' ratings of their executive self-regulation were related to their academic achievement.

As predicted, the SREFI scales differentiated students of different academic performance. Students with high marks (above 80%) in Math reported good abilities in time management, monitoring, and initiative. In addition to these abilities, planning and goal setting were reported to be good for those students in Language Arts. There was a great deal of variability in reports of self-regulation among students with average and low-average marks (marks in the 60 to 80% range). Students with marks below 60% did not report many difficulties with self-regulation. Considering the hierarchical structure of self-regulated executive functions suggested in the literature, it is most likely that students who do poorly academically at school have delayed metacognition. Such students not only have difficulty in choosing, applying, and monitoring appropriate strategies that lead to achieving goals and plans, but they also have poor insight into, or awareness of, their lack of these strategies. This also suggests that subjective reports of good self-regulated executive functions are necessary but not sufficient for obtaining high academic marks. Differences in IQ between the high- and low-performance groups suggest that both intelligence and self-regulated executive functions are important to do well academically.

These results suggest that different strategies should be applied in developing self-regulated executive functions for students of different academic levels. Students who have adequate insight into and awareness of their difficulties in the area of self-regulated executive functions should get help in developing different ways of applying these strategies to academic routines. Students who do not have insight into their difficulties in this area should first get help in developing realistic knowledge about their own strengths and weaknesses. For example, students in a course for developing self-regulation provided at the University of Texas (Weinstein et al., 2000) first learn to recognize the different elements of self-regulation and then learn how to transfer and engage their knowledge of self-regulation in the academic setting.

Although in general students with better scores on cognitive self-regulation had higher academic marks, further statistical analysis revealed that academic marks in both Math and Language Arts moderately correlated with three out of seven scales of the SREFI, namely Time Management, Monitoring, and Initiative. The highest correlation was with the Time Management scale, which was the only SREFI scale that significantly contributed to the prediction of marks. It also had the highest correlation with IQ. Therefore, students' reports of whether they finished assignments, put off important things until the last minute, completed tasks on time, etc., served as good estimates of both their academic success and their measured intellectual abilities.

The important role of time management for academic achievement has been supported by other studies. For example, Cooper et al. (1999) found that higher test scores and class grades were associated with more time having been spent in extracurricular activities and other structured groups and less time spent in paid employment or television viewing. Extracurricular activities during high school were found to play a significant role in the prediction of students' achievement in college (Ting & Robinson, 1998).

Despite the fact that time management plays such a significant role in self-regulated academic achievement, most researchers who work in this area do not recognize it. For example,

time management is not included in any of the reviewed questionnaires that tap self-regulation or executive functions. Nevertheless, studies demonstrate that large action sets as opposed to short concrete actions might not be correctly executed if there are deficits in the ability to bridge cross-temporal contingencies from past, present, and/or future anticipations (Fuster, 1985). Several studies also connect time management to working memory (Gibbon, Church, & Meck, 1984; Treisman, Faulkner, Naish, & Brogan 1990; Zakay & Block, 1996) and to executive monitoring (Halbig, von Cramon, Schmid, Gall, & Friederici, 2002).

While a significant difference in responses on the SREFI was found between students with different levels of marks, the analysis revealed no significant differences in the Composite scores of the SREFI among the three achievement groups (underachievers, achievers, and overachievers) in either Language Arts or Math. Analysis of the scores for each of the SREFI scales showed that achievers reported more problems with time management than did overachievers, but did not differ much from underachievers in this regard. Overachievers in both subjects reported better self-regulated executive functions than did overachievers in only one subject, despite the fact that these groups did not differ in IQ.

The fact that there was a significant difference between students with different academic marks, but no significant difference between students of different achievement levels, suggested an interactive role of self-regulated executive functions and intelligence in academic achievement.

Interactive Role of Self-Regulated Executive Functions and Intelligence in Academic Achievement

The interactive relationship of IQs and self-regulation in academic performance was previously reported by Minnaert and Janssen (1999). They found a cubic relationship between intelligence and self-regulation: Low-intelligence students with high scores on regulatory activities tended to perform at the same level as high-intelligence students with low scores on regulatory performance. An interactive relationship between students of different intelligence

levels was also supported by the present findings. Underachieving students with above-average IQ reported many more problems compared to achievers of the same cognitive range. Overachieving students with above-average IQ who reported better self-regulated executive functions had better marks. Students of below-average IQ reported significantly more problems on the Goal Setting, Time Management, and Monitoring scales of the SREFI compared to students with average and above-average IQ. They also differed significantly from students with above-average IQ on the Initiative and Working Memory scales. These results support the independency model proposed by Veenman (1993). According to this model, metacognitive skills have a substantial cumulative value in addition to intelligence in explaining learning outcomes. Students of high intelligence perform much better if, in addition to their cognitive abilities, they reported high ability for self-regulation.

For overachievers of average and below average IQ, good self-regulation compensated for the intellectual abilities. This pattern fits more into the compensatory model (Veenman, 1993). According to the compensatory model, high metacognitive individuals outperform lower metacognitive individuals regardless of their overall aptitude, indicating that metacognitive skills can compensate for intelligence. In general, the findings supported both the independency and compensatory models, and were consistent with Minnaert and Janssen's (1999) conclusions.

Minnaert and Janssen's (1999) found a much lower correlation between IQ and academic marks than that observed in the current study. Specifically, intelligence explained 12% of academic marks in Minnaert and Janssen's (1999) study compared to 25% in the present study. This discrepency may be explained by the difference in age groups used in the studies (college freshmen vs. middle school students, respectively) and the fact that college samples are more homogeneous in IQ levels compared to secondary school samples. Taken together, the results from Minnaert and Janssen's and the present study are consistent with the literature on the role of intelligence in academic achievement: the correlation is normally much higher for children than for young adults (Burke, 1989; Grano, Kenny, & Campbell, 1972; McLaurin & Farrar,

1973; Poteat, Wuensch, & Gregg, 1988). This may well be explained by the observation that traditional measures of IQ tap cognitive skills important for success at the elementary school level, such as decoding, visual scanning, and expressive language, but do not measure abilities more relevant to success at the higher levels of education, such as planning and time management.

In general, the analyses of variance confirmed a significant relationship between students' IQs and responses on the SREFI scales. Five scales of the SREFI, namely Time Management, Working Memory, Initiative, Monitoring, and Goal-Setting, but not Planning and Self-Control, were significantly correlated with IQ level. The fact that the Planning scale of the SREFI was not significantly correlated with IQ was surprising and may be explained by high variability in the responses on this scale. Despite the lack of correlation between the SREFI Self-Control scale and IQ, Self-Control was the only SREFI scale that significantly differentiated between Average- and Above- Average Intelligence groups. Students with above-average IQ reported fewer problems on the Self-Control scale. The ability to control emotions and behavior is most likely related to the ability to inhibit irrelevant information and disengage from an interfering affect state. The Self-Control scale of the SREFI was moderately correlated with the Inhibition scale of the BRIEF completed by parents, which supports this idea.

Additional support comes from Moffitt's study (1993) on the adolescent onset of antisocial conduct problems, in which higher IQs were associated with a better prognosis among adolescents with Conduct Disorder. The author hypothesized that their better metacognitive skills provided opportunities for increased self-control and problem solving.

Comparison of SREFI responses among subgroups based on performance versus intelligence suggested different patterns. Students with above-average marks reported significantly better self-regulated executive functions than those with average and below-average marks, whereas students with above-average intelligence did not differ much from those with average IQ. Both these intelligence groups, however, reported significantly better self-regulated

executive functions than students with below-average IQ. In addition, high achievers among students with above-average intelligence and students with far below-average intelligence reported good self-regulated executive functions. As discussed earlier, it is most likely that achievers and overachievers with high intelligence have well developed self-regulation that they can apply in the academic setting, whereas students' of far below intelligence do not have well developed metacognition and, therefore, have poor insight into their difficulties. This suggestion, however, requires further study in the future.

Relationship between Learning Skills and Self-Regulated Executive Functions

The results of the current study support the hypothesis that there is a relationship between learning skills and self-regulation, as was suggested by Weinstein's Model of Strategic Learning (2000). Correlations between students' reports of self-regulation and teacher-rated learning skills were significant and varied from weak to moderate.

The highest correlation was found between the Time Management scale of the SREFI and the Homework Completion teacher-rated learning skill. Twenty-five percent of the variability in teacher-rated Homework Completion skill was accounted for by the student-rated time management skill. This result was predictable. Doing school work at home places an additional demand on self-regulatory abilities, and especially on time management. These results are consistent with Weinstein's (2000) emphasis on the role of time management and a systematic approach to learning as one of the most important factors of self-regulation in relationship to academic achievement.

In general, only three teacher-rated learning skills significantly contributed to the prediction of marks in Language Art, namely Initiative, Participation, and Use of Information. The teacher-rated skills that significantly contributed to the prediction of marks in Math were the Problem-Solving and Goal-Setting scales. The teacher-rated Homework Completion skill did not contribute significantly to the prediction of marks. In contrast, the student-rated Time Management ability was the only scale of the SREFI that significantly predicted marks. This

result confirms the notion that completing homework requires good time management, but not all students who complete homework obtain good marks. Someone may put forth effort in completing homework but not necessary have the required intelligence to do well at school.

Relationship between Self-Regulated Executive Functions and Affect in Academic Achievement

The present study confirmed the hypothesis that students with higher levels of self-regulation, as measured by the SREFI, had fewer personality problems and were generally more positive emotionally, as measured by the AMP-Jr, compared to students who reported problems with self-regulation. Moderate to high correlations were found among students' reported affect (e.g., happiness; relaxation) and self-regulation. These results confirmed the interaction between cognitive and affective aspects of self-regulated executive functions (Matthew et al., 2000; Wells & Matthews, 1996; Zimmerman, 2000).

There was no correlation, however, between students' composite scores of executive self-regulation and their levels of cooperativeness and teamwork, as measured by the AMP-Jr. This result can be explained by that fact that the SREFI did not consist of scales that were normally associated with behavioral problems, namely inhibition and the ability to shift.

Scores on the Time Management scale of the SREFI were strongly correlated with students' perceptions of their level of achievement and level of motivation, as measured with the AMP-Jr. Forty-one percent of the variability on Time Management was accounted for by the Achiever and Motivation scales of the AMP-Jr. The Achiever scale contains items that tap academic achievement, attitude toward school, and work habits. The scale consists of statements such as "I learn quickly in school," "I take on new responsibilities, I follow through and complete them," and "My grades in school reflect my abilities." The Motivation scale measures a student's need to achieve and motivation to succeed. The Motivation scale's items evaluate energy level, optimism, effort, and degree of follow-through. An excessively low score may reflect an absence of the need to achieve or it may reflect a student's resignation about the lack of past achievement. An excessively high score may reflect a student who has exaggerated goals

or achievement needs. In the present study, the Motivation scale of the AMP-Jr. was significantly correlated with all scales of the SREFI, and contributed 59% of the variability on the Composite score of the SREFI. In contrast, it accounted for only 3% of the variability in IQ. This result further supports Weinstein's (2000) Model of Strategic Learning, in which the Self-Regulation factor, which includes time management, was interconnected with the Will factor, which includes variables such as Motivation for Achievement, Affect Toward Learning, and Beliefs.

Significant covariances were found between the cognitive and affective factors of the Performance phase of Ellis and Zimmerman's model (2001), but not with the affective factors of the Forethought phase of self-regulation. This result supports Ellis and Zimmerman's suggestion that affective factors play a more significant role during the phases of working on tasks and monitoring, rather than during the period of goal-setting and planning. The model, however, could not be tested fully due to the relatively small sample and high number of variables involved in the model.

Implications of the Findings for Educators and Parents

The ultimate goal of the current study was to contribute to the growing base of knowledge, strategies and techniques that both educators and parents can use to enhance the learning, development, success, and quality of life for both individuals and society in general. Efforts in the service of this goal have been predominantly focused on the prevention of learning difficulties and underachievement by developing knowledge about important variables in the early years, both at the preschool and primary levels.

Most remediation efforts have been focused on learning problems of students at the junior level, in Grades 4 to 6. Much less work has been done on students who have done well academically up to the middle school, secondary school, or postgraduate levels of education, but whose performance then declines rapidly, resulting in either failure or dropout.

The results of the current study suggest that the most important strategy for both educators and parents is to assess a student's ongoing development of self-regulated executive functioning and develop and implement strategies to enhance very important aspects of development. The literature suggests that modeling of self-regulation by parents, teachers, coaches, and other important adults in a child's life facilitates the development of self-regulation. Parents may find that explaining to their children how they manage time and organize their lives may be very helpful. The teaching of learning skills in general, and self-regulated executive functions, especially time management, should be addressed at school.

Regarding the assessment of executive functioning, these results should encourage school psychologists to include formal measures as well as observations of executive functioning in their regular test batteries that usually include traditional tests of cognitive ability and the acquisition of basic academic skills. Asking parents to complete the BRIEF and the student to complete the newly published BRIEF self-report (Guy, Isquith, & Gioia, 2004) might be a good step in this direction. Educational assessors should also place more emphasis on evaluating the development of learning skills.

Limitations of the Study

The relatively small sample of students (N = 172) involved in the current study was a limitation. This factor did not allow for the examination of patterns of interactive relationships among cognitive, emotional, and skills factors across different achievement groups.

Another limitation of the current study was the use of heterogeneous samples of students due to demographic difference between the two schools that participated in the study. It was found that School B had significantly higher scores on both scales of the WASI as well as on general IQ levels, on marks in Language Arts, but not in Math, and two of the nine teacher-rated students' learning skills, namely Initiative and Problem Solving. The relatively low effect size indexes for the scales of the WASI, SREFI, teacher-rated learning skills, and marks in Language

Arts and Math indicated that with increased sample size the difference between the two schools may not be significant.

The impact of socio-economic factors was not explored in the study. Differences in responses between the two schools, which are located in different cultural and socioeconomic areas, suggested that these latter factors might affect self-regulation. Significant differences between the two schools were found on the Goal Setting, Time Management, Monitoring, and Initiative scales of the SREFI, but not on the Working Memory, Planning, and Self-Control scales.

Although analysis of the demographic data was not a primary focus of the current study, the above results were consistent with other studies. According to Zimmerman (2000), youth often form standards for self-evaluative judgment on the basis of instruction, social feedback, and modeling from peers, parents, teachers, and coaches. Zimmerman supported this observation with research showing that child prodigies often come from families where successful parents, siblings, or relatives model high standards of performance and self-judgment.

Jimerson, Egeland, and Teo (1999) found that the quality of the home environment, socioeconomic status, and parental involvement in a child's education in Grades 1-6 improved academic achievement across time. Asian-American adolescents who took more units of academic study during high school tended to have parents with a higher level of educational attainment (House, 1997). Steinberg, Dornbush, and Brown (1993) found that students of different ethnicities benefit from different combinations of familial values about education and youngsters' beliefs about the occupational rewards of academic success. For example, white youngsters benefited from the combination of authoritative parenting and peer support, whereas for Asian-American students peer support for academic excellence offset the negative consequences of authoritarian parenting. Further research should be done to investigate the role of cultural and social class differences, parental involvement and education level, language at

home, and other socioeconomic factors that may play a significant role in children's development of self-regulation in relation to academic achievement.

Of course it is important to use direct measures to compare self-reports and more objective data. However, the use of the D-KEFS was time consuming to administer and did not have composite scores that would facilitate analysis of data. It is hoped that the current dearth of direct measures of executive self-regulation components will encourage test developers to find creative ways to directly assess these most important functions.

Suggestions for Future Research

The results of the study have importance for both scientific research and educational practice. Below are some issues that scientists in the field should consider in future theory and research.

1. Theoretical framework: There is a need for a theoretical framework of constructs related to executive self-regulation. Overlapping constructs, such as executive functions, metacognition, and self-regulation should be clarified in relationship to self-regulated achievement.

2. Models of self-regulation: There is a need for more refined and detailed models of executive self-regulation. In this regard, the role of more biological factors, such as intelligence and personality, as well as environmental factors, such as culture, family values, social-economic class, and approaches in skills training should be further analyzed.

3. The interactive role of intelligence and executive self-regulation and, perhaps, its developmental trends, should be further investigated. These interactions and trends should be further analyzed, and, if supported, applied to specific recommendations for teachers.

4. Emotional and cognitive factors: There is a need for further examination of the relationship between emotional and cognitive factors in executive self-regulation. Recent theoretical and empirical work to differentiate executive functions as "hot" and "cold," or affective and cognitive constructs has been a good start in this regard. Several new measures

have been proposed, but none has been used to investigate the role of affective and cognitive factors in self-regulation of academic achievement.

5. Acquisition and development of self-regulation: There is a need for research that examines the process of acquisition and refinement of self-regulatory processes in general, and more specifically, of the relation between self-regulation and academic achievement.

6. Time management: Although time management seems to be crucial in executive self-regulation of middle school students, this area has been neglected in the field. Clarifying processes and constructs of time management in relation to executive self-regulation is, therefore, important. In this regard, it will be fruitful to address concepts such as prospective memory, inner clock, synchronizing different cognitive processes and activities, and time estimation.

7. The measurement of self-regulation: There is a need for improvement of existing measures of self-regulation as well as the development of new measures of specific constructs of executive self-regulation, screening tools, and questionnaires for children of different developmental stages.

8. Applications for individual and group training of self-regulation: There is a need to develop a range of individual and group or classroom approaches in the training of executive self-regulation. Early evaluation of students' self-regulatory repertoire should be systematic and self-evident in order to identify students at risk, on the one hand, and to provide adequate advice toward the development of a more effective and productive repertoire, on the other hand. Teachers should be alert to students' levels of self-regulation and modify their instructional strategies.

It is hoped that this study addresses the needs in the field to develop broad and integrative perspectives on the development of executive self-regulation in relation to academic achievement. The conceptual and methodological picture is far from complete, and many avenues await further theoretical and empirical exploration.

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Appendix A

Student Self-Regulated Executive Functions Inventory by I.Valentin, M.A.

Your Name: _____

Your date of birth (mm/dd/yy): _____

Your gender: male female (check one)

Here is a list of things that happen to people and that people think or feel. Read each sentence carefully, and circle the one word (Never, Sometimes, Often, or Always) that tells about you best. There are no right or wrong answers.

#	Statement	Please circle one of these			
1	I know the areas in which I need improvement	Never	Sometimes	Often	Always
2	When I become angry or disappointed, I cannot concentrate on doing anything for a long time	Never	Sometimes	Often	Always
3	I do not put off working on assignments	Never	Sometimes	Often	Always
4	I take on more responsibility at home without being asked	Never	Sometimes	Often	Always
5	I work harder at subjects that are difficult for me	Never	Sometimes	Often	Always
6	I carry out my plans	Never	Sometimes	Often	Always
7	It is difficult for me to take turns	Never	Sometimes	Often	Always
8	When given three things, I remember only the first or last one	Never	Sometimes	Often	Always
9	Mostly I follow my daily routines without supervision (e.g., get up in the morning, do my homework, etc.)	Never	Sometimes	Often	Always
10	It is easy for me to join an extra-curricular activity	Never	Sometimes	Often	Always
11	Others can easily interrupt my studying (e.g., by calling on the phone; talking to me, etc.)	Never	Sometimes	Often	Always
12	I do not set a time line for my goals	Never	Sometimes	Often	Always
13	I ask for clarification and help when needed	Never	Sometimes	Often	Always
14	Usually it is my parents who know what I have to do	Never	Sometimes	Often	Always

15	I take home and return needed materials (e.g., text books, reading materials)	Never	Sometimes	Often	Always
16	I have my own study schedule	Never	Sometimes	Often	Always
17	I revise goals or steps and strategies when necessary	Never	Sometimes	Often	Always
18	I forget what I was doing	Never	Sometimes	Often	Always
19	I help others without being asked	Never	Sometimes	Often	Always
20	I start a task without thinking much about what the task involves	Never	Sometimes	Often	Always
21	I put off important things until the last minute	Never	Sometimes	Often	Always
22	I care about getting finding out how well I did on my work	Never	Sometimes	Often	Always
23	My goals are vague and confused	Never	Sometimes	Often	Always
24	I'm usually patient when there are differences between me and my classmates or brothers or sisters	Never	Sometimes	Often	Always
25	I need somebody to remind me what I have to do	Never	Sometimes	Often	Always
26	I arrange to work on what is important first	Never	Sometimes	Often	Always
27	I get mad when someone doesn't agree with me	Never	Sometimes	Often	Always
28	I have a regular time for planning what I have to do	Never	Sometimes	Often	Always
29	A job at home with many parts is difficult for me	Never	Sometimes	Often	Always
30	When I make mistakes I see them and correct them	Never	Sometimes	Often	Always
31	I am easy about trying a new sport or activity	Never	Sometimes	Often	Always
32	I decide ahead of time when I will do the steps of my projects	Never	Sometimes	Often	Always
33	I am on time for meals and activities	Never	Sometimes	Often	Always
34	When I change from one thing to another I forget about the first one	Never	Sometimes	Often	Always
35	I keep going until I finish assignments and projects	Never	Sometimes	Often	Always
36	I do not regularly check my agenda for homework	Never	Sometimes	Often	Always
37	I like finding additional and new information from library	Never	Sometimes	Often	Always

	books, the Internet, and other resources				
38	If my parents say no when I want to do something, I get angry and argue with them	Never	Sometimes	Often	Always
39	When I plan my goals I also plan actions to reach my goals	Never	Sometimes	Often	Always
40	I check my work for mistakes	Never	Sometimes	Often	Always
41	I have difficulty when school projects have many parts	Never	Sometimes	Often	Always
42	When my teacher gives an assignment that I don't like, I don't do it	Never	Sometimes	Often	Always
43	I complete my jobs at home on time and without reminders	Never	Sometimes	Often	Always
44	I have a hard time listening to others	Never	Sometimes	Often	Always
45	I know what the deadlines are for my assignments	Never	Sometimes	Often	Always
46	I am on time for school and each class	Never	Sometimes	Often	Always
47	I avoid working on complicated and difficult tasks	Never	Sometimes	Often	Always
48	I break down my projects or goals into small, easier steps	Never	Sometimes	Often	Always
49	I get upset when I have to change my plans	Never	Sometimes	Often	Always
50	I think about how my actions now will affect my future	Never	Sometimes	Often	Always
51	I usually work without supervision	Never	Sometimes	Often	Always
52	I review my work and check off all completed tasks	Never	Sometimes	Often	Always
53	I often complain about a problem rather than solve it	Never	Sometimes	Often	Always
54	I do not get my assignments done ahead of time	Never	Sometimes	Often	Always
55	I have difficulty staying with a task until completion (e.g., cleaning a desk when work is done; completing all steps in cleaning my room)	Never	Sometimes	Often	Always
56	Figuring out in my head is difficult for me	Never	Sometimes	Often	Always
57	I discuss my goals with others	Never	Sometimes	Often	Always
58	I record all homework assignments and test dates carefully	Never	Sometimes	Often	Always
59	I am usually wrong in estimating the time needed to finish my	Never	Sometimes	Often	Always

	assignments				
60	I understand what I read without rereading it	Never	Sometimes	Often	Always
61	I consider my strengths and weaknesses while working on something	Never	Sometimes	Often	Always
62	I have difficulty starting a task or activity (e.g., doing chores or assignments)	Never	Sometimes	Often	Always
63	When I decide to do something, I develop my "plan of action"	Never	Sometimes	Often	Always
64	I complete tasks and assignments on time and with care	Never	Sometimes	Often	Always
65	I am good at monitoring my tasks or activities	Never	Sometimes	Often	Always
66	I am good in goal setting	Never	Sometimes	Often	Always
67	I don't give up when things go wrong	Never	Sometimes	Often	Always
68	I allow myself time to study before tests or quizzes	Never	Sometimes	Often	Always
69	I use my planner to organize time effectively	Never	Sometimes	Often	Always
70	I have difficulty starting a task or activity on my own, without having others remind or motivate me	Never	Sometimes	Often	Always
71	I have good self-control	Never	Sometimes	Often	Always
72	It is very difficult for me to work on long-term assignments or projects	Never	Sometimes	Often	Always
73	I have long-term goals	Never	Sometimes	Often	Always
74	I am good in starting things on my own	Never	Sometimes	Often	Always
75	I schedule my days	Never	Sometimes	Often	Always
76	I usually set goals for the whole week	Never	Sometimes	Often	Always
77	I am easily distracted while studying	Never	Sometimes	Often	Always
78	I have good memory	Never	Sometimes	Often	Always
79	When I don't understand something I look for help	Never	Sometimes	Often	Always
80	My goals are realistic	Never	Sometimes	Often	Always
81	I have a hard time letting others finish speaking before I reply	Never	Sometimes	Often	Always

82	I am good in time management	Never	Sometimes	Often	Always
83	I remember what others have asked me to do	Never	Sometimes	Often	Always
84	I am good in planning	Never	Sometimes	Often	Always

Appendix B

Scales of the Self-Regulated Executive Functions Inventory (SREFI)

# in SREFI	# in the subscale	Statements
1. Goal Setting		
23	1	My goals are vague and confused
12	2	I do not set a time line for my goals
17	3	I revise goals or steps and strategies when necessary
14	4	Usually it is my parents who know what I have to do
45	5	I know what the deadlines are for my assignments
50	6	I think about how my actions now will affect my future
73	7	I have long-term goals
76	8	I usually set goals for the whole week
1	9	I know the areas in which I need improvement
57	10	I discuss my goals with others
80	11	My goals are realistic
66	12	I am good in goal setting
2. Self-control		
38	1	If my parents say no when I want to do something, I get angry and argue with them
2	2	When I become angry or disappointed, I cannot concentrate on doing anything for long time
42	3	When my teacher gives an assignment that I don't like, I don't do it
44	4	I have a hard time listening to others
81	5	I have a hard time letting others finish speaking before I reply

27	6	I get mad when someone doesn't agree with me
24	7	I'm usually patient when there are differences between me and my classmates or brothers or sisters
7	8	It is difficult for me to take turns
11	9	Others can easily interrupt my studying (e.g., by calling on the phone, talking to me, etc.)
67	10	I don't give up when things go wrong
77	11	I am easily distracted while studying
71	12	I have good self-control

3. Time management

21	1	I put off important things until the last minute
36	2	I do not regularly check my agenda for homework
46	3	I am on time for school and each class
59	4	I am usually wrong in estimating the time needed to finish my assignments
54	5	I do not get my assignments done ahead of time
33	6	I am on time for meals and activities
64	7	I complete tasks and assignments on time and with care
9	8	Mostly I follow my daily routines without supervision (e.g., I get up in the morning; I do my homework, etc.)
3	9	I do not put off working on assignments
68	10	I allow myself time to study before tests or quizzes
72	11	It is very difficult for me to work on long-term assignments or projects
82	12	I am good in time management

4. Planning

28	1	I have a regular time for planning what I have to do
39	2	When I plan my goals I also plan actions to reach my goals
48	3	I break down my projects or goals into small, easier steps
20	4	I start a task without thinking much about what the task involves
32	5	I decide ahead when I will do the steps of my projects
26	6	I arrange to work on what is important first
58	7	I record all homework assignments and test dates carefully
16	8	I have my own study schedule
63	9	When I decide to do something I develop my "plan of action"
69	10	I use my planner to organize time effectively
75	11	I schedule my days
84	12	I am good in planning

5. Monitor

22	1	I care about getting finding out how well I did on my work
52	2	I review my work and check off all completed tasks
13	3	I ask for clarification and help when needed
15	4	I take home and return needed materials (e.g., text books, reading materials)
35	5	I keep going until I finish assignments and projects
6	6	I carry out my plans
5	7	I work harder at subjects that are difficult for me
40	8	I check my work for mistakes
30	9	When I make mistakes I see them and correct them
55	10	I have difficulty staying with a task until completion (e.g., cleaning a desk when work is done; completing all steps in cleaning my room)

61	11	I consider my strengths and weaknesses while working on something
65	12	I am good at monitoring my tasks or activities

6. Initiative

53	1	I ask for help when needed
31	2	I am easy about trying a new sport or activity
4	3	I take on more responsibility at home without being asked
10	4	It is easy for me to join an extra-curricular activity
43	5	I complete my jobs at home on time and without reminders
51	6	I usually work without supervision
19	7	I help others without being asked
37	8	I like finding additional and new information from library books, the Internet, and other resources
62	9	I have difficulty starting a task or activity (e.g., doing chores or assignments)
70	10	I have difficulty starting a task or activity on my own, without having others remind or motivate me
79	11	When I don't understand something I look for help
74	12	I am good in starting things on my own

7. Working Memory

8	1	When given three things I remember only the first or last one
29	2	A job at home with many parts is difficult for me
18	3	I forget what I was doing
41	4	I have difficulty when school projects have many parts
25	5	I need somebody to remind me what I have to do
47	6	I avoid working on complicated and difficult tasks
34	7	When I change from one thing to another I forget about the first one

49	8	I get upset when I have to change my plans
56	9	Figuring out in my head is difficult for me
60	10	I understand what I read without rereading it
83	11	I remember what others have asked me to do
78	12	I have good memory

Appendix C

Parent and Student Consent

Stage 1 of the Research

Institute of Achievement and Motivation

York University

Date

Dear parent(s),

My name is Irina Valentin, M.A. I am a doctoral student in psychology from York University, supervised by Dr. Harvey Mandel. For my doctoral research, I will examine how ability to plan and organize materials contributes to academic achievement.

Has this research been approved?

Yes. The York Region District School Board, at the recommendation of its Research Review Committee and your principal have given permission for this study to be carried out in your son's/daughter's school. The study has also received ethical approval from York University.

How will you/my child be involved in the study?

- If your child agrees to participate in the study, please make sure that he or she also signs the form at the end of the letter.
- Students who return the consent form will then be tested with short test of vocabulary and nonverbal reasoning individually during school hours for less than 15 minutes.
- In addition, you/your child will complete the Self-Report Inventory of Executive Functions in class with other participating students during school hours. Administration of this inventory will take approximately 20 minutes per class.

☐ Yes, I consent to my child's participation in the study

☐ No, I do not consent to my child's participation in the study

Parent name (please print): _____ Parent signature_____

Date_____

☐ Yes, I consent to my participation in the study

☐ No, I do not consent to my participation in the study

Student name: (please print): _____ Student signature_____

Home Room #_____ Date_____

Parent and Student Consent

Stage 2 of the Research

Institute of Achievement and Motivation

York University

Date

Dear parent(s),

You have agreed earlier your child participate in my study on how ability to plan and organize materials contributes to academic achievement. I appreciated this. As a result of the assessment completed and discrepancy analysis between your child's grades and abilities we selected your child for the second stage of the research. This stage requires additional testing.

- You will be asked to complete the Behavior Rating Inventory of Executive Function (BRIEF) at home. The BRIEF has been developed to assess students' abilities to plan, organize, and follow through on goals. It is an 86-item questionnaire that takes 10-15 minutes to complete. This questionnaire will be sent home with the students with instructions to return completed forms to the school office.
- Your child will be administered the Delis – Kaplan Executive Function System (D-KEFS) The D-KEFS tests 8 skills, including the ability to organize and plan. This test will be administered by me on an individual basis at school during school hours. The testing will take approximately 2 hours. The child will not be taken from class during subjects that are very important for your child to attend from teacher's point of view or the child will not want to miss that class.
- If you and your child agree to participate please sign the form at the second page of the letter and return that page with your child to his/her teacher.

Appendix D

Frequency Distribution of Achievement Groups

Type of Achievement	Girls	Boys	Total
School A (n = 56):			
Underachievers (at least in one of the subjects):	4	6	10
In both subjects	2	3	5
Only in Language Arts	1	2	3
Only in Math	1	1	2
Achievers	18	18	36
Overachievers (at least in one of the subjects):	6	4	10
In both subjects	0	2	2
Only in Language Arts	4	1	5
Only in Math	2	1	3
School B (n = 78):			
Underachievers (at least in one of the subjects):	6	7	13
In both subjects	1	1	2
Only in Language Arts	1	2	3
Only in Math	4	4	8
Achievers	19	15	34
Overachievers (at least in one of the subjects)	15	16	31
In both subjects	5	4	9
Only in Language Arts	6	9	15
Only in Math	4	3	7

Appendix E

Person Correlation Coefficients between the SREFI and AM-Jr scales (n = 79); (Underlined coefficients were not significant at the p=.05)

SREFI/ AMP-Jr	Self-Enhancing	Self-Critical	Achiever	Motivation	Competitiveness	Goal Orientation	Relaxed Style	Happiness	Patience	Self-Confidence	Assertiveness	Diplomacy	Extroversion	Cooperativeness	Organization	Initiative	Team Player
Goal Setting	-.4	.34	-.44	-.6	-.57	-.61	-.5	-.48	-.22	-.42	-.46	-.53	-.52	-.04	.16	.12	-.04
Self-Control	-.33	.35	-.38	-.42	-.35	-.36	-.46	-.33	-.5	-.37	-.17	-.47	-.25	-.02	.01	-.03	-.04
Time Management	-.44	.41	-.64	-.64	-.53	-.56	-.52	-.51	-.3	-.36	-.21	-.51	-.37	-.09	.09	.21	.04
Planning	-.33	.36	-.5	-.58	-.44	-.51	-.41	-.36	-.27	-.24	-.24	-.48	-.35	-.07	.12	.17	.09
Monitoring	-.45	.36	-.57	-.61	-.45	-.5	-.41	-.42	-.37	-.37	-.34	-.53	-.44	.02	.15	.22	.14
Initiative	-.52	.3	-.57	-.61	-.63	-.57	-.51	-.45	-.28	-.41	-.52	-.58	-.57	-.1	.28	.27	.1
Working Memory	-.41	.38	-.54	-.64	-.45	-.6	-.59	-.56	-.32	-.5	-.23	-.53	-.38	-.1	.07	.16	.02

Appendix F

Regression Weights and the Covariances of the Model of Self-Regulation

The SREFI and AMP-Jr Scales	Factors (Phase/Components) and Variables		Estimate	Standard Error	t	p
Goal Setting	Forethought/	Cognitive		1		
Planning	Forethought/	Cognitive	0.101	1.217	12.03	<.01
Goal Orientation	Forethought/	Affective		1		
Competitiveness	Forethought/	Affective	0.116	0.722	6.244	<.01
Motivation	Forethought/	Affective	0.103	1.104	10.733	<.01
Achiever	Forethought/	Affective	0.103	0.974	9.472	<.01
Time Management	Performance/	Cognitive		1		
Monitoring	Performance/	Cognitive	0.099	1.112	11.268	<.01
Initiative	Performance/	Cognitive	0.091	0.886	9.696	<.01
Working Memory	Performance/	Cognitive	0.094	0.656	6.991	<.01
Self-Control	Performance/	Affective		1		
Relaxed Style	Performance/	Affective	0.464	-2.593	-5.589	<.01
Patience	Performance/	Affective	0.414	-1.613	-3.895	<.01
Self-Confidence	Performance/	Affective	0.593	-2.968	-5.006	<.01
Marks in Language	Performance/	Cognitive	6.266	-9.006	-1.437	.151
Marks in Math	Performance/	Cognitive	2.213	2.657	1.2	.23
Marks in Language	Forethought/	Cognitive	5.833	8.338	1.429	.15
Marks in Math	Performance/	Affective	0.617	0.727	1.177	.24
Marks in Language	IQ		0.033	0.199	6.054	<.01
Marks in Math	IQ		0.045	0.277	6.106	<.01
Marks in Math	Forethought/	Cognitive	3.527	7.59	2.152	.03

Marks in Math	Performance/	Cognitive	3.78	-8.115	-2.147	.03
Marks in Language	Forethought/	Affective	0.84	0.863	1.027	.31
Marks in Language	Performance/	Affective	3.291	3.445	1.047	.30
Covariances:						
Forethought/Cognitive	Forethought/Affective		1.379	2.23	0.619	.54
Performance/Affective	Performance/Cognitive		1.623	0.694	2.337	.02
Performance/Affective	Forethought/Affective		-20.12	4.676	-4.303	<.01
Forethought/Cognitive	Performance/Cognitive		14.121	1.992	7.088	<.01